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Electrical Experimenter

233 FULTON STREET, NEW YORK

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EDITORIAL

Metallic "Paper"

WE have been repeatedly assured by experts that our present visible paper supply will give out in less than 25 years. During the past few years the paper shortage has become worldwide—not because of an actual shortage of the raw materials that go into the making of paper—but because the world is using about 25% more paper than can be manufactured.

Of course, new mills are being built right along, and as it takes from one to two years to build a paper manufacturing plant, thus the present shortage will have disappeared in a few years. But this will not allay the general situation; quite the contrary. The more mills we build and the more paper we use, the quicker do we reach the inevitable point where our raw materials give out.

Ninety per cent of our present day paper is made from wood. Briefly the process consists in reducing the wood to a pulp by a macerating process. Properly digested under steam pressure in a solution of bisulphite of magnesium, washed and bleached, this wood pulp called "sulphite" in trade parlance, forms the base from which nearly all of our paper is derived. While paper pulp can be made theoretically from *any* vegetable fibre, only wood fibre so far has been found economical enough on a large scale.

Alfalfa, straw, grass, seaweed and a host of other substances have been mentioned from time to time as a serious competitor to wood, but so far not one of these have been able to compete, and paper continues to be made of wood pulp.

But as mentioned before, wood will surely not last forever. It can't last while we are daily turning whole forests into newspapers. It simply does not grow fast enough to keep step with the present enormous demand. Besides, wood is used for thousands of other purposes, and all this great demand drives up its cost to such a height, that in a very few years, wood for paper purposes will be unthinkable. The paper on which this is printed cost 3½ cents a pound in 1914. Today it costs from 14 to 18 cents in the open market, and is going higher. Even with new mills to take care of the present excessive demand, paper prices will never recede to their former levels or even anywhere near them. What then? On what will our books and magazines be printed in 25 years? Paper? It is very doubtful. And if it is paper, it will not resemble our present-day paper any more than the latter resembles the *papyrus* of the old Egyptians, or the rag papers first made in 1150 by the Italians.

What substitute our children will use, it is of course impossible to forecast. With modern chemistry and mechanics anything is possible—even synthetic wood pulp with synthetic fibres!

There is one substitute, however, which has not been mentioned much lately, altho it deserves it, particularly now with paper selling at the present fabulous figures.

We refer to metallic foil. Preposterous as the idea appears, it was proposed by no less a man than Edison. During his researches with his storage battery he produced nickel foil by the electrolytic method four to five times as thin as an ordinary sheet of paper. Moreover, this nickel sheeting, tho very much thinner, was stronger and far more durable than paper. Such nickel foil is flexible, strong, uniform in thickness and can be printed upon readily. It will outlast paper for centuries. A thousand-page nickel foil book is less than one-half inch thick. Now nickel is of course not the only metal that can be used. Aluminum, or a correct aluminum alloy, would seem to be ideal, due to its whiteness, its extreme lightness and strength. Aluminum now sells at about 40 cents a pound. If it can be produced cheap electrolytically in foils, only three times thinner than for instance magazine paper, then one pound of aluminum will go about six times as far as a pound of paper. In other words, for about six cents you could print as many pages on aluminum as it would cost you to print the same pages on paper costing fifteen cents.

H. GERNSBACK.

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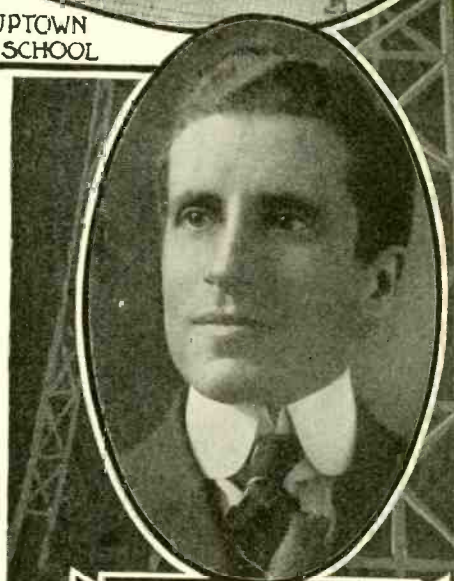

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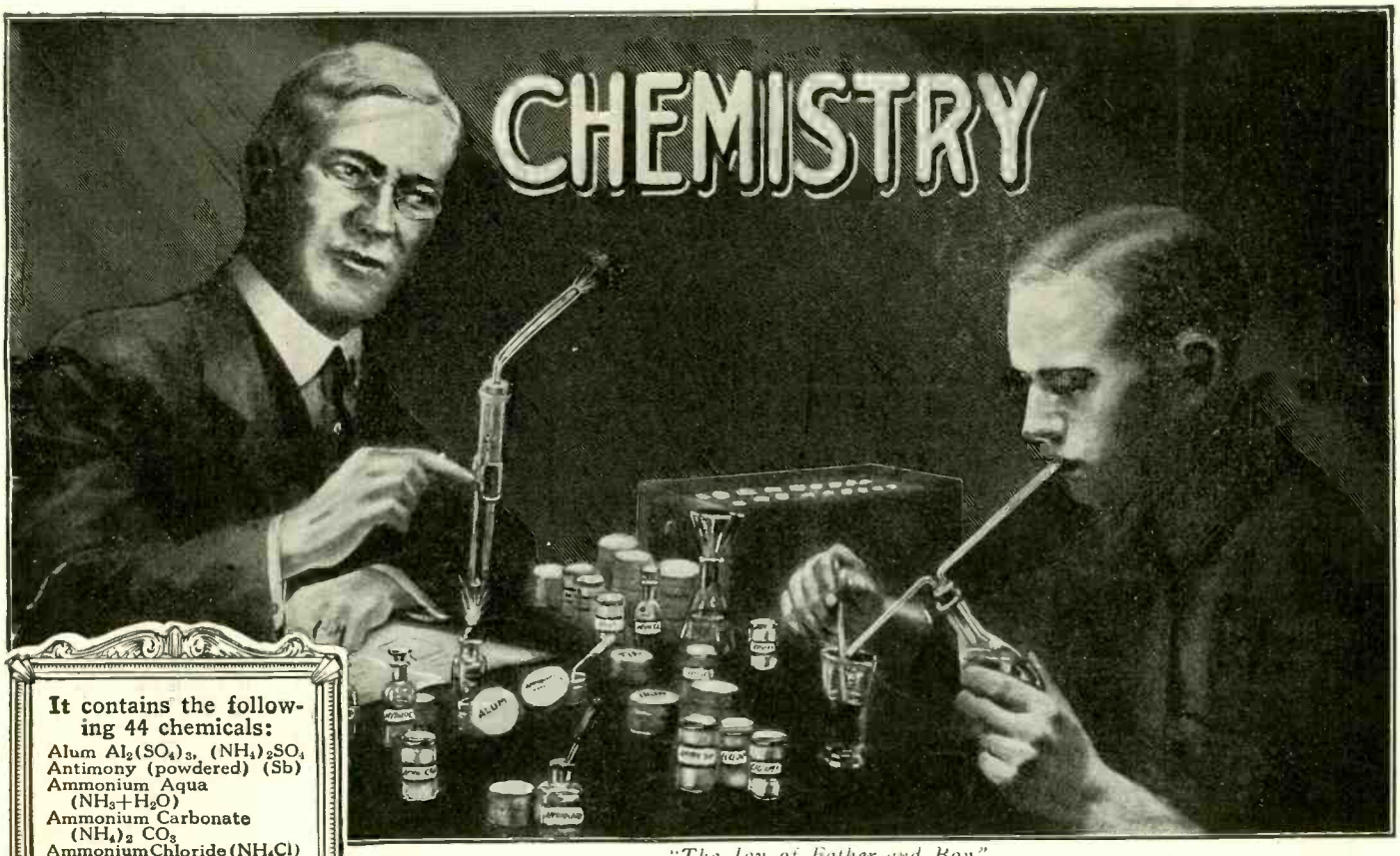

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The assurance of the speaker—in the crowded corridor of the Hotel McAlpin—compelled me to turn and look at him.

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And he did.

Later the toastmaster was introducing a long line of guests to Mr. Roth. I got in line and when it came my turn, Mr. Roth asked, "What are your initials, Mr. Jones, and your business connection and telephone number?" Two hours later he picked out the 60 men he had met before and called each by name without a mistake—and he named each man's business and telephone number, for good measure.

I won't tell you all the other amazing things this man did except to tell how he called back, without a minute's hesitation, long lists of numbers, bank clearings, prices, lot numbers, parcel post rates and anything else the guests had given him in rapid order.

* * * * * *

When I met Mr. Roth again he rather bowled me over by saying, in his quiet, modest way:

"There is nothing miraculous about my remembering anything I want to remember, whether it be names, faces, figures, facts or something I have read in a magazine.

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"Mr. Jones," he replied, "I can teach you the secret of a good memory in one evening. I have done it with thousands of pupils. In the first of seven simple lessons which I have prepared for home study, I show you the basic principle of my whole system. Really it's more like playing a fascinating game. I will prove it to you."

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When I tackled the first lesson, I was surprised to find that I had learned—in about one hour—how to remember a list of one hundred words so that I could call them off forward and back without a single mistake.

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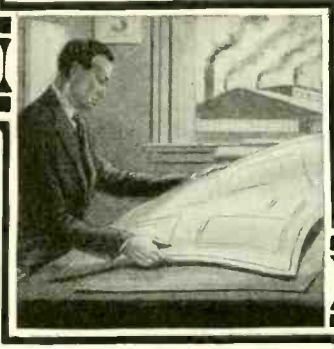

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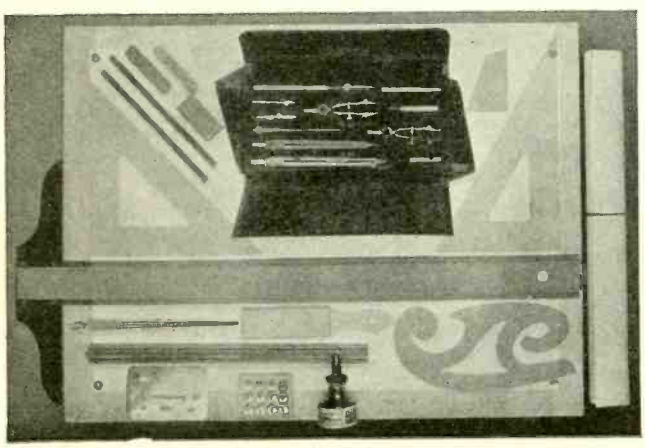

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Can you show in what way a transformer differs in its functions from a motor or generator?

What are the first things to be considered when estimating the cost of wiring an old building?

What do you know about the National Electric Code and the Underwriters Requirements?

Do you know two methods of varying line e. m. f.?

Can you sketch and describe the methods of passing through floors when metal molding is being installed?

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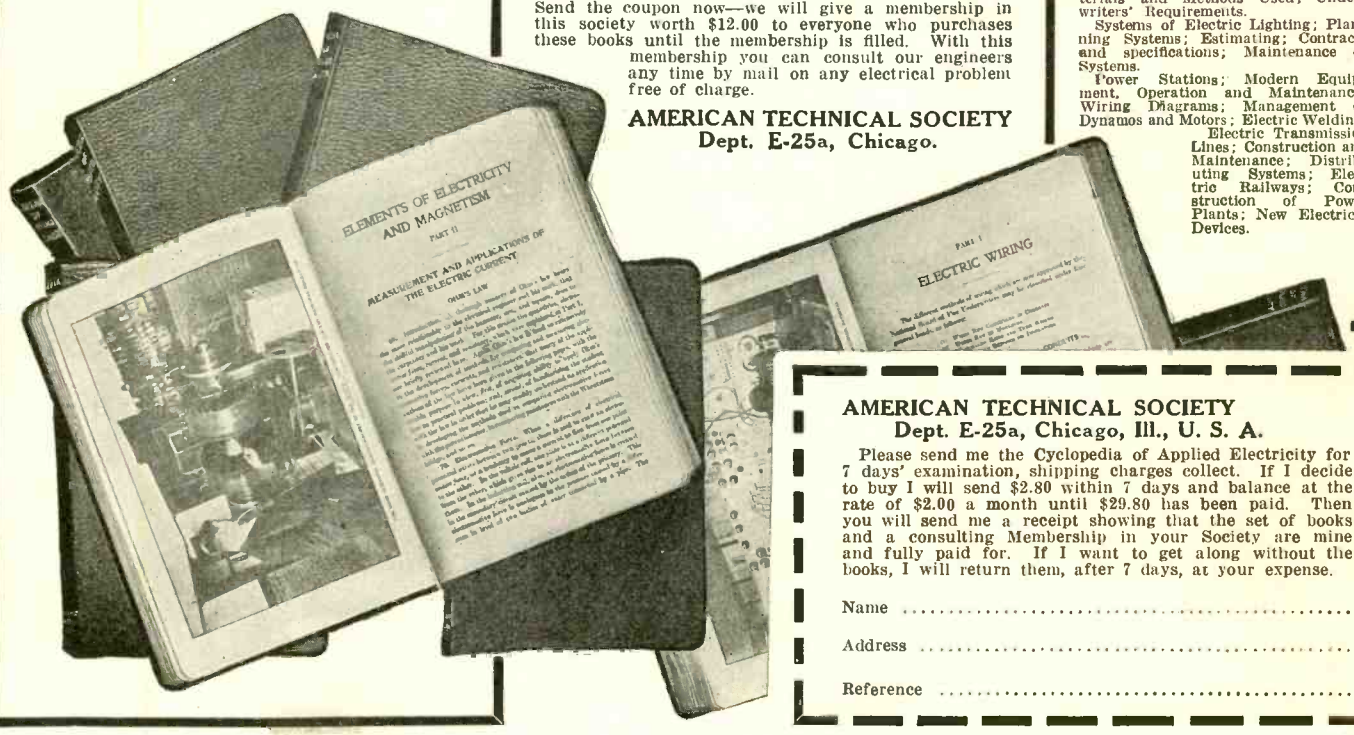

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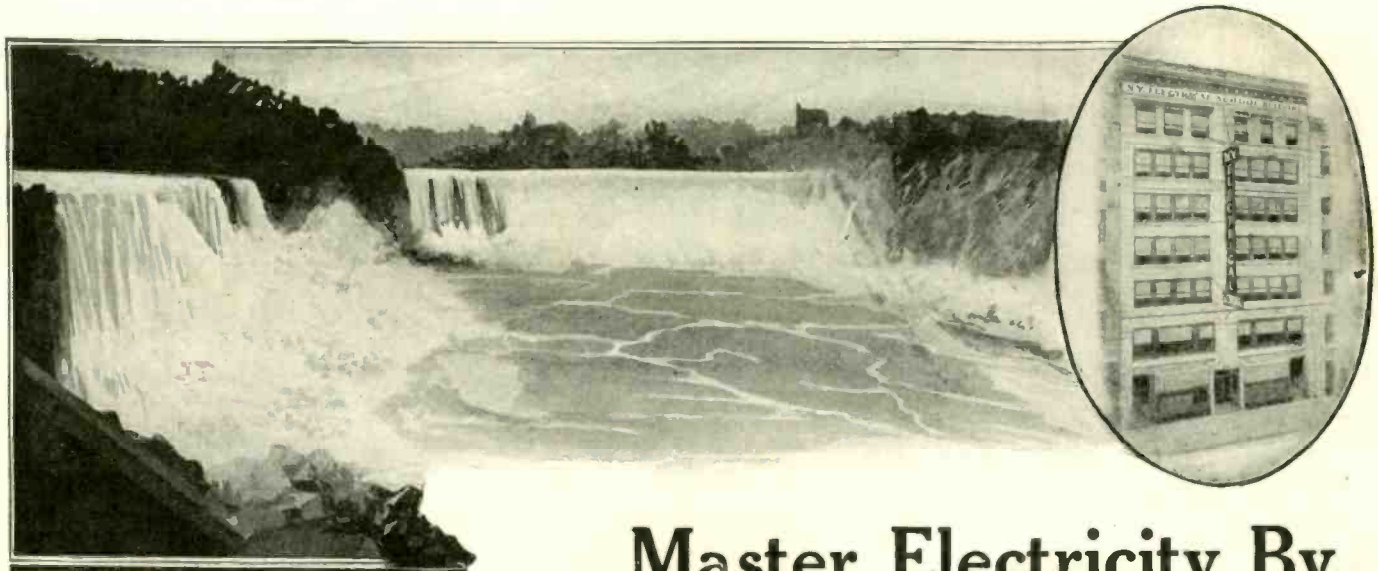

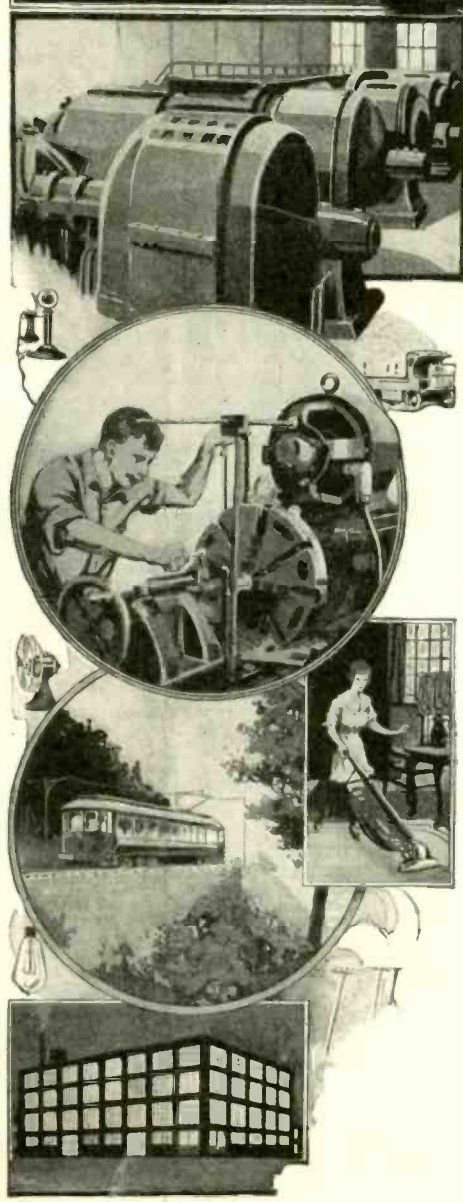

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Vol. VIII. Whole No. 86 June, 1920 No. 2

Signal Buoy for Ocean Ships

By EDWIN F. LINDER, M. E.

A Radio And Searchlight Buoy to be Carried By Ocean Ships

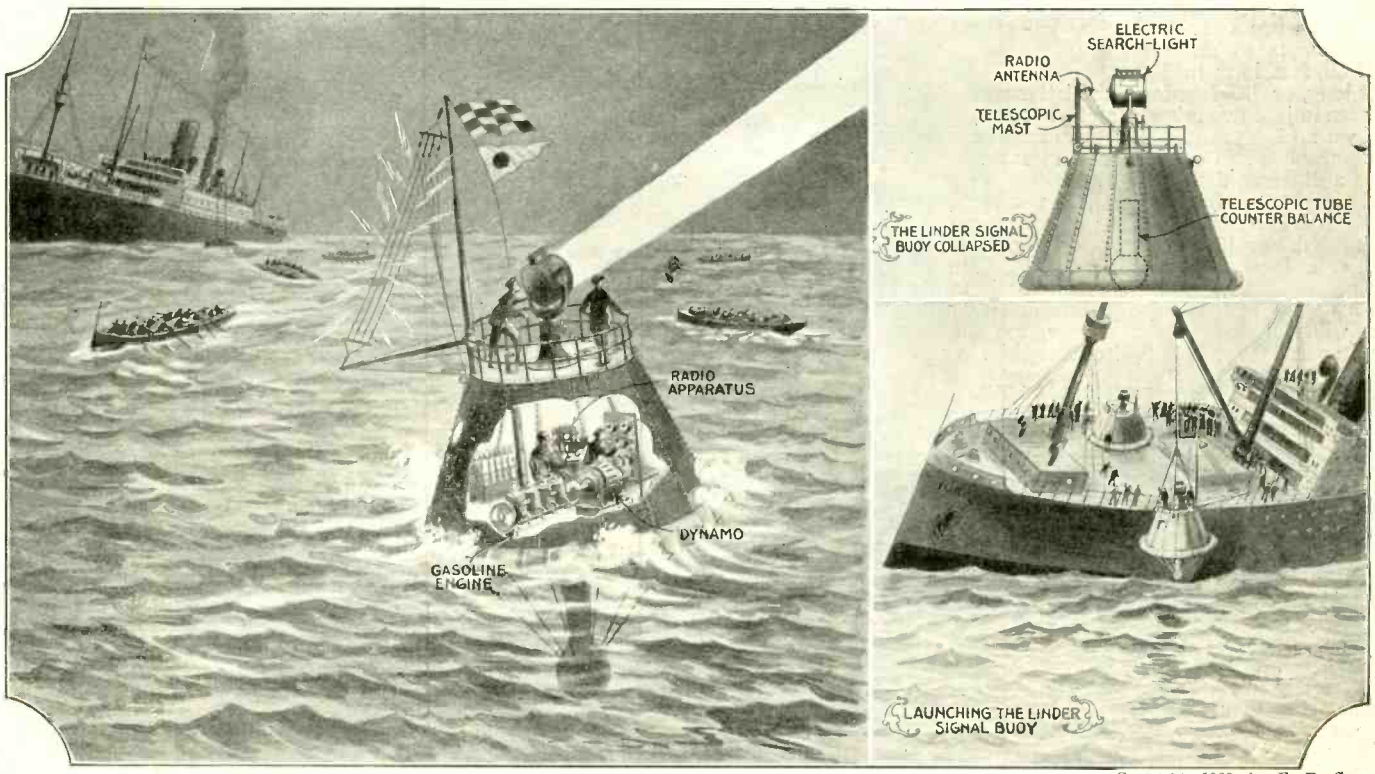
THE searchlight signal buoy is primarily a life-saving device; however, it is not designed to replace the customary lifeboats and rafts with which all modern ocean-going steamships are equipt at the present time.

A hollow double bottom ring about twenty feet in diameter serves as the float of the buoy. Upon this is constructed the housing and the bridge on which the powerful electric searchlight is mounted. The entire construction is light sheet steel reinforced with angle iron. Underneath the float on its axis is a telescopic counterbalance, so weighted that it prevents the buoy from being overturned when in a rough sea. This counter-balance is extended on lowering the buoy over the side of the vessel when it becomes necessary in the case of accident at sea, and when it has reached its full length it is locked by the operator from within. Wire rope stays, made fast to the outer surface of the float, take the tension and hold it firmly in a central position.

In the machinery compartment a gasoline engine furnishes power for the electric units necessary for the operation of the searchlight and wireless apparatus. The mast of the aerial for the latter is made up of telescopic pipes so as to be out of the way when the buoy is being lowered from the vessel's deck to the water.

When not in use the buoy (one or more) is carried on the forward deck of the steamer before the mast with wire rope slings attached to the rings fastened around the top of the sheet steel housing for that purpose. The slings come together above the searchlight and at this point are hooked into the usual boom tackle, ready to be put overboard instantly at the word of the commanding officer of the ship. While on deck the counter-balance is telescoped and is flush with the bottom of the float, making a solid flat face for the apparatus to rest on.

(*Continued on page* 225)



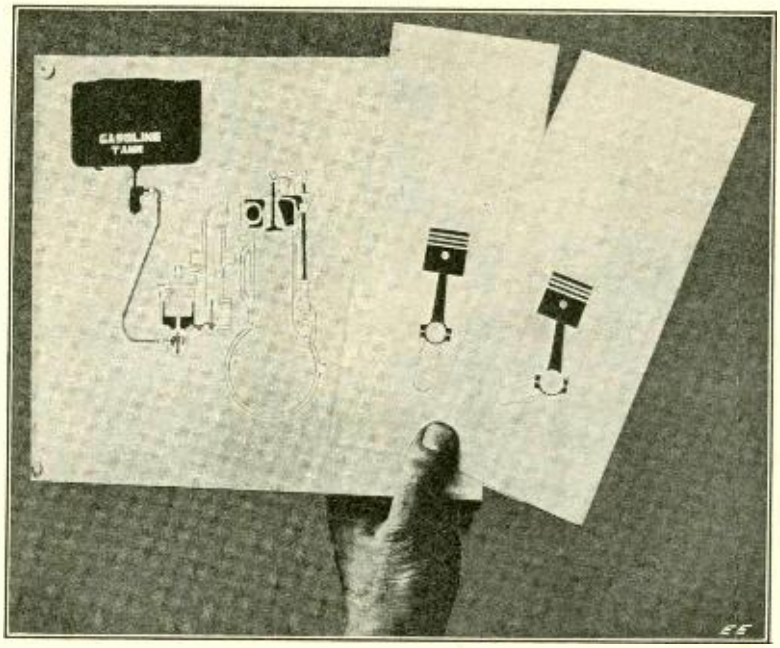
When a Ship Collision Happens at Sea, and Altho Practically Every Vessel Today Carries Wireless Signaling Apparatus, It Has Often Occurred That a Ship's "S.O.S." Calls Have Failed to Bring Assistance in Time, for the Reason That the Dynamo Room Became Flooded Almost Instantly. An American Inventor Here Proposes a Complete Radio and Searchlight Signal Buoy Which Could Be Released From the Ship Instantly, No Matter How Sudden the Ship May Sink, the Buoy Being Released by Push Button Controlled Clutches. The Searchlight, Besides Calling for Aid Over a Hundred-Mile Radius, Helps to Keep the Life Boats Together

How "Cartoon Movies" Are Made

By JOSEPH H. KRAUS

ONE often wonders at the astonishing speed and skill displayed by the cartoonist in drawing so many lines in a short fraction of time, and asks himself how it is all done. Sometimes a pencil is seen to move, sometimes the hand holding the pencil dashes from spot to spot, dabbing a little ink here and a little ink there, and sometimes just the line is seen to expand itself and mould itself into the forms of animated beings which go thru the most realistic motions imaginable.

There is an immense number of parts necessary for the successful delineations of "cartoon movies." By this is meant drawings, celluloids, tones, cut-outs, and fades, and their relation to each other. It must also be remembered that there are 16 distinct pictures to every foot of film and when a cartoonist attempts to make a reel 50 feet long to 100 feet long, or 125 feet long, the latter would be seen in just two minutes and five seconds, and yet no less than 2,000 pictures have been photographed and every picture meant perhaps a different drawing.



Here Are Three of the Actual Drawings Used In Producing the "Movie"—How the Gasoline Engine Works. Hundreds of Them, Each a Little More Advanced, Are Required. The Complete Engine View Is Drawn on a Sheet of Celluloid. By Slipping the Successive Piston Drawings Behind the Celluloid, and Photographing Them in Turn, Realistic Action Is Accurately Reproduced By the "Cartoon Movie" Expert.

Let us take, for instance, the various angles of cartoon drawings; the cartoonist first draws his picture on paper, it is then traced upon a sheet of celluloid. We are assuming now that the cartoonist is to use his hand in the entire picture and that you will, in viewing the picture, see the hand as in figures 1, 2, 3, 4 of the ship.

DRAWING FIRST MADE ON CELLULOID.

The sheet of celluloid with the complete drawing now upon it, is placed in a frame and another sheet of white paper placed upon it. This frame has a perfectly translucent bottom made of ground glass, and underneath which are placed several electric lamps. A switch is now turned on, which causes this light to shine thru the celluloid sheet, just the same as if a sheet of newspaper were placed up against a window pane and then covered with a white sheet, the lines and reading would be perfectly discernable thru the paper. The artist then follows the outlines of his previous drawing.

After making a line ½ inch long he turns off the light under the picture, presses a button, at the same time, holding his hand in a stationary position. The shutter of the motion picture camera clicks once, it being in a vertical position so that best results may be obtained. The light under the picture is again turned on, another short line made, it is turned off, and again the camera clicks another picture and so on, until the end of the cartoon, each frame being photographed separately.

In those cartoons where no guiding hand is seen, practically the same procedure takes place, except that after drawing the line, the artist removes his hand from the frame and photographs the picture without the presence of the pencil or the hand. The resulting effect being a line broadening out and extending itself into forms.

Another type of this stationary cartoon is the showing of various objects such as a side of a ship, for instance, the hull of which is black, and then while watching the vessel, a hole in the side seems to peel right off, leaving a space thru which machinery is seen. This is simply done by having all the machinery of the ship drawn upon celluloid, the hull then painted black on white paper, is inserted under the celluloid, so that in the complete blackness so resulting, the lines on the celluloid are lost. This gives us a ship with a black hull. All very simple, isn't it?

A sheet of paper with the blackness removed from one corner, is then placed under the picture, replacing the totally black sheet, and again a photograph is taken. This is continued, the white area growing larger constantly, as each sheet of paper is changed so that eventually, when the "movie" is projected, it seems as tho the skin or outside hull of the ship is rolling up of its own accord, exposing its vital parts.

CARTOONING THE "KAISER."

It takes two photographers working far into the night, under high speed, one solid week to photograph the 2,000 or 3,000 odd drawings required for producing a little five-minute laugh. Let us take an example of one of these animated cartoons in determining how they are made. The one showing the "Kaiser" and the "Crown Prince" gives a good example and the various steps are there clearly depicted.

First, a little of the coat of the "Kaiser" is drawn—photographed—then a little more—photographed again, and so on until we have the "Kaiser" complete. After each drawing of a minute step, the artist must stop to photograph.

He then starts to draw the "Crown Prince". A little of the hat is drawn and the same procedure as before. The artist then draws the "English Lion" until that is completed, but mind you, that each step necessitates an interruption for the photographic operation.

The projected picture then represents the faces in the act of moving and a large "breath spot" appears, the usual indications for speech in comic drawings. Whenever a face or an object starts to move, invariably the work is done by drawing the picture on celluloid, at least all of those parts which do not move, and the moving parts are drawn upon separate sheets of paper, each one about 1/64 of an inch, different or further progrest from the one preceding.

(*Continued on page* 201)

For "July" E. E.

Suspended Electric Railways of Tomorrow; What Chicago and Other Cities Are Doing.

Shafts of Light for Regulating Street Traffic, by Edwin F. Linder, M. E.

Movies of Dynamo and Electro-Magnet Action,—the Generation and Movement of Electric Current Thru Conductors Visualized, by Jerome Lachenbruch.

Are the Martians Signaling via Radio? Specially written by Dr. F. H. Millener.

Alarm No. 18—A Live Wire Story Containing a Liberal Mixture of Fiction, Science and Electric Fire Alarms, by Charles S. Wolfe.

Pursuit of the Elusive Electron, by Walter E. Keever.

My Message to Mars, by Clement Fezandié.

How to Build Water-Wheels and Measure the Horse-Power of Brooks and Streams, by H. Winfield Secor.

Radio Spark Gaps and Oscillatory Circuits, by Pierre H. Boucheron; as well as Part Three of the "Radio Detective" Stories by the same author.

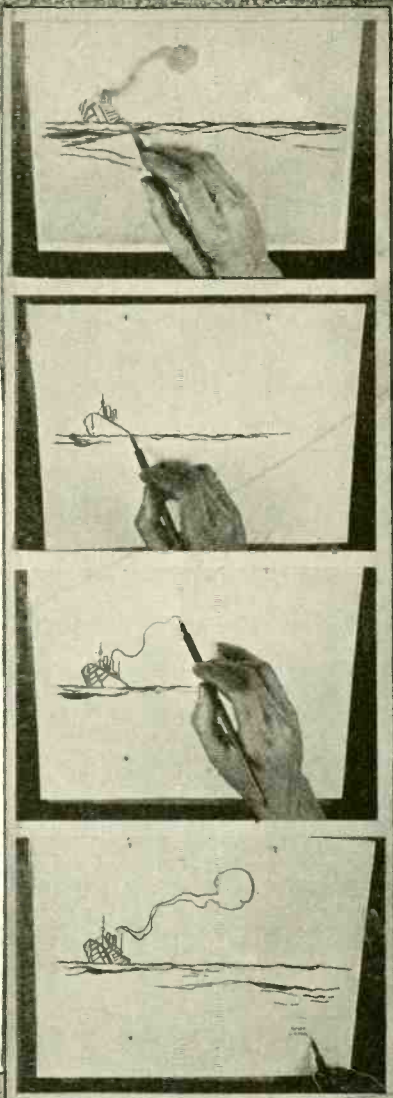
Glass,—How It Is Made and What It Is.—A Popular Illustrated Scientific Story by Prof. F. L. Darrow.

Aurora Borealis,—What Causes It? with beautiful illustrations, by Prof. Lindley M. Pyle.

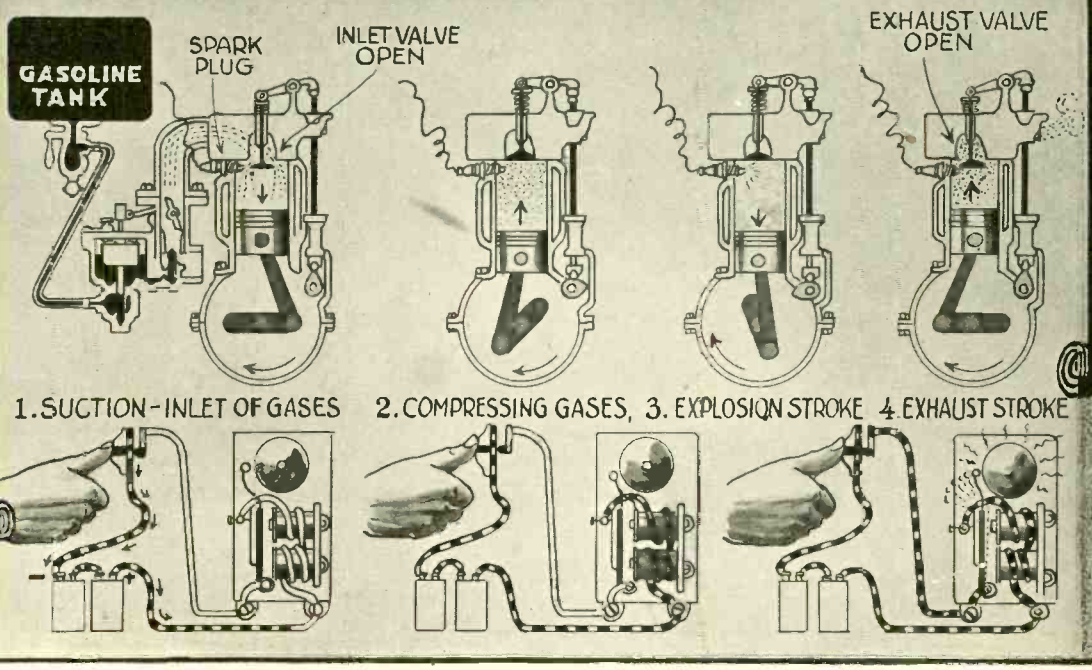
HOW CARTOON MOVIES ARE MADE

At the Left, Two Photos are Shown of Mr. Bert Green, the Well Known Movie Cartoonist, at Work In His Studio. Note How the Movie Camera is Mounted Vertically Upon the Drafting Table. At His Right May Be Seen the Powerful Electric Lamps, and These are Switched On, as Well as the Shutter of the Camera Opened and Closed for One Exposure, by Pressing a Button Which He Is Seen in the Act of Doing. Underneath the Frame in Which the Drawing Is Held, are Other Electric Lights Which are Illuminated While the Successive Stages of the Drawing are Made, as Shown In the Four Progressive Drawings at the Right.

These Drawings, 1 to 4, Illustrate the Following Stages: At the Top, the Complete Ship drawing is Made on a Sheet of Celluloid; 2nd the First Stage of the Drawing Is Made on a Sheet of Paper Placed Over the Celluloid Drawing and Illuminated From Behind. After Photographing This, the 3rd Stage Occurs and the Drawing Is Still More Elaborated as Shown. After snapping These With the Movie Camera, Several hundred more are Made and Photographed, and Finally We Arrive at the Complete Autographed Cartoon Shown at the Bottom.



The Action of a Gasoline Engine as Well as That of An Electric Bell are Shown In Part Below. These Pictures, the Actual "Movies" of Which Required Several Hundred Drawings, Are Used In Schools With Wonderful Results



(FULL DESCRIPTION ON OPPOSITE PAGE)

A Stereoscopic "Movie" Screen

By JOHN J. FURIA, A.M.

A new invention eliminating eyestrain from movies and giving three-dimensional pictures

EVER since the *motion picture* came into existence, the two outstanding objections against them have been fatigue to the eye (the strain being so great to some people that they have to forego the pleasure of seeing movies), and flatness (no depth); giving the pictures the appearance of painted scenery or billboard posters. From time to time, little improvements have been developed which have tended to reduce these objections. The principal reduction of eyestrain has resulted from the elimination of streaks in the film which produce what is technically known and popularly familiar as "rain." This has been effected by improvements in the manufacture of film, in the camera and projection apparatus mechanism and in the various steps of the chemical photographic processes. The reduction of flatness has been accomplisht by artistic lighting effects employed by the producers [the high grade pictures giving a fair amount of depth and seeming more real (less reel), and lifelike]. At best, even the highest quality pictures are flat and produce fatigue and eyestrain. Fatigue and eyestrain are especially marked at seats up front and off to the side, because of the hideous distortion of the pictures viewed from these positions. The elimination of eyestrain and fatigue is of especial interest to the movie house owner since it restricts him from the sale of seats too far front, and off to the side, causing him financial loss.

Strangely enough the invention which reduces flatness, distortion, fatigue and eyestrain in movies to a minimum has resulted from the experimenting and theorizing of a man not in any way connected with the movie industry. Dr. Jaques Louis Pech, professor in the faculty of medicine at the *University of Montpellier* (France), has for many years made a study of vision and eyestrain entirely aside from the viewpoint of the movie. The results of his Physiological, Psychological and Physical investigations led him to conclude that a factor of considerable importance and thus far neglected in three-dimensional vision and sense of depth is the distortion of images on the retina of the eye because of the shape of the retina. If the retina were a flat surface, the images produced on it would be similar to those produced on the ground glass, film or plate of the ordinary camera and would give the impression of being flat (without depth) as the ordinary photograph does. Stereoscopic vision is artificial and the depth produced by the stereoscope is exaggerated. If the eye had a flat retina it is quite doubtful whether or not depth could be produced by stereoscope. The argument usually put forth in favor of stereoscopic vision is that when a person loses the use of one eye, he loses his sense of depth. However, might this not be caused by the failure of the eye to accommodate itself to its new conditions? As time elapses it has been found that the person gradually regains his sense of depth to a large extent. A person who has lost the use of one eye during his infancy, is not troubled with lack of sense of depth. It is difficult for us to explain by means of our stereoscopic theory why a solid sphere of homogeneous surface, uniformly illuminated, should have a three-dimensional appearance, *and is a well establisht fact that its three-dimensional appearance is not at all diminished when viewed by one eye.*

Reasoning along similar lines, together with that along highly theoretical lines (not suitable for presentation in an article of this kind) led Dr. Pech to look for a new theory. He formulated the following: *A straight line in space gives a curved image on the retina of the eye.* Also, as the line is brought nearer and nearer it occupies a larger distance on the retina. If the curvature of the retina is such that it changes progressively, the curvature of the image of the end of the line will change progressively as the line approaches or recedes. This change in curvature of the lines which make up the marginal perifery of the image of any object causes, *via the brain,* the impression of distance and consequently depth. Just as the brain interprets the inverted image on the retina to represent an erect object, it also interprets an object, the marginal perifery of the image of which has greater curvature to be nearer than that of one of less curvature, taking into account the interpretation of differences in sizes of object gained thru experience. If the retina is *hyperboloidal* in shape, it meets all the requirements of the new theory. *Microscopic examination shows this to indeed be the case.* If the theory be true, the image of a flat photograph reflected by a concave hyperboloidal mirror should be three-dimensional and should show depth. *This is indeed the case also.* The reader can satisfy himself of the truth of this fact by observing the image of a picture postcard reflected from the ordinary concave shaving mirror. *The image will show true depth, without the artificiality of the stereoscope.* Since the shaving mirror is not hyperboloidal, there will be a slight distortion of the image in proportion to the deviation of the mirror

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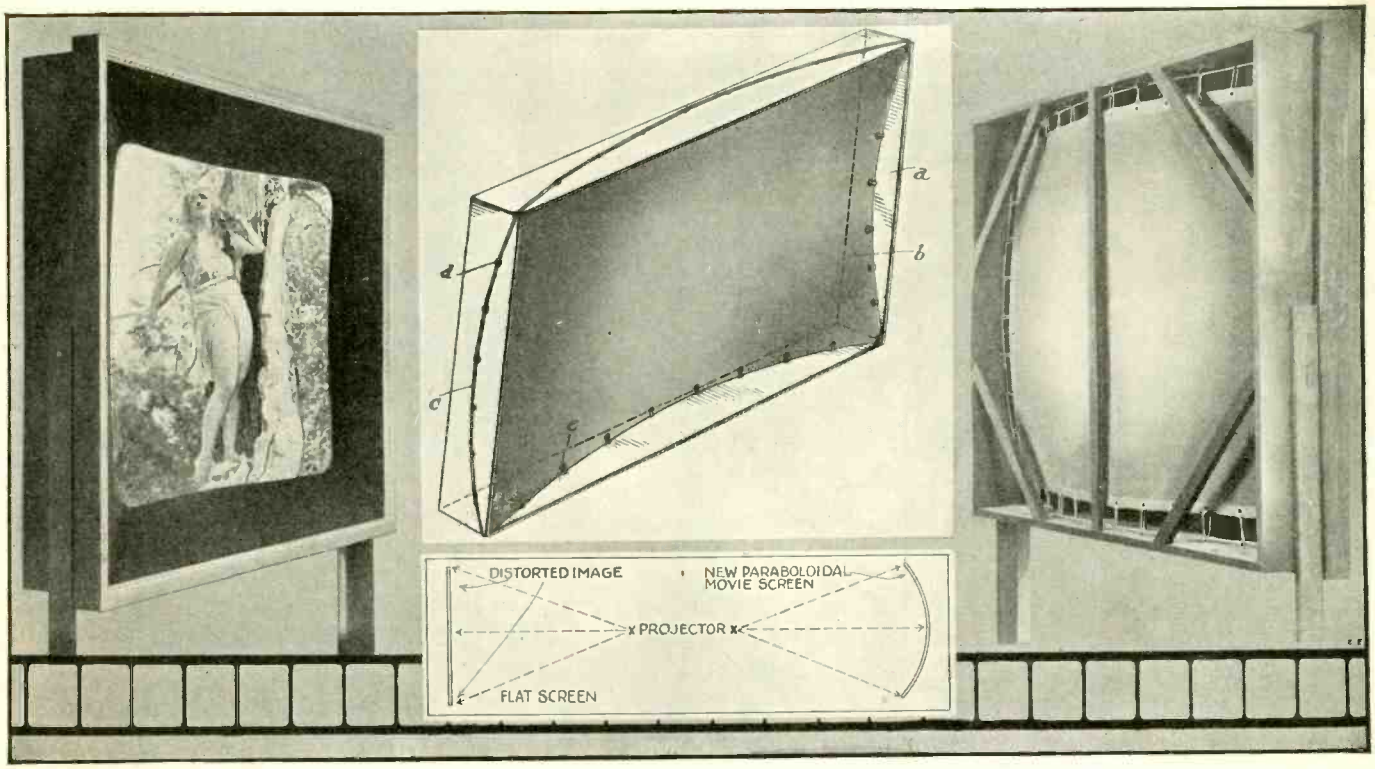
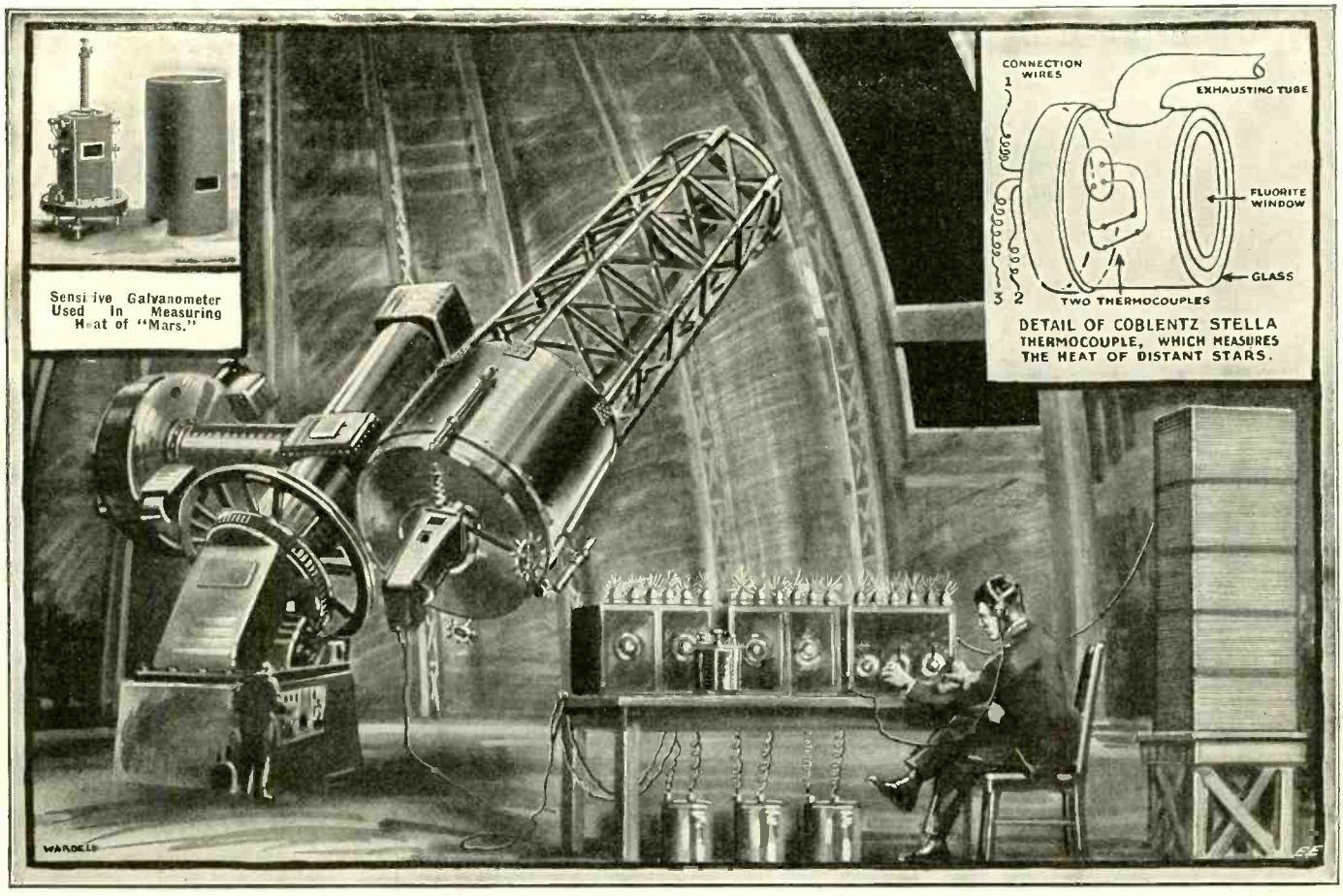


The Newest Idea in Motion Picture Screens, is That Having a Paraboloidal Or in Other Words, a Screen, Every Spot On the Surface of Which Corresponds to Some Arc of a Paraboloid. The Diagram Shows How the New Screen Corrects the Form of the Image for Every Observer in a Theater, Unlike the Flat Screen Which Distorts the Image. This New Screen, the Invention of a French Professor of Medicine, Gives the True Form of Image At Every Angle, Elimnates Eye-strain and Fatigue, and Further Causes the Image to Actually Stand Out in Relief the Same as Stereoscopic Photos.



A New Idea in Attempting to Pick Up Signals of an Interplanetary Nature Is Here Suggested by the Author. His Plan Is to Utilize Extremely Sensitive Photo-Electric or Thermos-Electric Instruments Such as Bolometers, Similar to Those Employed in Measuring the Heat of Distant Stars, and to Mount These Instruments at the Focus of Powerful Astronomical Telescopes. Signals Which Might Be Extremely Faint and Undetectable by Any Ordinary Wireless Apparatus Could Then Be Amplified by Means of 10 to 20 Stage Audion Amplifiers. Heat Measurements From the Planet "Mars," Have Already Been Made by the Bureau of Standards by Means of the Sensitive Coblentz Stellar Thermo-Couples

Interplanetary Communication

By ALBERT V. T. DAY

IF Mars, or another planet, is inhabited by beings whose sense development, intelligence and applied science, are about like our own, it seems probable they would regard light as the most likely agency of interplanetary communication, being not only the primitive agency which first disclosed the planets to each other, but also the agency most conveniently generated and directed by artificial means for signaling purposes. If these premises are accepted, it follows as a most plausible surmise that one or more of our planetary neighbors are now trying to signal us by light waves, or else endeavoring to detect light-wave signals from us.

All proposals for interplanetary light signals which have come to my notice, have assumed that the signals must be detected by sight, which seems strange, since it would be most natural for the sender to fluctuate his signal light, and there are so many known physical instruments for detecting a light fluctuation. Recently, in particular, the development of the vacuum-tube electrical amplifier has seemed to provide a most fascinating possibility of detecting such a signal by the photo-electric reactions of a selenium detector, bolometer, thermo-electric couple, or equivalent device.

In the focal plane of a telescope may be placed an opaque screen having an aperture coextensive with the image of the planet, or perhaps smaller than the image and registering with that point from which the light signal may emanate. The signal light projected through this screen aperture may be dispersed on the photo-electric detector placed some distance behind the focal plane. The screen will thus exclude from the detector much light extraneous to the signal. However, some detectors having a minimum sensitivity greater than the available signaling light, may require an independent exciting illumination upon which the signal light may be superposed. If necessary the detector may be independently excited by a fluctuating light supplied in any convenient manner and having a definite period, so that its superposed electric reactions may be selectively suppresst in the receiving circuits.

Many difficulties may be expected, such as disturbing currents produced by various inconstant light fluctuations finding access to the detector. These might be caused by vibrations or inconstant movements of the telescope, or by erratic atmospheric effects upon the illumination, or by illumination of the atmosphere from variable sources, either natural or factitious. Assuming that the signal fluctuations will have a definite frequency—it would seem that these difficulties must resolve themselves mainly into a problem of electrical selectivity like the problem of eliminating the so-called static disturbances in radio signaling. Much has already been done in this direction.

In the least optimistic view it seems a fair presumption that this method must be capable of detecting the flash or periodic fluctuation of a light too weak to be seen through a telescope.

The idea engenders most entertaining speculations on the possibility of receiving not only code signals, but music and voice messages as well. It is certainly practicable to effect musical or phonetic control of any light power which would be employed for interplanetary signaling, for instance by vibrating reflectors under the control of a telephonic current. If music is indeed a universal language, then who shall deny that most exalted and beneficient inspirations might be thus transmitted to us at once, without the establishment of any other code.

As concerns the mere detection of signals, without effort to transmit reply, the general scheme may be much more feasible than could be predicated upon our own scientific knowledge, for our planetary neighbors may have devised optical means for producing light rays so nearly parallel as to accomplish interplanetary projection with very little dispersion. In any event it would seem that such an equipment for detecting signals could be added to an establisht astronomical observatory for a relatively small cost. If it is undertaken I should much like to participate in the experiments.

Entirely aside from the detection of intelligent signals, a photo-electric detecting and amplifying apparatus of this general character should be a useful adjunct to any great telescope employed in astro-physical research. For instance, it is probable that star-twinkling effects could be recorded on an oscillograph, and their relations to the diameter of the optical objective investigated. Various interesting fluctuations

(*Continued on page 209*)

Searchlight and Mirrors Mark Aero Field

By EDWIN F. LINDER, M. E.

ONE of the most important of the many types of apparatus used during the recent war was the *electric* searchlight. Without the help of these powerful eyes of detection undoubtedly it would have been extremely difficult to repulse night attacks of the enemy with any degree of success, either on land or on sea. Much has been written during the last few years of the many uses to which searchlights were put by the armies and navies, and a great deal has been learned during the period of conflict that can be of vast service to the civilized world in the development of commercial enterprises.

The searchlight, as a medium for outlining safe landings for airplanes at night, is a particularly worthy and useful application which deserves the consideration, not alone of governmental officials, but should be of interest to private individuals engaged in the transportation of perishable goods and all classes of parcels requiring speedy forwarding to their proper destination.

Airplane service for the carrying of mail, newspapers and many other articles, has already been establisht in this country in a limited way, the flights being so timed as to take advantage of daylight as far as possible. Until properly equipt landing fields are constructed and maintained thruout the country, very little progress can be expected along these lines, especially where long distances are to be traversed on non-stop flights during the night.

For transcontinental services, the number and size of such stations would depend on the proposed routes of travel and the location of the cities, the distances between the latter and the number of airplanes that would be placed into operation. In the illustration are shown several parts of the equipment of a field for *day* and *night* use.

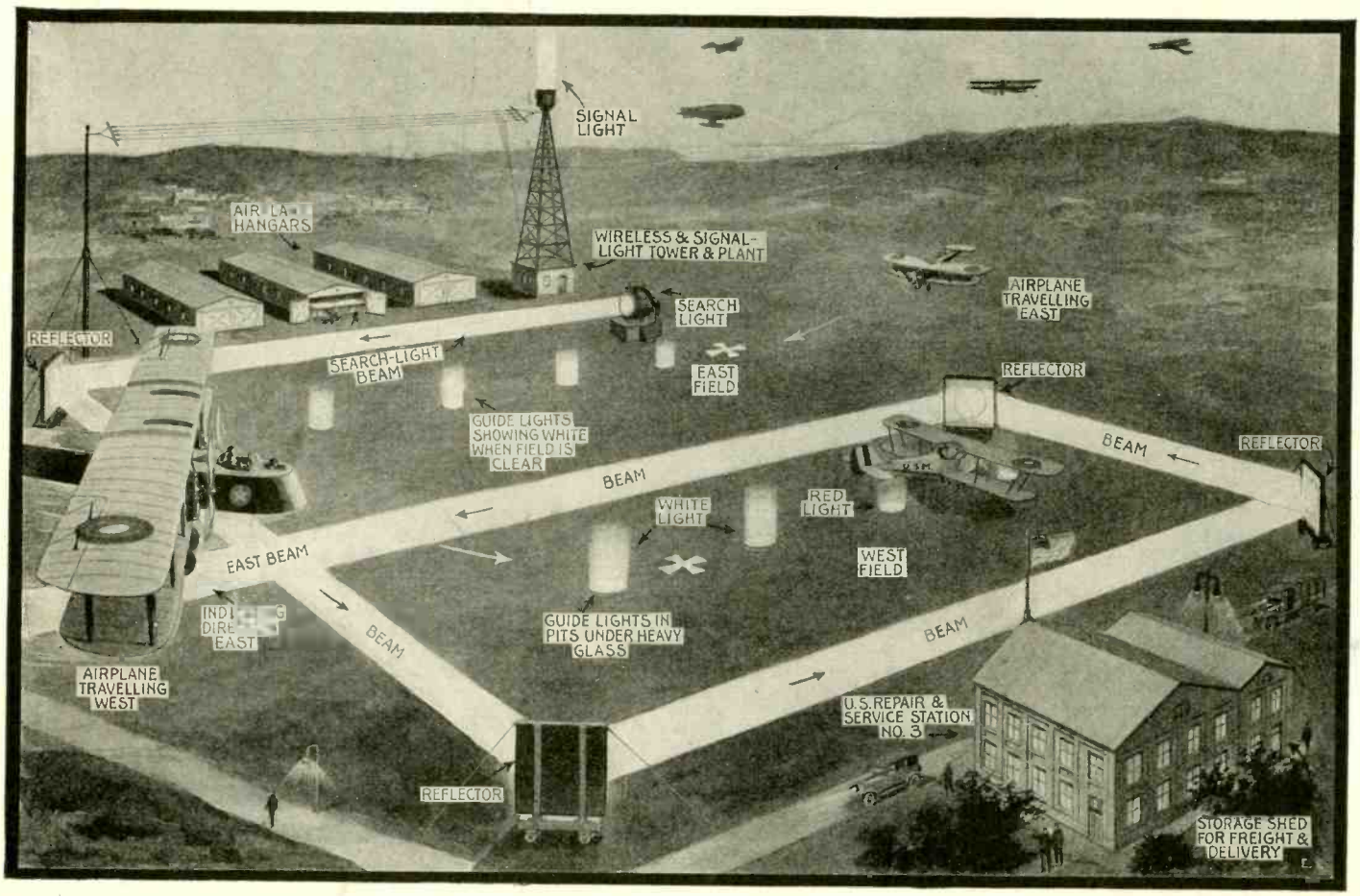
The most important feature of this method of marking the boundaries of the field is the searchlight, the beam of which encloses all but the half of one side of the field and by the use of reflectors or mirrors divides it into two sections—one for Eastbound and the other for Westbound traffic. It further shows the aviator his course, it being the intention to have all such fields placed so as to have the final reflected beam projecting to the East. Should it be desired to enlarge the field from time to time, the reflectors can be easily moved to new locations and then secured in position by guy ropes or cables.

In the east and west sections, guide lights are placed in pits covered with heavy glass windows, flush with the ground. These lights are designed to make it safe for the aviator to enter the grounds. In the event of a portion of the field already being occupied by landed planes, the oncoming pilot is warned by these lights, the free part of the field being designated by the ordinary *white* lights and the occupied part blocked off by *red* lights, operated by a man assigned to this duty.

In order to more readily pick out a station at a distance when in low flight, a high tower with a signal light flashing automatically the number or name of the station in code, by means of a vertical beam of light, is built on one side of the field. The tower also can be used for the wireless equipment, with which each station is usually supplied.

For ordinary use, the signal light on the top of the tower will give forth a white beam; however, should some difficulty occur which would make it dangerous to permit a landing, the approaching aviator would be warned far in advance before his reaching the station, by a red beam.

All types of aircraft, especially those cruising in the higher altitudes, would be greatly assisted in their navigation by these light-bounded stations; their pattern being identical with the other stations, would at once make known to the flying pilot his position—the tower signal giving the number of the station which appears on the air-chart and the "east-beam" the direction of the aircraft's course.



Why Use Several High-Powered Searchlights to Illuminate and Mark the Outlines of an Airplane Landing Field at Night, When This Simple Scheme Comprising the Use of But One Searchlight and a Set of Mirrors to Reflect the Beam Around the Corners Solves the Problem Equally as Well? A Very Ingenious Scheme Indeed, We Believe, and One That Possesses Complete Flexibility, Allowing the Shape and Size of the Field To Be Changed as Frequently as Becomes Necessary. The Shape of the Field, Owing to Rainy Weather, Etc., and Due to Submerged Portions, May Have To Be Changed Several Times In Twenty-four Hours, and This Scheme Provides the Way to Do It with the Minimum of Labor and Expense.

Photo at Left Shows the German Chess Players in Their Club Room Just Before the Start of the Great International Chess Match, the Progress of Which Was Recorded by Telegraph.

Photo at Right Shows Mr. Albert Hughes, of Berlin, at the Telegraph Receiving Station Where He Transmitted the Scores of the Recent International Chess Game Over the Telegraph Circuit to Holland.

Playing Chess Via Telegraph

The accompanying photographs illustrate one of the most interesting sport events in Europe—when a "chess match" was recently played between a city in Holland and Berlin, Germany. The most famous players of each country participated in the game and the respective "moves" of the players at each end of the line were immediately telegraphed to the opposite players.

One photograph shows the German players in their club room, just before the start of the great international chess match. The second photograph shows Mr. Albert Hughes, of Berlin, at the telegraph receiving station, where he transmitted the course of the game telegraphically over the electric circuit to the city in Holland, where the Dutch players were assembled.

It is interesting to note the double clock arrangement at each player's position which was necessary to keep the tally right, owing to the difference in time between the two cities, one clock registering the local time and the other the time at the opposite end of the line.

Chess matches played by wireless are not so new in a small way, but large matches such as this one are out of the ordinary and attract a great deal of attention whenever they are held. From time to time in the past few years, chess matches and other games of a similar nature have been played *via* wireless, especially in the United States, between various college teams. A number of these matches were played a few years ago between several of the largest American universities with entire success, each successive move of the player at either end being transmitted by the wireless operator to the receiving operator of the opposite contestants.

Wind and Rain to Order

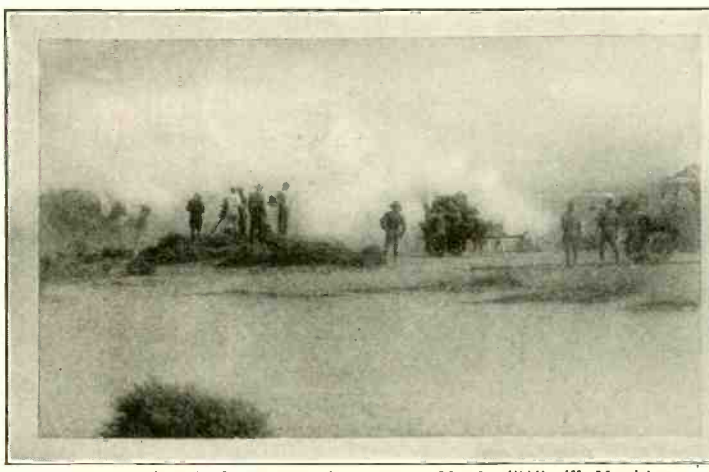
IT is no longer necessary for motion picture directors to await a choice thunderstorm in order to take pictures of several scenes wherein rain is required; nor is it advisable to cover the territory with elaborate pipe systems in or near the settings. Under circumstances such as these, it is obvious that another method must be discovered in order to make good "rainfall" pictures.

Pictures taken during an actual thunderstorm, when the sky is beclouded with heavy dark rifts and accompanied by occasional flashes of lightning which crash across the murky blackness, never produce the same realism on a film as in nature. But the movies and science have a peculiar way of working together, hand in hand, and thanks to science, it is only necessary now for motion picture directors to send in the alarm for a few firemen and the rain carts, and scurry away to the scene where the picture is to be produced. The rain cart is simple, being essentially composed of an automobile truck upon which is mounted a huge airplane engine. The truck is wheeled to the scene of action and the propeller started whirling.

A stream from an ordinary fire hose is now directed up into the air so that when on its downward path the water is broken up into large particles and drops are hurled against the actors and "acterines," completely drenching them. So terrific is the force and the wind produced that it is necessary to incline the body forward while attempting to cope with it.

Wonderful pictures are produced and the exact replica of nature's own rainfall is obtained without the shortcomings of the God Thor's method.

Operating on a plan similar to this rain machine is a sand-storm producing apparatus. It is also a truck equipt with an engine and propeller suitably mounted so that it is capable of churning up the sand all around it. In this way its ability to throw up and create a real Arizona blizzard or tropical hurricane is most complete. In the accompanying photograph is shown the Arizona sand-storm à la airplane propeller.



The Scene at the Left Shows the Latest Movie "Wind" Machine Kicking Up a Deuce of a Fuss on a Sandy Plain so as to Give a Perfect Arizona Sand-Storm Scene for the "Movies." An Airplane Propeller and Gasoline Engine Do the Trick

And Here We See the Boys Who Make That "Realistic" Rain, Which We All Enjoyed so Much at the Last "Movie" Play. Again the Airplane Propeller Does a Good Turn and Breaks Up the Descending Streams of Water Into Millions of Fine Droplets. Result—PERFECT Rain!

Odd Photo Contest

TRIPLE MIRROR PHOTOGRAPHY.

Robert Gordon, who co-stars with Sylvia Breamer in the Pathé-Blackton productions "Respectable by Proxy" and "The Blood Barrier," is shown from three different points of view. The photo is a single view taken by the aid of three mirrors, a Graflex camera, and a good light.

A "HUMAN" MONSTER!

We see here a picture of a boy, endowed with two heads and two pair of legs! Remarkable,—yes, but the effect is produced by double exposure!

Contributed by LESTER WAGNER.

SOME SNAKE!

The snake in the illustration is only a very small one (Garter variety), and the fence pictured is but one foot long, since it consists only of a few twigs arranged to give the desired "forest" effect.

WHAT PART OF A FLY IS THIS?

This view, the section of a fly's wing at the joint where member was torn from body, was taken by a Seneca camera placed in an apparatus of my own construction, so as to be able to take the picture in a horizontal position. The camera, in the apparatus, was then placed over a Bausch & Lomb microscope of 75 magnifying power and the view obtained as you see it. This was the third picture I have taken in this line, and am working with the end in view of being able to photograph disease germs and other things of interest to the experimenter.

Contributed by N. Nushawg.

$1.00 Prize Paid For Each Photo Publisht

THESE BOYS ARE CANNED!

This picture is a double exposure of a number of high school boys who were canned from school for "committing crimes," which did not agree with the faculty.

The boys committed these acts because they were forced to go to school on NEW YEAR'S DAY, 1919.

Contributed by GARET DENISE.

FALLING WATER TANK.

This is a photo of a water tank which was pulled down with ropes, after the timber structure had been partly cut in various places.

Contributed by A. J. VIKEN.

ODD LIGHTNING PHOTO.

There was really no special preparation for taking this picture; the shutter was opened and left open until after the flash, and then closed.

It might appear from this picture, that there was more than one stroke of lightning, but such was not the case, there being only one stroke. The body of water shown in the foreground is the Penobscot River.

Contributed by C. A. KITTREDGE.

HE DEFIES GRAVITY.

Jimmy Aubrey, *Vitagraph* Comedy Star, does a stunt that defies the laws of gravitation. He attracted a crowd of several hundred people to West Lake Park, Los Angeles, all of whom tried to figure out how the comedian could lean over at an angle of forty-five degrees and regain an upright position, apparently without effort. (Shoe clips fastened to the ground solves the mystery) —*Photo courtesy Vitagraph Company.*

SUN'S ANNULAR ECLIPSE.

This photo was taken, Nov. 22nd, 1919, in Havana 8^h 05^m A. M. The seemingly black shadows are clouds, and at the left of the photo are sunspots. Photo taken on telescope of the equatorial type of mounting.

Contributed by MIGUEL GUTIERREZ, Astronomer, Loma de Casa-Blanca, Habana, Cuba.

A WONDERFUL CAKE OF ICE.

This photograph represents a cake of ice, made by the American Ice Company, at one of their plants in Baltimore, Md.

OH, LOOK! HE'S HANGING!?**—!?*

The fellow in the picture is not having the least difficulty in getting his breath, inasmuch as the rope passes under his arm, as can undoubtedly be seen from the picture, upon close inspection.

Contributed by F. K. LOW.

SEEING HIS DOUBLE!

If it wasn't for the fact that we are denied even 2.75 per cent "fire-water," these strenuous days, Mr. G. V. Seyffertitz, of the "Slaves of Pride" film play, might easely imagine he was seeing his exact double or likeness in this scene from the play. But sh-sh! It's a great secret! It ain't no living likeness or double of Mr. Seyffertitz at all, but the very finest dummy ever constructed. —*Photo Courtesy of Vitagraph Films.*

Electricity Triumphs Over Steam

AT Erie, Pa., recently, one hundred and fifty prominent railway men and engineers from this country and Canada witnest one of the most remarkable and interesting trial tests of locomotives ever conducted in the history of railroading. These tests were made to demonstrate the mastodonic power and efficiency of the new model gearless electric passenger locomotive. Altho several other tests were made before the engineers, the principal event was a test of brute strength between two powerful steam locomotives of the Mallet type, such as those the New York Central Railroad uses to haul its big limited trains, and this new electric giant of the rails, which was built especially to haul trains over the Chicago, Milwaukee and St. Paul electrified mountain route in the western part of the United States.

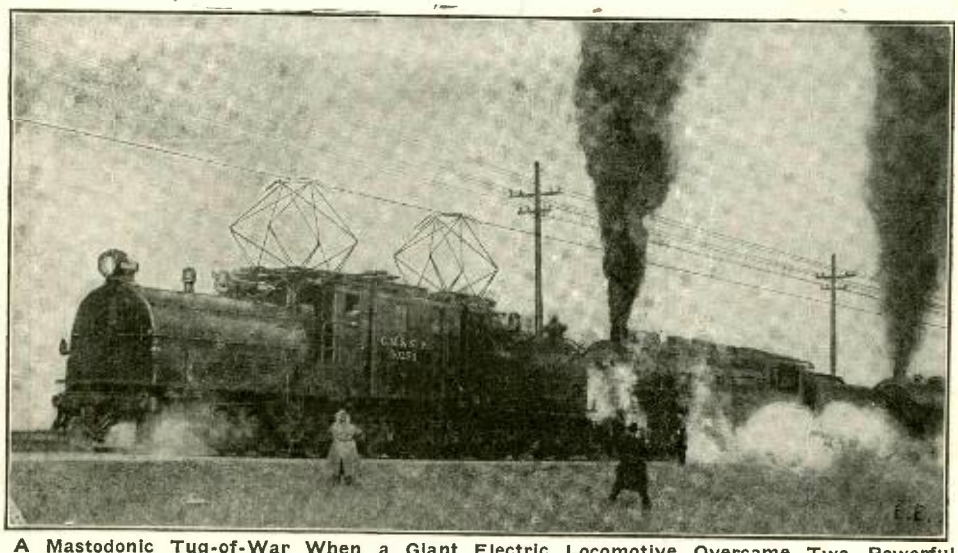
The greatest "tug-of-war" one could wish to see took place with thousands of horsepower let loose in the titanic struggle to prove the supremacy of the successful contestant. To obviate the possibility of pulling out the draw-bars of one or the other of the locomotives, which would probably have occurred if they pulled in opposite directions, the engines were caused to push against each other.

At a given signal the two powerful steam locomotives started pushing the big electric engine ahead of them, the latter having no current on at the start. Then the engineer in the electric locomotive gradually turned on the current and the powerful motors responded nobly. In the meanwhile, the throttles on both steam locomotives were opened up to their full capacity.

What was the surprise of the crowd to see the steam engines slowly but surely lose momentum and finally come to a complete stop, still with their throttles wide open, puffing and chugging as if under an extraordinary strain. Then what appeared to be the impossible happened, and a great cheer went up from the crowd as they saw the steam engines forced backward, first only by inches, but gradually, as the full power of the electric was brought into play, the procession became almost a rout, and when the test ended a few minutes later the steam locomotives were moving steadily backward and the electric locomotive was declared the victor.

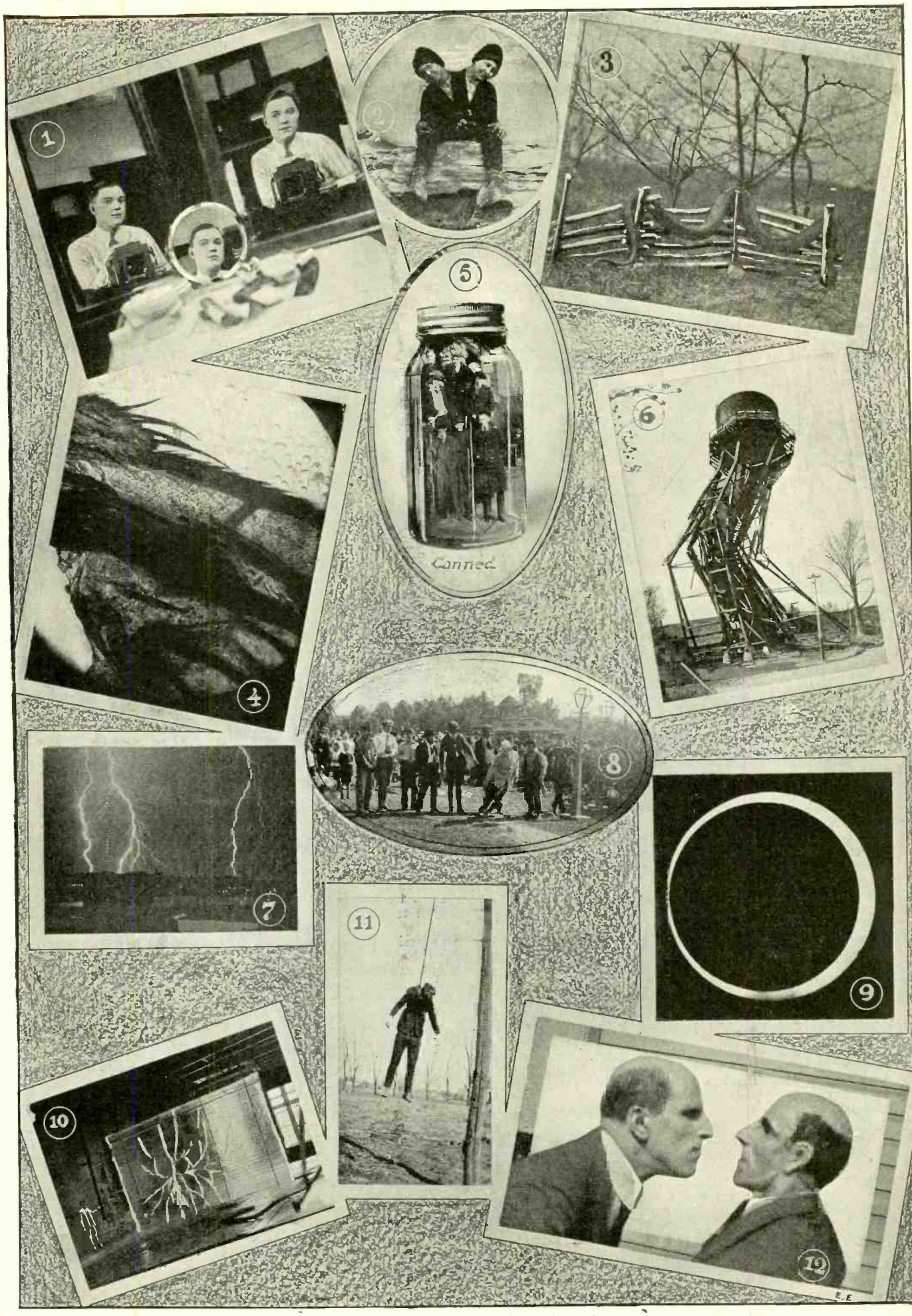
Interesting and spectacular as this test was to the laymen present, it was more significant to the engineers of the General Electric Company, who had devoted years to the perfection of this powerful electric locomotive. It was a conclusive test of power between steam and electricity.

This new locomotive is one of the most powerful passenger locomotives in the world. It uses 3,000 volts direct current and its horsepower is 3,240. There are fourteen axles on which are mounted direct connected motors.

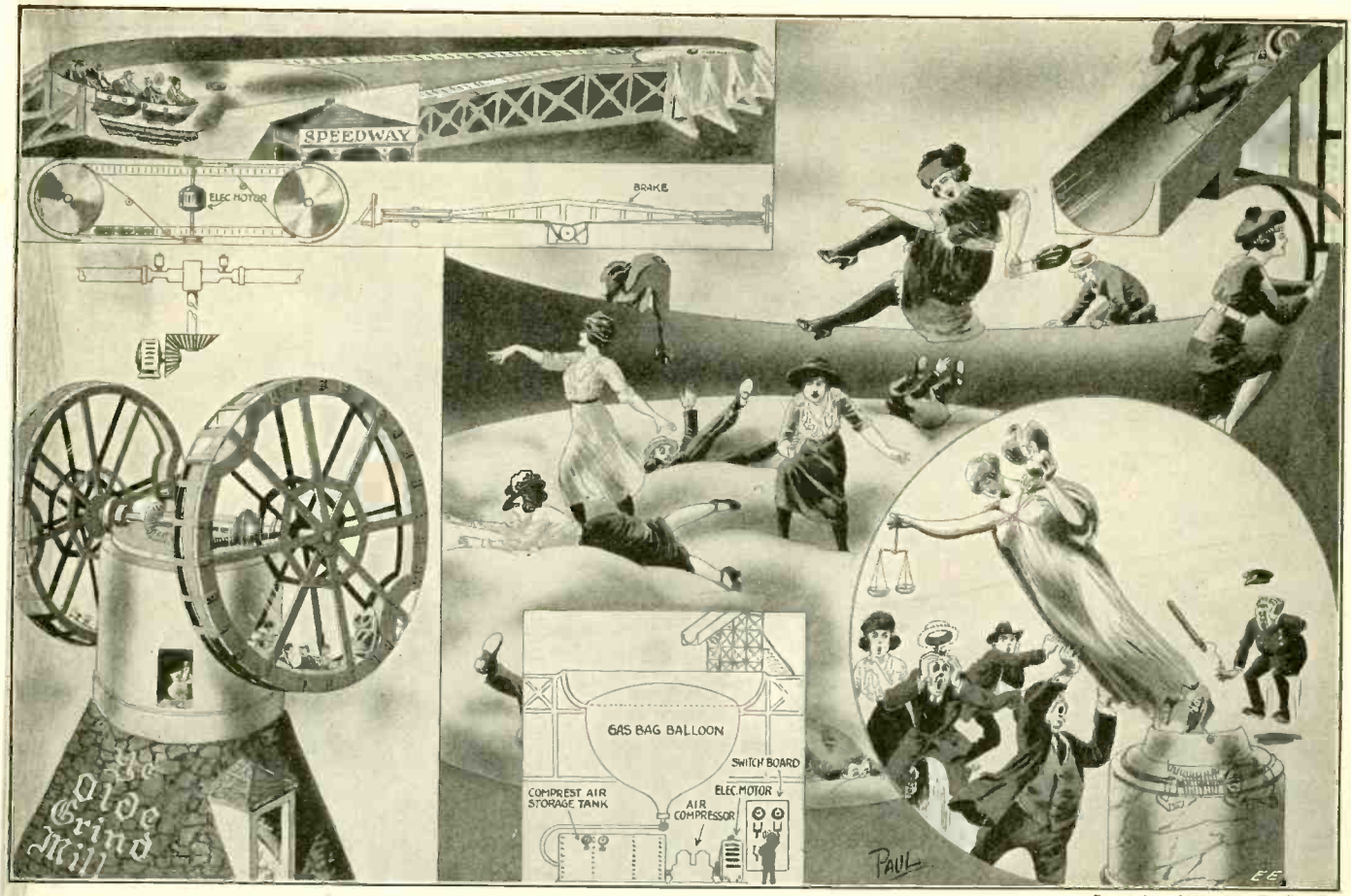


A Mastodonic Tug-of-War When a Giant Electric Locomotive Overcame Two Powerful Steam Locomotives.

ODD PHOTO CONTEST



(Full Description on Opposite Page. See if You Can Guess Each One Before Reading Text)



Well, "Folks," the Latest Machinery for Pleasure Torture, for So We May Call It, Is About Ready for Business, Down at the Sea-Side. What Between the New Motor Speedway, the "Soft Spot" or Bouncing Balloon, the "Humpty-Dumpty" Wheel and the Falling (?) Statue, We Apparently Are Going to Be Highly Amused This Summer

The Latest Pleasure Tortures

LUNA Park, at Coney Island, probably the greatest of all amusement places on the east coast and known to hundreds of thousands of pleasure seekers the world over, promises this year to rival any season heretofore held. New novel amusement schemes have been built which will please the gala crowd constantly attracted to that resort, which eclipse any of the wonderful amusement schemes ever before attempted.

A few samples of these ideas are described here. Not by any means complete, but selected, because of their remarkable characteristic features which mark them as being distinctly exceptional.

THE "FALLING STATUE"?!

The *falling statue* itself will be one of the free amusements, which add to the jovial attitude, driving away blues and producing hurricanes of laughter. Mr. Pleasure Seeker, on entering the park with a young lady at his side, is startled when suddenly a magnificent statue, the statue of "Justice" perhaps, starts to wiggle around in the exact semblance of a "shimmy", then suddenly it seems as tho "Justice" has outshimmied herself, and the wiggles are augmented to such an extent that the statue commences to topple forward, the scales in her hand trying their best to preserve their equilibrium. A voice in the crowd is heard, "Hold her up, she's falling," and forty or fifty "honest to goodness" strong men rush to her rescue. But the weight seems to be too great for them as they are rapidly borne down. If once "Justice" falls over, things would come to a very poor end.

The figure continues to decline forty-five, fifty-five and even sixty degrees, and the men who were attempting to hold her up, desert her for fear of being crushed with the weight when suddenly, as tho by magic, it looms up again into an erect position, the scales steady themselves and the laugh is on the crowd. Imagine how Mr. Fun Seeker feels when he returns to his girl friend after having attempted to play the part of a hero in vain.

The statue itself is of massive design, amply reinforced and mounted upon bearing which permits of motion. The ball at the base prevents anyone from seeing that the entire ball rotates slowly, due to a wormgear drive acting upon it in the base. In this way the statue can easily be allowed to topple forward about 60 to 65 degrees without any danger of it becoming injured or creating any injury, and just a word from any individual calling attention to that mechanism suffices to attract the pleasure seekers to the pending danger.

THE MILE-A-MINUTE SPEEDWAY.

A short time later, the couple move along after having recuperated from the partial excitement and step into one of the cars of the novel Speedway. The entire train of three cars is filled with people and the car starts on a slight downward decline toward its driving factors at either end. No motor is in the car nor are they operated over any steep embankment. At both ends of this oval Speedway are two discs about 26 ft. in diameter traveling around at tremendous speed.

The car enters this zone and sufficient momentum is imparted to it due to the friction of this disc which enables it to fly out tangently along the track to the wheel at the opposite end. Friction upon the car by the rapidly revolving disc thru the medium of the wheels again imparts momentum sufficient to give it added swiftness and sends it to the other end of the track from whence it had just come, and so on. One disc throws the occupants across the stretch to the other which plays ball with them, throwing them back. Three minutes ride in this and Mr. and Miss Pleasure Seeker who have just come from the statue are becoming to feel an effect similar to the distressing symptom resulting from imbibing neighbor Smith's home brew, containing two or three beets, an onion, and some garlic to produce the required kick (a horse-shoe sometimes answers the same purpose, especially, when on a good pair of horse's feet). The pleasure seekers eventually manage to escape and proceed from the run-way to another part of Luna.

The speedway, itself, has the two rotating discs mounted upon roller bearings. Guide rails surround the entire runaway and also the discs, to prevent the car from flying off the track except in the desired manner. Both whirling discs are connected by means of cable drives to a motor situated in a pit. The cables themselves travel over pulleys to the driving wheel of the disc. The slight incline in one track allows the car to be started without any difficulty and it glides to the disc at one end. The starting position is likewise, the position of a friction brake which stops the cars for the discharge of passengers.

(*Continued on page* 206)

ELECTRIC ODDS AND ENDS

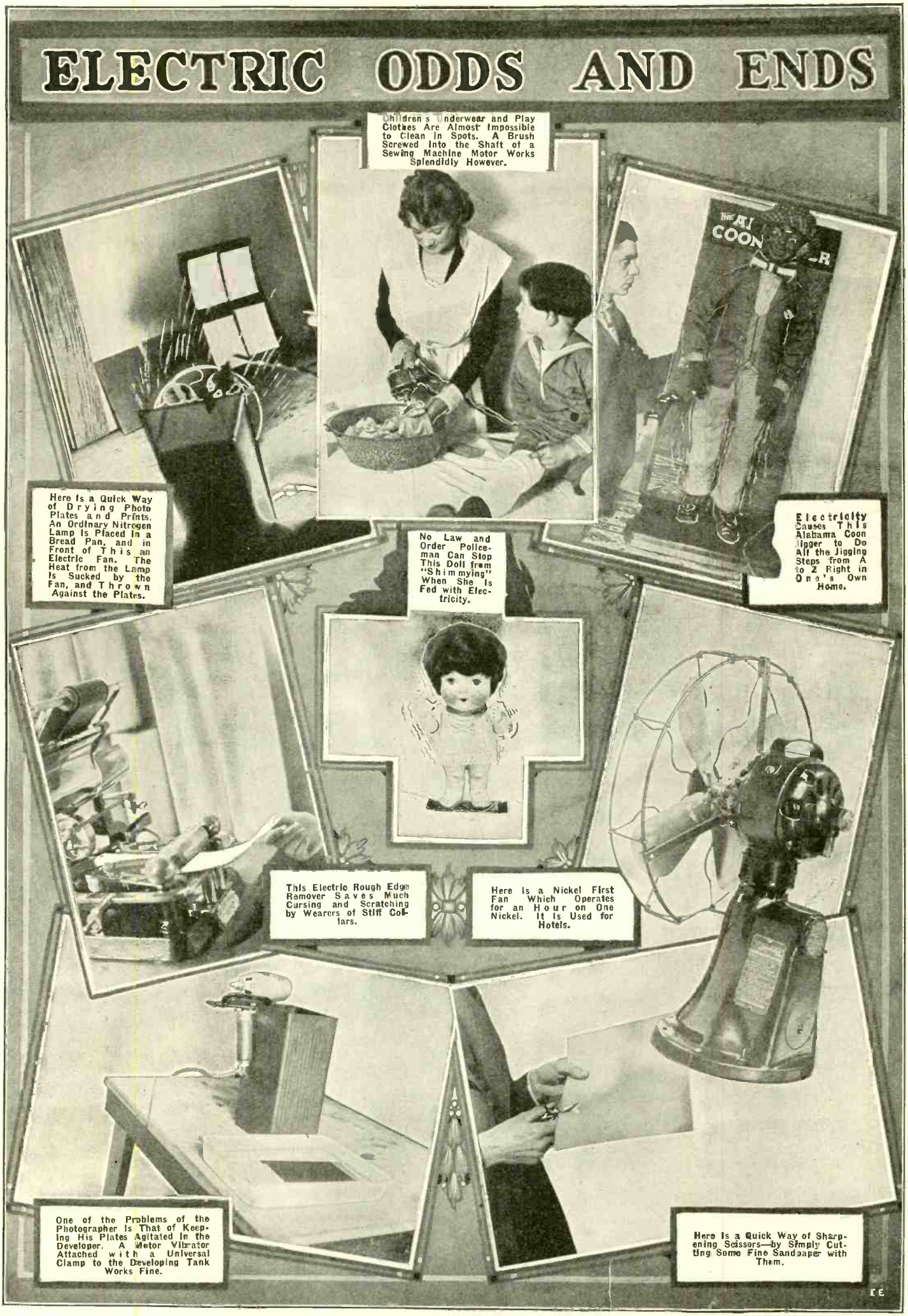
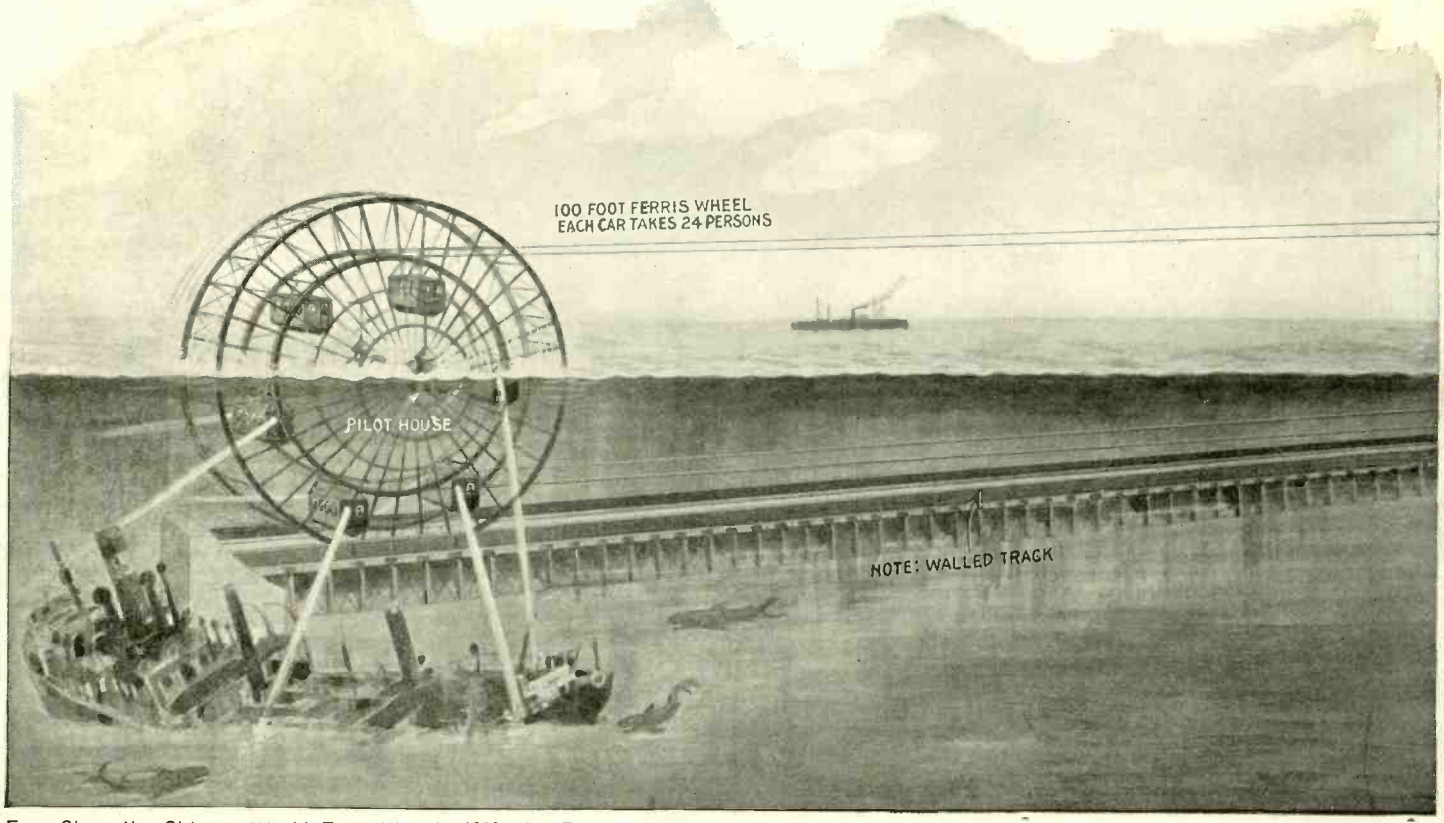


Photo by Edna Pindy

A Sea-Going

By H. GERNSBACK



Ever Since the Chicago World Exposition in 1893, the Ferris Wheel Has Been With Us to Delight Amusement Lovers At Our Expositions and Beach Resorts. The Latest Improvement On the Stationary Ferris Wheel is Shown Above. It Consists of the Regulation Wheel, Which With Certain Additions is Made to Roll Upon a Track, Out Into the Sea, Lake, or Other Body of Water. The Track Being Inclined Into the Water, the Wheel Rolls Down By Gravity. It is Pulled Back By Means of Two Steel Traction Cables as Shown. The

THE good old Ferris wheel has been with us for many years now, and ever since it was invented by G. W. G. Ferris, who erected the first one at the World's Exposition of 1893 at Chicago it has not been much improved upon. When it first came into use at our sea-shores and amusement parks, it was considered a wonder, but during the last decades the novelty has worn off.

Last year the writer took a trip on one of these wheels and was imprest by the lack of popularity in the device. There was no great crowding, and the writer particularly remembers a remark past by a young girl who refused to take the trip, giving as her reason that "it was not exciting enough for her." This seems to put the finger right on the whole crux. It is not exciting! Hence it has fallen into disuse with the amusement-seeking, merry-making crowds.

Another thing with which the writer was imprest on his trip was the cumbersome way of loading and unloading the passengers of these Ferris wheels. Once the cars are loaded, the wheel may spin merrily, but the loading and unloading is another matter. As each car comes down, the wheel must be stopt to allow one set of passengers to get out and allow another set to get in. Consequently it will be seen that there must be as many such stops as there are cars to the wheel. Loading and unloading thus takes an average of 10 to 15 minutes, which does not improve the temper of the occupants who expect speed and excitement.

For these reasons and various other ones, the writer advances a radically new idea which is shown graphically here, and also forms the subject of our cover illustration. The writer has simply taken a Ferris wheel, and instead of revolving it on its axis, he has placed it upon a steel track and rolls it out into the water as our illustration well depicts. The object is twofold. First of all a new brand of sensation is had, so much craved for by our present amusement seekers. Secondly, the old and well establisht features of the Ferris wheel are kept and improved upon as well.

The idea which forms the subject of a patent is in brief as follows:

The Ferris wheel runs upon a special kind of track, which latter is built right into the ocean, lake or other water body, the tracks being supported by the regulation piling work, similar to that on which our ocean piers are built. The track itself, as will be noted, should be inclined; the slope being inconsiderable. Using a hundred foot Ferris wheel, the track may run out into the water a thousand feet or more, all depending upon the expense the builders wish to go to. At the end of the track there is a concrete safety pier, which stops the wheel should the supporting cables break.

The mode of propulsion is rather simple. You have no doubt seen the principle many a time, particularly before prohibition arrived. Surely you have seen how a beer keg or wine barrel was lowered by means of two ropes down the stairways into the cellar. Two ropes would be slung around the barrel, and two men would play out the ropes as the barrel descended easily and gracefully down the incline stairs and into the cellar. The same principle is made use of in the present invention. As will be seen there are two steel cables, both running parallel to each other, one side engaging a circular sheave of the wheel, while the other side connects to the power house.

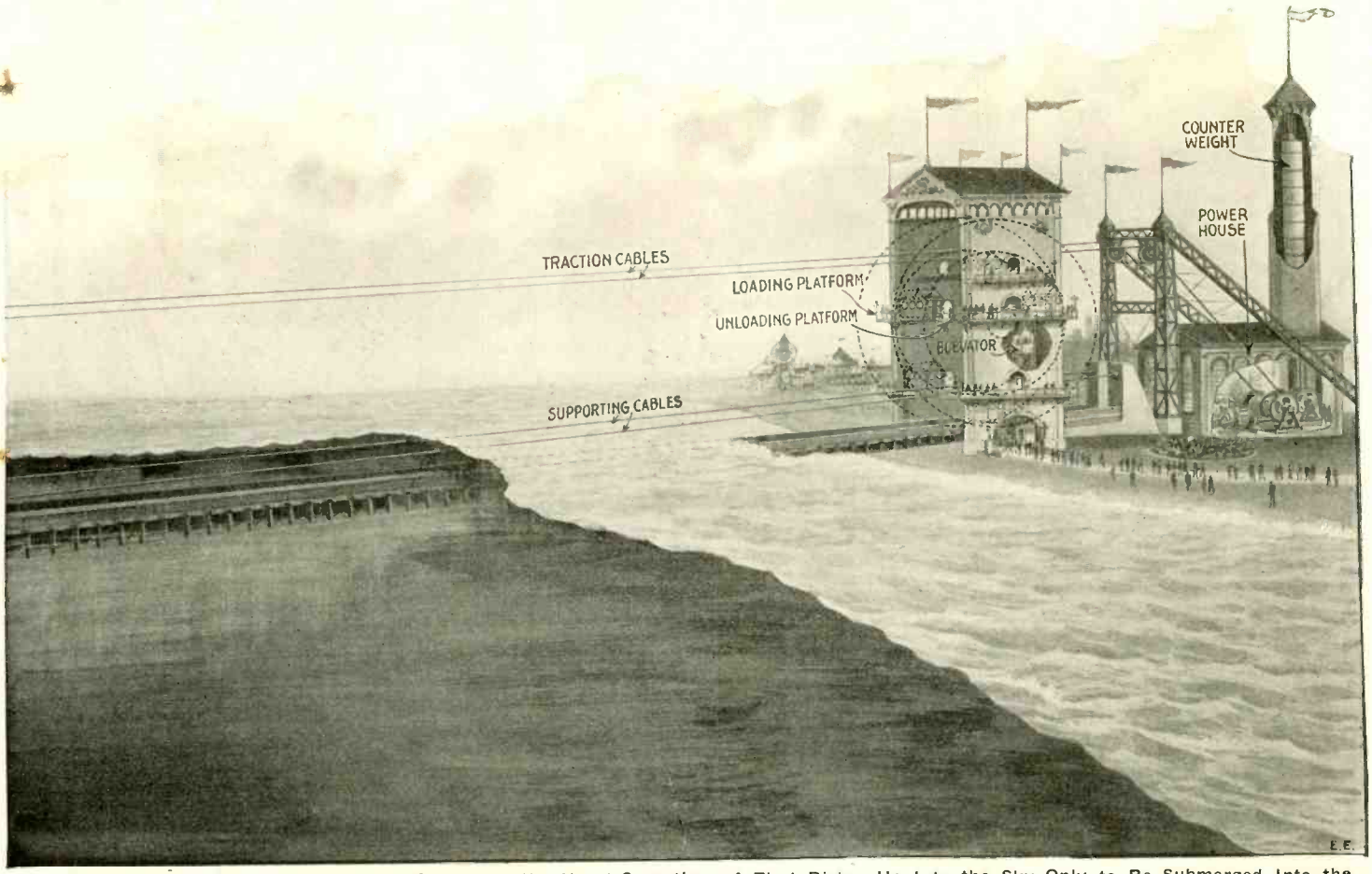
In the position shown in our illustration above, the wheel has arrived at the end of its trip and is now pulled landward again by means of the two traction cables which wind up on huge drums in the power house. Very little power is required inasmuch as big counter weights are used which practically pull in the wheel themselves. Only a small amount of power, let us say a 50 H.P. motor, is required to bring the wheel back to land. On its outward trip practically no power is required, the wheel running down the incline by gravity, the traction cable simply paying out; the action is, of course, under the control of the men at the power house, who will see to it that the wheel does not go too fast for reasons which will be apparent hereafter.

Let us now take an imaginary trip in this future sea-going Ferris wheel, and see what happens.

After paying our fare, we ascend by means of elevators on to a loading platform, and we will find that there are three such platforms. The cars of the Ferris wheel come into a resting position level with the platforms, the top platform and the bottom platform each accommodating one car, while the second and third platforms each accommodate two cars. The device is made so that, inasmuch as there are six cars and the wheel always returning in its same position, the cars will always stop at their assigned platforms and not otherwise.

We now enter one of the steel cars, each car accommodating 24 persons. There is not much room offered us, and every inch of available space has been taken advantage of, as we must not have too much buoyancy, otherwise it will take too great a weight to pull the cars down below the level of the water. For that reason the

Ferris Wheel



Passengers in the Water-tight Cars Experience the Novel Sensation of First Rising Up Into the Sky Only to Be Submerged Into the Water. The Maximum Immersion is About 50 Feet. The Experience Which is Gained in Submarine Building, Makes It Possible for Us to Make the Cars Thoroly Safe in All Respects, Without the Passengers Undergoing Any Risks Whatsoever. A Novel Means for Loading and Unloading the Cars is Shown as Well in the Present Invention, Which Does Away with the Tedious Starting and Stopping of the Old-time Ferris Wheel. The Sea-going Ferris Wheel Will Probably Be Built At Coney Island Next Season.

ceiling or roof of the car is very low.

There is just enough room in the cars to allow people to sit comfortably, and when the car is full there is not much room left.

We note that the windows are made of thick plate glass one inch thick, and that the room can be lighted by electric lamps, fed from a storage battery placed under the seats. It being a hot summer day, several small fans are kept running to circulate the air. We note the thick, massive steel walls of the car, and our particular attention is directed to the steel door which slides up and down like a window in air and water-tight brass fittings. This door is raised and lowered by means of a rack and pinion and forms an absolutely water-tight closure, which does not permit a drop of water to get by. Similar water-tight doors are used on all of our battle-ships and modern steamers, which connect the bulk heads, and which can bear enormous water pressures without allowing a drop of water to leak.

All the cars being loaded simultaneously in less than two minutes, we faintly hear a shrill whistle outside, and we are off. Slowly and majestically the big wheel begins moving, and keeps on moving at a steady gait. The sea-going Ferris Wheel is not intended as a racing device—quite the contrary, it only moves at about three or four miles per hour. Pretty soon the wheel begins to dip into the water, and as our particular car is way up in the sky, we have as yet to experience our first "dip" into the ocean. In a few seconds, we dive into the surf gracefully, and we experience the thrilling sensation of sinking into the green ocean water, while the spray of the big waves break against the thick glass windows, slightly swaying the car. Truly enough, here is sensation and excitement sufficient to please the most blasé. Down, down we go, and we note that the sunlight becomes dimmer and dimmer as we dip further into the water. This, however, only lasts for a few seconds, and suddenly we are aware that we *seem* to be moving backwards. The reason of course is that the car is now going the other way, and soon will dip out of the water entirely. In a few seconds, we are out of the water again, and are soon once more high up in the air, only to dip down still deeper into the water than the first time. As we go down for the last time, we know that we are about 50 feet below the water level, and here it is almost dark, very little sunlight coming down to this depth.

The attendant now turns on a little searchlight, and we can see small and large fish swimming about curiously. At the end of the track, we also make out the dim outline of a stranded steamer buried in the sand many years ago. It gives us a good view of what a sunken steamer looks like, and how it has disintegrated with age. As the wheel only stops for a few seconds, we have not much time to notice all the submarine wonders, for soon the wheel starts rolling back, and we dip out of the water once more.

We note that every time the car dips out of the water, an attendant turns a hand wheel, which is for the purpose of renewing the air in the car. A pipe connects somewhere with the roof of the car, and this pipe lets in fresh air every time the car rises from the water. A funnel-shaped cover prevents the water from entering the car when air is let in, while a suction fan forces fresh air into the car. This change of air is greatly welcomed because there is not too much air in the cars anyway, and while the entire trip only lasts about 20 minutes, and tho the original air would be sufficient to keep everyone comfortable during this time, it is far better that the air should be renewed, giving the passengers a chance to get a breath of clean and fresh sea air.

Soon we are back on *terra firma* once more, and arrive at our unloading platform. The door is slid open, and we emerge to make room for subsequent passengers.

So far for the whole trip. Our illustration shows the other items which the passengers do not see. For instance, there are two pilot houses attached to the hubs of the wheel. Each one of these pilot houses has a semaphore arrangement on top of its little housing, which is used by the pilot to inform the land station in case anything goes wrong, but more for the purpose to start, stop, or accelerate the speed of the wheel or for any other purpose. The passenger cars have a triangular attachment at the bottom for two reasons. If the car was entirely flat, it would have difficulty in making its dive into the water. Secondly, inasmuch as we have a large buoyant body in the form of the car itself, we must weight it down to such an extent that it will not float. If it were floating, then the car would overturn and spill the passengers inside of the car. For that reason, the triangular appendage of the car is weighted with iron to overcome the natural buoyancy of the car. A good percentage of the buoyancy of the car itself has been destroyed by the great weight of the car (built of 3/8" steel), but this is not sufficient to sink it, hence the ballast weight is needed. It is necessary also to have the car good and heavy for if

(*Continued on page* 205)

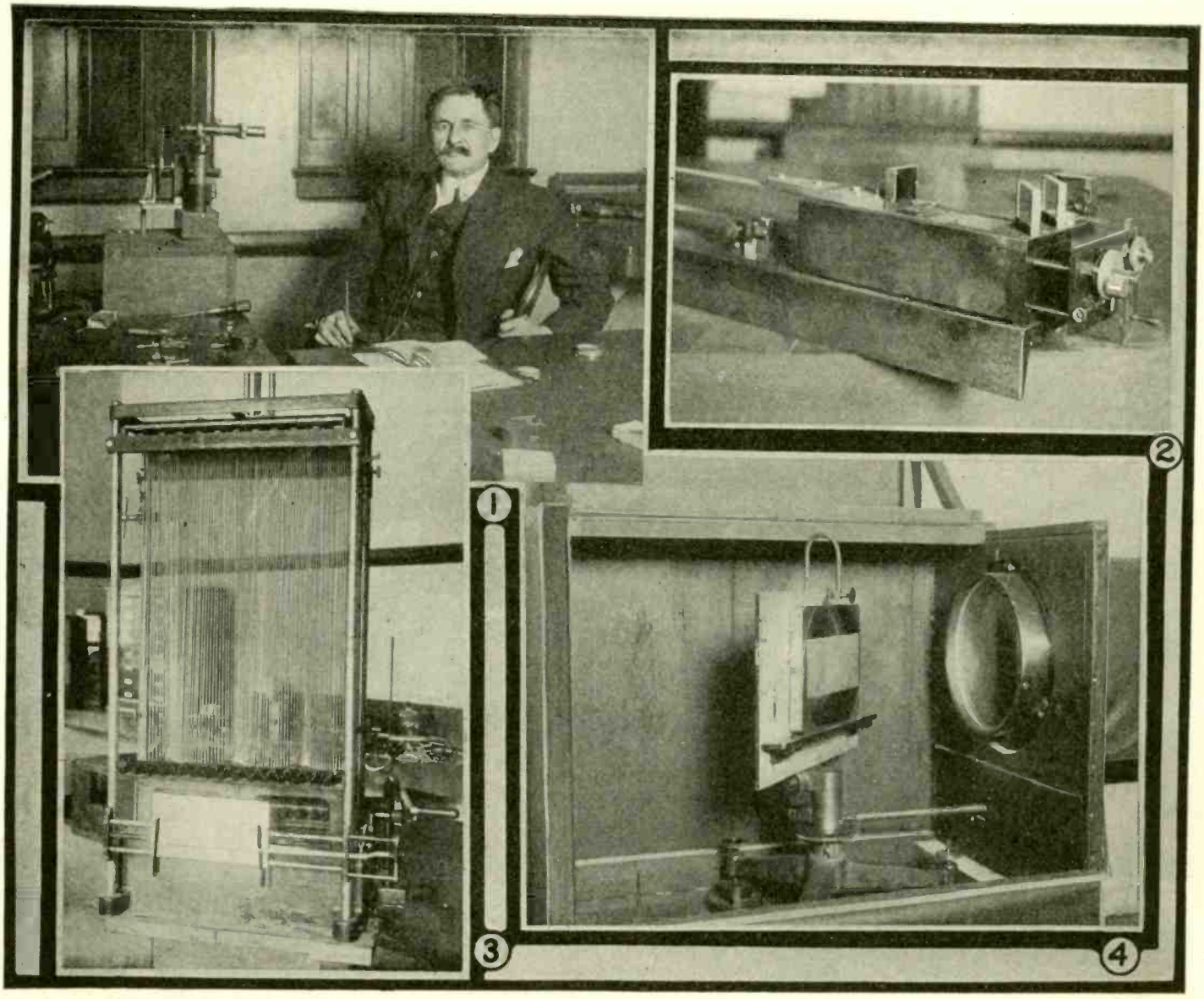


Fig. 1. Dr. Albert A. Michelson, of Chicago, Famous American Physicist, Whose Work Is Said to Have Inspired the Basis of the Einstein Theory. Fig. 2. Dr. Michelson's "Interferometer." In Measuring Small Changes in Distances or Angles, This Instrument Is Fifty Times as Strong as the Most Powerful Microscope Which Can Ever Be Made. Fig. 3. Prof. Michelson's "Harmonic Analyzer" for Analyzing Spectral Lines Into Their Constituent Parts. Fig. 4. Prof. Michelson's "Echelon Spectroscope" Which Has a Glass Grating Containing Fifteen Thousand Parallel and Equally Spaced Lines to the Inch.

Chicago Professor Gave Foundation for Einstein's Theory

By ROBERT H. MOULTON

A UNIVERSE with four dimensions. Stars that seem to twinkle in one place and really hang in another section of the sky.

Yardsticks that are longer east and west than if lying north and south.

Light with weight that jars the earth when sunbeams fall.

These are bits of the now famous Einstein theory of "The Relativity of Earth-Motion and Ether-Motion." Einstein, philosopher and mathematician, based his profound yet fantastic theory upon experiments performed with a marvelously delicate measuring instrument, the "interferometer," invented by Dr. Albert A. Michelson, of the University of Chicago.

Scientists have long endeavored to determine the absolute motion of the earth thru space. It is known that the earth swings around the sun and that the entire solar system is moving toward the constellation Hercules at the rate of twelve miles per second, or 400,000,000 miles per day. However, as scientists have not been able to measure the motion of Hercules, they still do not know the absolute motion of the earth. In 1880 Professor Michelson attacked the problem of determining the motion of the earth with reference to the ether, the all-pervading medium that fills interstellar space.

He eventually overcame the tremendous experimental difficulties in connection with this problem; but no motion of the earth with respect to the ether was found. This result came as a profound surprise to the entire scientific world. It does not mean that there is no motion relatively between the earth and the surrounding ether; but a number of basic scientific theories must be revised to account for this new condition.

In order to solve this problem Professor Michelson invented the "interferometer." This instrument is fifty times more powerful than an absolutely perfect microscope would be. The microscope's power is limited by the length of a light wave; and the smallest distance it can reveal is one-half a wave length, or one hundred-thousandth of an inch. By utilizing the properties of light in another manner, the interferometer can reveal distances equivalent to *one five-millionth of an inch!* The microscope has been of immense value both in scientific work and in practical life; and the invention of the interferometer, an instrument fifty times more powerful, is in itself an achievement that should win for Professor Michelson undying fame.

He used this instrument to aid him in measuring the standard meter, the foundation of the metric system, in terms of infinite exactitude and in a manner that will make this unit perpetual. The original meter length is a rod of solid platinum carefully preserved in Paris; but scientists have long worried over the possibility of its destruction. In 1893 an international commis-

(*Continued on page* 231)

Master "Movie" Thrills

IT is really remarkable, in fact astounding, to what extent motion picture actors and actresses will go in order to furnish the "Movie" thrillers which we so delight to view from a nice cosy box seat. While we take life easy the "cast" works overtime to send us thru all kinds of imaginary feelings of torture, suspense and mystery. There is no branch of science which is not used in some way or other to furnish the jaded theatre-goer with these remarkable hair-raising adventures. Spiritualism being one of the paramount topics of discussion all over the world at present, this 4th dimension scientific theorism is brought into play in making the thrilling Vitagraph photoplay "Smashing Barriers" a success.

William Duncan, playing the leading rôle, is an athlete of exceptional merit and is ably supported by the leading lady, Edith Johnson, who willingly attempts some of the most daring, hair-raising stunts imaginable, whereby, aided by good fortune and a sure hand, her life is saved time and again. Don't think for a moment that these scenes are "faked," dear reader! The realistic photoplay must combine with it the *actual* daredevil and reckless stunts in order to have the true gripping effect required by the serials. Some of these serial film plays have been so ably staged that they exercise such a hold upon the public that the installments of the serial are never mist, from Little Johnny to Old Grandad.

This is particularly true of the photoplay just mentioned. Take, for instance, the three scenes showing the "Crystal Gazing" and subsequent acts, which clearly demonstrate the elaborateness of such a display. The chair made to order and the immense revolving floor alone present mute testimony as to what extent a modern photoplay producer will go in order to furnish something strange, something with that ever-sought-for "thrill," and at the same time hold both the newcomers and those who have mist the first few installments. So in this case, after fabulous sums were spent in order to construct a revolving floor the chairs of which were bolted down, the mechanism for revolving the floor had to be built strong enough to withstand the abnormal condition that it was put to, and the chairs themselves constructed in such a manner as to firmly lock the occupants in place so that when the floor was revolved there would be no danger of them slipping from their bonds to go crashing down into the room below. By what miraculous power the occupants in the chairs maintain their position is not known particularly, inasmuch as the chair itself seems to be quite weak, but the fact remains that they revolve completely until they are in an inverted position and photographs of them suspended from the ceiling of the room below are shown in the serial.

The story itself is one in which countless wrecks, tons of dynamite and T.N.T. and scores of hair-breadth escapes figure and were it not for the wonderful physique of the actors it would be utterly impossible to conduct a serial so rich in ideas as this one. The three photographs show the spiritualists in the den of the treacherous clairvoyant.

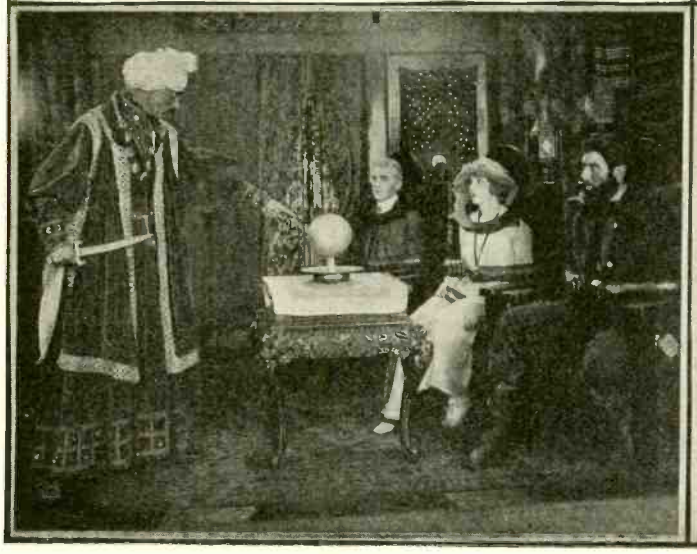
Then the exceptionally clever Vitagraph photoplay serial, "The Invisible Hand," starring Antonio Marino and Pauline Curley, is found to be equally as elaborate as the one just mentioned, and with as many "thrills"—featuring submarine caves, poison gas, dynamite, airplane and submarine activities and in fact every thrill that can possibly be produced on land, sea, in the air, or in the water.

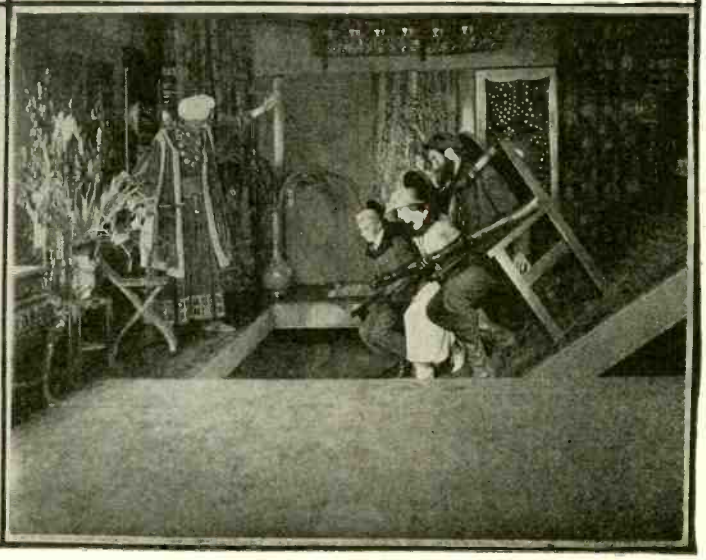
This story is a detective serial of the very unusual high-class type in which the heroine does some exceedingly thrilling and strength-daring, daredevil stunts. There are very few heroines who can run, jump,

(*Continued on page* 235)

The First Scene of the Vitagraph Serial "Smashing Barriers." By the Press of a Buttor on the Table Automatically the Chairs in Which They Are Sitting Become "Alive," and They Are Imprisoned by the Bonds.

When the Hero Enters He Finds the Room Empty, While the Poor Victims Are Hanging in an Inverted Position from the Ceiling of the Floor Below. Above—an Elaborate Radio Station in Vitagraph Serial, "The Invisible Hand."





Eliminating the "Hello Girl"

By H. E. CLAPHAM*

THE announcements made during recent months concerning proposed installations of automatic telephone equipment in several of the larger cities of the United States have come with rather dramatic suddenness to those who have been unacquainted with the trend of affairs in the telephone world. To men who have been intimately associated with the telephone industry it has been no surprise at all, but rather the logical outcome of the events of the past few years.

Automatic telephony is by no means an innovation. The advantages of machine made connections have been recognized almost from the beginning of the telephone art, and it is now almost thirty years since the first public automatic exchange was installed. In the early years of the art, the apparatus was necessarily crude and its adoption for public use gradual. At the time that it was first put into use, telephone service consisted of hardly anything more complex than simple party-to-party calling and it was to relieve the operators of this burden that the automatic system was originally conceived. The development of the telephone during the last thirty years has been phenomenal. That the automatic system has met every requirement that has been demanded of manual systems would not be stating the case fully. The automatic system has been developed to a point where it can do anything that can be done with a manual system, and most things better and more economically.

ADVANTAGES OF AUTOMATIC TELEPHONE SYSTEM.

The advantages accruing from the elimination of the operator alone are many and are too well known to need enlarging upon here. There are, however, many other advantages not so generally known. Chief among these are: Absolute privacy; rapidity of connections; immediate signals indicating condition of called line; instantaneous release of connections upon replacement of receiver; constant and uniform service day and night. To the operating company also the system has decided economical advantages, as follows: Saving of operators' wages, training expenses and accommodations; economy of space; economy in line construction; low maintenance charge and long life.

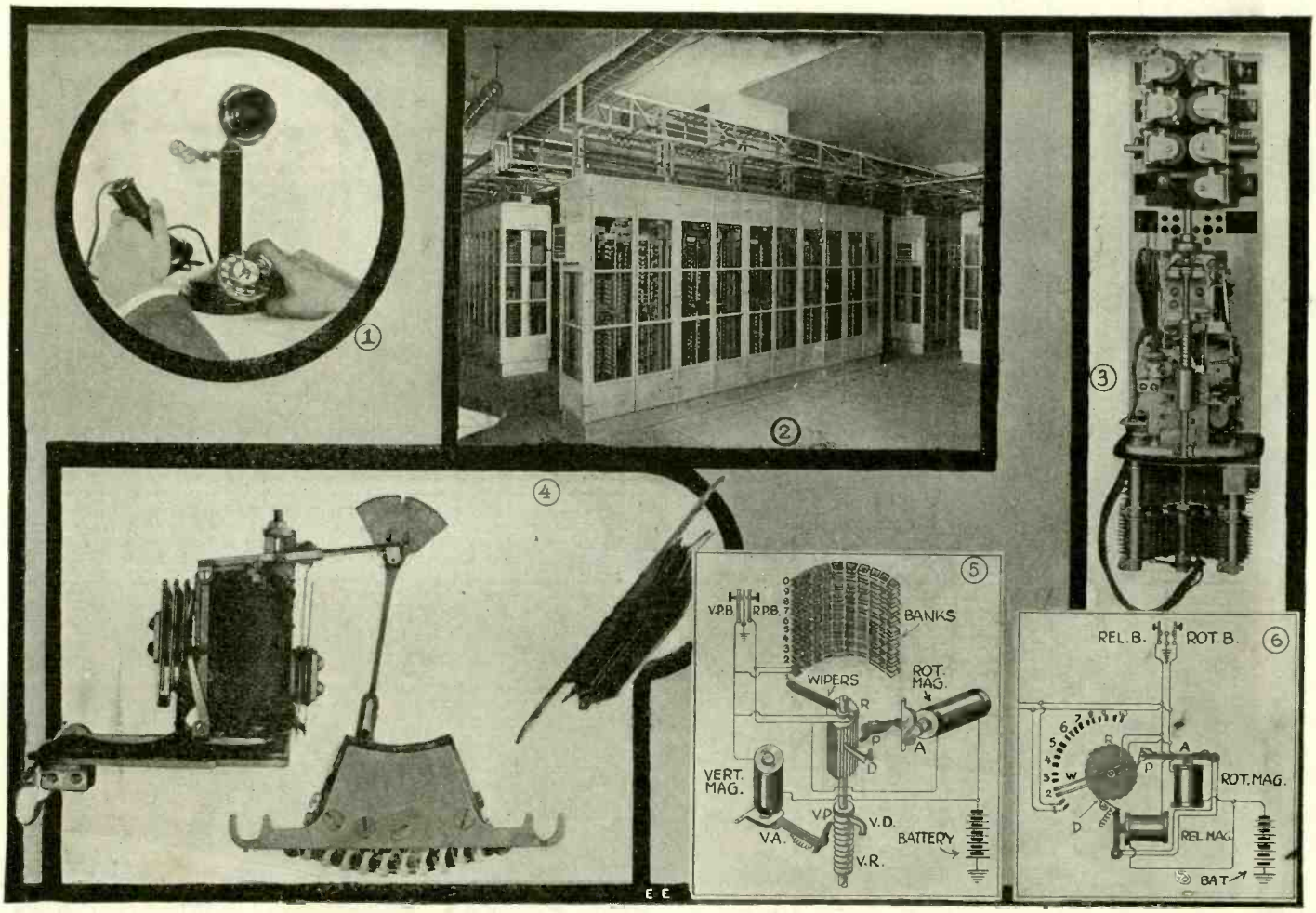
The matter of economy in building space can be easily appreciated when it is considered that often, when a manual exchange is converted to automatic, it has been found possible to install the complete automatic unit in the space that, up to that time, had been used for operators' recreation, lunch and locker rooms.

Great economy in line construction is made possible because of the flexibility of automatic equipment. While the size of a manual office has definite limitations, there is no limit to the number of lines that may be placed in one automatic office. On the other hand, the nature of automatic equipment is such that in communities where the telephone traffic is distributed over a considerable area, it may be subdivided into small units and operated advantageously in a number of widely separated offices.

The general plan of an automatic exchange divides the number of lines into groups and sub-groups, and 100 lines form a minor group or unit. A thousand line system is built up by grouping together ten 100-line units and providing means to select the particular unit desired. Larger systems are built up by grouping a number of 1,000 line systems together and providing means to select the particular 1,000 line system containing the desired line.

Almost from the beginning automatic telephony has followed this plan of *trunking by groups*. The process of selecting a

(*Continued on page* 225)



The Above Illustrations Show, 1—Calling a Number on the Automatic Telephone by Placing the Finger in the Ring Over Each Desired Digit, Rotating the Ring to the Fixt Stop and Releasing the Ring for Each Successive Number.

2—Large Automatic Telephone Exchange—Not a Girl in Sight!

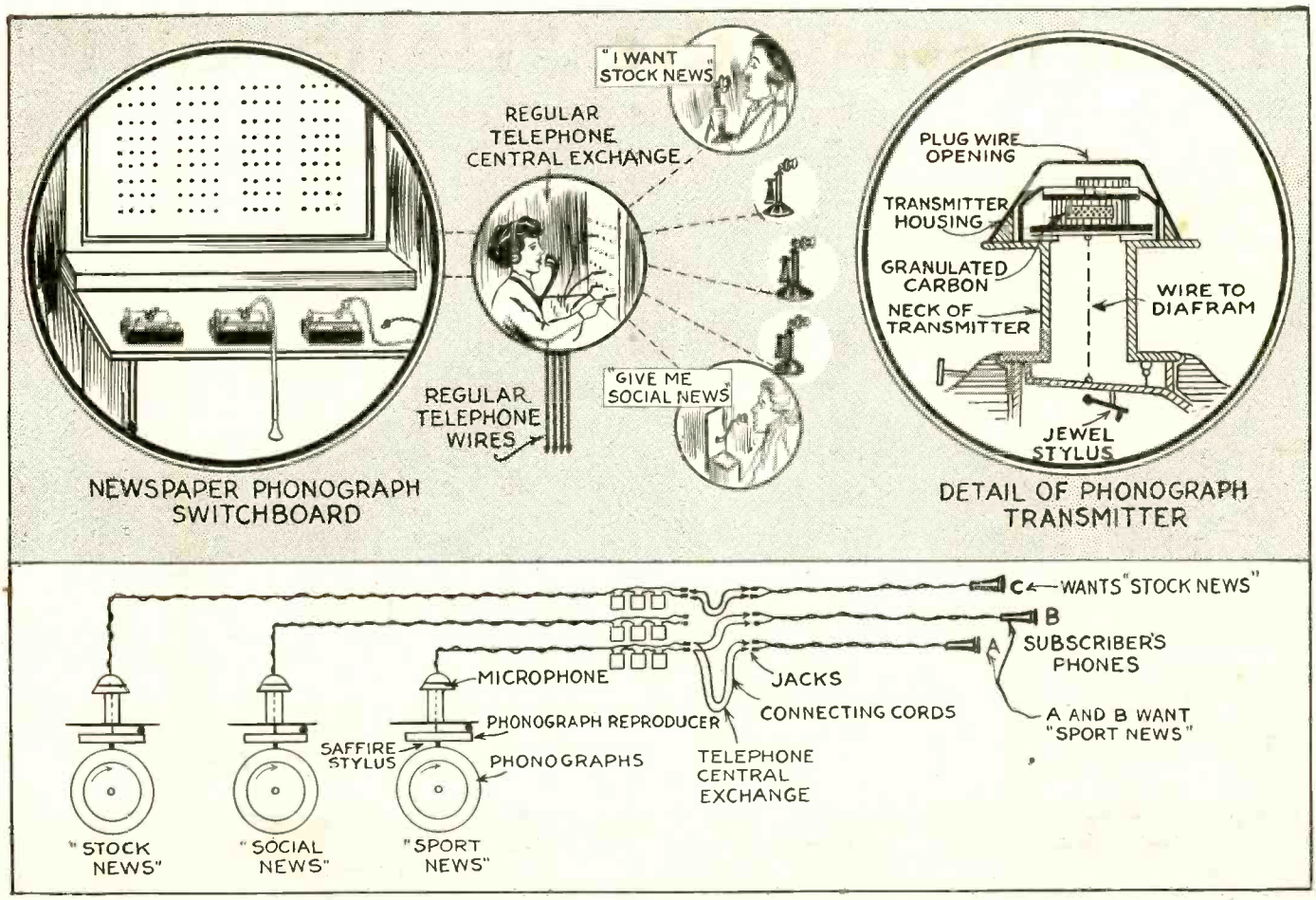
3—Close-Up of One of the "Connector Switches" Which Help to Select the Called Subscriber's Telephone Circuit. The Switch Arms May Be Lifted to Any Desired Tier of Contacts and Rotated at Any Level, All by Sets of Electro-Magnets, Operated by the Calling Subscriber's Instrument. If the Line Is Busy You Hear the "Busy Tone" In Your Receiver.

4—The "Line Switch"—the First Selecting Mechanism Actuated by the Subscriber Calling Thru the Agency of His "Dial-Switch" on His Instrument. The Electro-Magnet at the Left Actuates the Switch Arm. In Spite of the Several Switches Thru Which a Party Is Called, the Total Time for Called Is But 8 to 10 Seconds Usually, Which Compares Favorably and in Fact Surpasses Most Manually Made Calls.

5—Showing 100 Subscribers' Lines Arranged in Banks with Selector Switch Arm, Raised and Lowered as Well as Rotated by Magnets and Pawls.

6—Simple Circuit Finder, or Automatic Selector, for Exchange of 10 Subscribers.

* Of the Automatic Electric Company.



Instead of Reading a Newspaper We May Tomorrow Call Up "Via Telephone," and Ask for the Latest "Social," "Sport" or "Financial" Information and Hear the "News" Spoken Over the Telephone from a Phonograph. This Invention Will Be a Great Boon to the Blind in Many Ways, and Instead of Having to Read by Raised Letters, Besides Missing the Latest News, Those Whose Sight Is Deficient May *Hear* the Latest News When the *Newsophone* as Its Inventor Calls It, Is Put into Service.

"Newsophone" to Supplant Newspapers

Latest Electrical Invention to Provide "News" via Telephone at Low Cost

INSTEAD of chasing out "Bill" the office boy for a copy of the latest "Uxtre-ee-e" detailing with horrible fidelity, the latest murder, scandal and I. W. W. outrage, you will in the near future, with the "Newsophone," the latest scientific distributing idea created by Mr. Lewis Yeager of Spokane, Washington, simply call up on your regular telephone and ask for the specific *news wire* you are interested in.

The present plans call for a comparatively simple arrangement of the *news wires* which may be centralized at either the newspaper headquarters, or at the offices of some large news distributing syndicate such as the Associated Press offices in the larger cities. The telephone subscriber who wishes the latest Social, Sport or others news will simply call "Central" and ask for the *news wire*. In a moment, the operator at the news headquarters will ask which news the subscriber desires, and having ascertained this, will immediately connect his line with the proper *Newsophone* instrument, and the newsophone is nothing more or less than our old friend the phonograph brought forth with a new dress,—in other words, the news that you now read is recorded vocally on a wax record so that when you want to hear all about the latest suicide, divorce scandal, or what is happening to little Mary Pickford and "Doug" Fairbanks, or how many points B. & O. stock dropt today, it will be *spoken to you*, in a pleasant voice.

Apparatus and plans for voluminous newsophone service have not reached a stage where the particular voice used has been decided upon, but eventually it may be possible to ask for any register of voice you like, tenor, baritone or bass,—with male voices for the ladies and delicately shaded female voices for the "gents."

Think what a boon the newsophone will be, once it is put into regular service during the summer, when the baseball fans pester the life out of telephone operators, and also the fifty-seven other varieties of "telephone bugs" who want to know all the latest doings from what the weather is going to be a week hence, down to the latest gossip on the "Mexican situation."

HOW THE NEWSOPHONE WORKS.

The newsophone as outlined by Mr. Yeager, possesses some very fine possibilities and while the service rendered by it might seem to entail a very large expenditure of money to make the initial installment of the apparatus, distributing switchboards, etc., this is not so gigantic as it might at first seem. This is so for one reason, and that is, that the various kinds of "news" furnisht would be limited to probably a few dozen different varieties such as stock news, social news, steamship arrivals and sailings, accidents, marriages, deaths, etc. Moreover, but one phonograph record containing any of these specific news items is required to supply any number of subscribers with news *simultaneously*, should a number of them call up at the same time.

Simply explained, this can be conceived of in this way: In the old Edison type phonographs, especially when it was first introduced, there were many times when instead of reproducing the music thru a horn, a multiple set of rubber ear tubes was fitted to the reproducer chamber on the phonograph, and each member of the family placed a set of the tubes in their ears. Thus, as many as five or six could listen at the same time and enjoy the music.

The Newsophone is nothing more nor less than a glorified phonograph and which in its final development, will require some of

(*Continued on page* 207)

Sub-Sea Talk Over Bare Wire

By DONALD MACGREGOR

LATE CAPTAIN, U. S. SIGNAL CORPS, STAFF OF MAJOR GENERAL SQUIER

Using Bare Wires as a Substitute for Ocean Cable and Buried Land Wires

ORDINARY "bare wires" for carrying telephone and telegraph messages thruout the world, in the place of the present highly expensive and delicate cables—this, revolutionary as it may seem, is the very latest proposal of Major General George O. Squier, Chief Signal Officer of the United States Army.

Major General Squier, whose remarkable developments in the field of cable and radio have attracted world-wide attention in recent years, renders the use of bare wires placed in the sea possible for the transmission of messages thru the application of "wired wireless," which he announced about eight years ago, and which already is in commercial use in the United States. "Wired wireless," popularly described, is a combination of radio and the old system of wire communication, in which the wire is used as the *guide for the radio,* thereby permitting transmission with a minimum of energy and with the fullest extent of secrecy, which radio ordinarily does not possess.

Up to the present time "wired wireless," which some of the Chief Signal Officer's close associates have come to call "Squiered wireless," has been used for telephony and telegraphy on land lines, under favorable conditions. There never was any attempt before to apply it to lines placed in the water—the ordinary type of cable, with its heavy armor to prevent damage to the wires—stood supreme for such long-distance communication.

Vacuum-tube amplifiers, however, make possible the communication over bare wires placed in the water, which has been proven beyond the shadow of a doubt in a long series of experiments that have been going on under the direction of Major General Squier in the vicinity of Washington. The experiments, which have been in direct charge of Lieutenant Colonel J. O. Mauborgne, chief of the engineering division of the Signal Corps, were conducted between Fort Hunt, Virginia, and Fort Washington, Maryland, which are across the Potomac river from each other and which are about 4,000 feet apart.

TALKING OVER BARE WIRE IN WATER.

Here telephone communication has been established over a bare wire placed in the Potomac river and weighted down with bricks tied to a clothes line, to prevent it from becoming entangled with river steamers. It has been possible to send and receive telephone messages just as distinctly as over the customary lines maintained under the most favorable conditions.

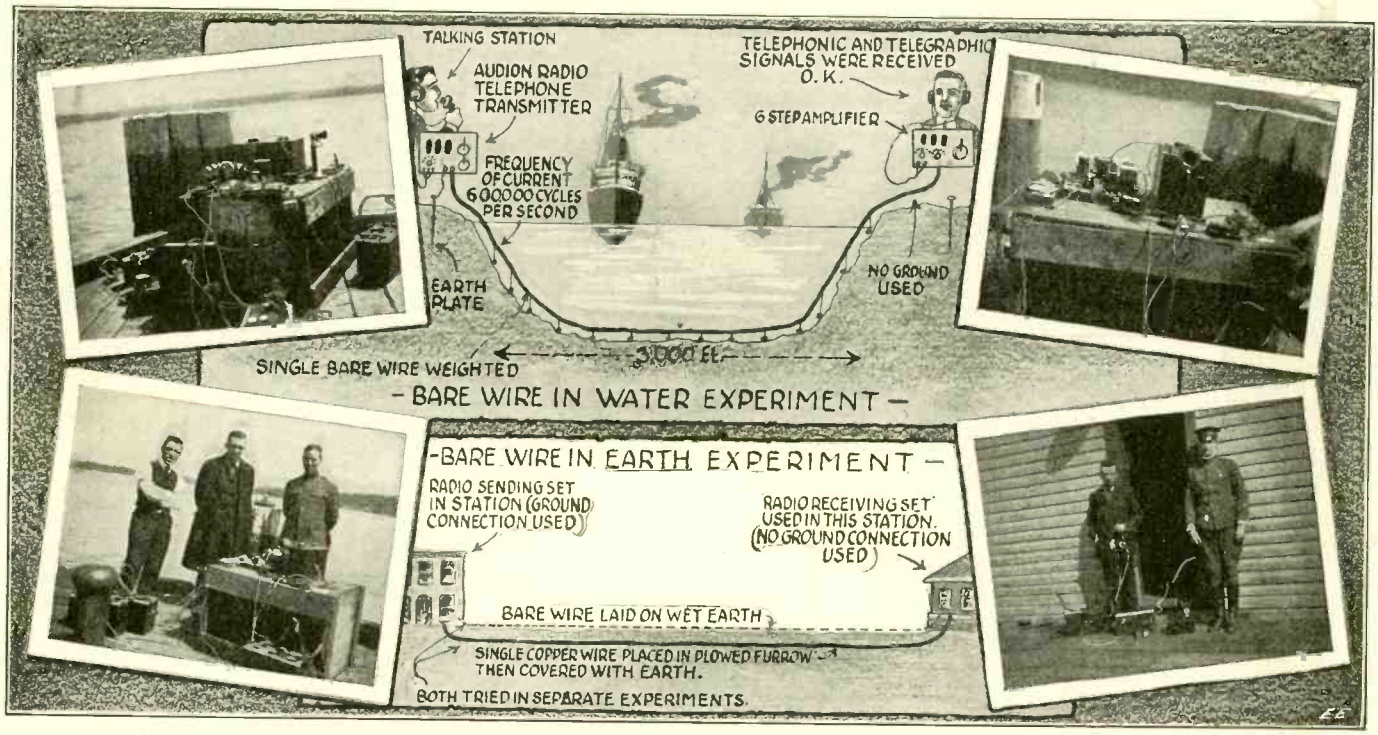
What has been done over this short distance can be done over a longer distance, in the opinion of Major General Squier, who maintains the view that a principle has been established which will have the most far-reaching effect on the future development of cabling. For long-distance communication it merely is a matter of the proper current and sufficiently powerful vacuum-tube amplifiers.

The idea of such an application of "wired wireless" occurred to Major General Squier last December, in studying over the Naval development during the war *which enabled two submarines while submerged to communicate with each other by radio.* It proved to the mind of the Chief Signal Officer that radio currents would travel thru water just as well as thru the air, and it seemed to him to follow that such a current could be *guided* by a wire when placed in the water.

Major General Squier explained the theory to Lieutenant Colonel Mauborgne, who immediately declared his belief that the scheme was feasible.

They realized the revolutionary aspect of the work they had undertaken; they knew that for years ocean cables had been laid at the greatest expense—in excess of $2,000 a mile with prices as they were before the war—and that even the slightest break in a cable put it out of commission, necessitating its repair by a cable ship after a wearying search.

Their experiments brought scant results at first, but they went ahead, firmly convinced that there was a way. They placed the wire in the water, placing a ground connection at either end, but this did not work.



The Latest Thing in "Wired Wireless" as Carried Out Under the Direction of Major Gen. George O. Squier; Telegraph and Telephone Messages Were Transmitted Over a Bare Wire Three-fifths of a Mile Buried Underground, and Also Immersed in the Potomac River, as Shown. Upper Left-Hand Photo Shows Apparatus Used on Pier on River Bank. Lower Left-Hand Photo Shows Members of Signal Corps, U. S. A., With Pier Apparatus. Upper Right-Hand Photo Shows Close-Up of Radio Apparatus Used. Lower Right-Hand Photo, Officer Is Colonel J. O. Mauborgne, With Signal Corps Laboratory Apparatus, and Assistant

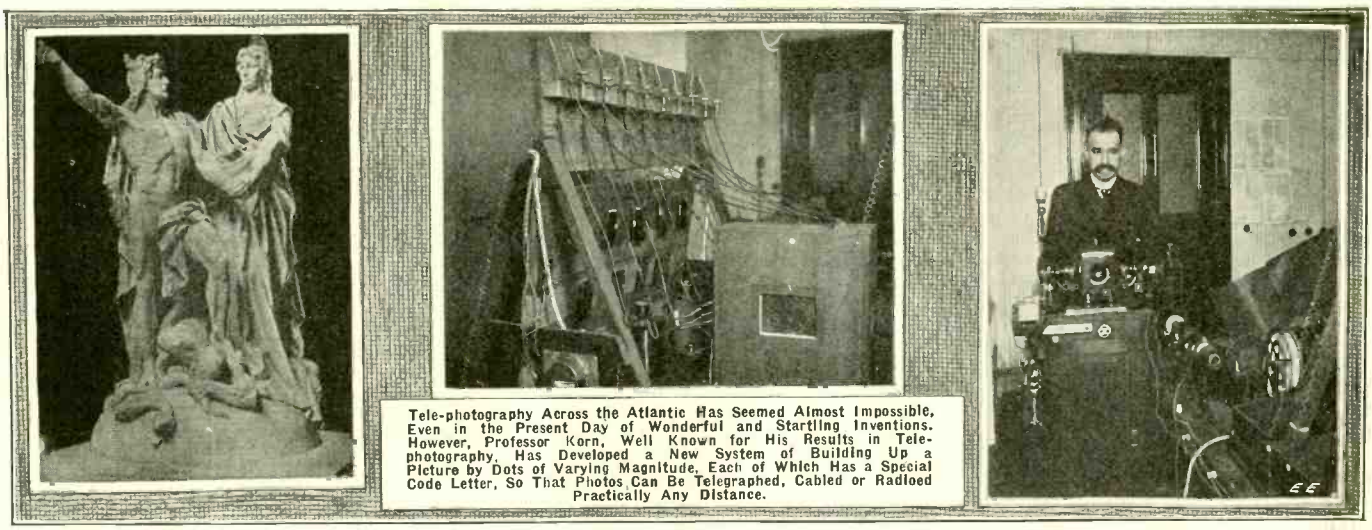
NO GROUND CONNECTION USED.

Finally, after numerous trials which did not seem to be sufficient, it happened that Colonel Mauborgne accidentally disconnected the ground connection. Surprising as it may seem, the line went into operation.

On reporting the incident to General Squier, that *the line worked when no ground connection was used,* Colonel Mauborgne learned that General Squier had discovered that the same thing had happened to him while conducting a series of experiments ten years before. He turned to his note books, producing the record of the operation of such a line on land without the use of a ground connection. The scientific reason for this is as yet not altogether clear to those who are conducting the experiments, but it is the subject of study.

With the line working successfully thru the Potomac river, the officers set about to see what might be done with a bare wire buried in the earth. The Signal Corps cantonment at Little Silver, N. J., Camp Alfred

(*Continued on page 222*)



Tele-photography Across the Atlantic Has Seemed Almost Impossible, Even in the Present Day of Wonderful and Startling Inventions. However, Professor Korn, Well Known for His Results in Tele-photography, Has Developed a New System of Building Up a Picture by Dots of Varying Magnitude, Each of Which Has a Special Code Letter, So That Photos Can Be Telegraphed, Cabled or Radioed Practically Any Distance.

Tele-Photography Across The Ocean

By DR. ALFRED GRADENWITZ

ONE of the most remarkable inventions perfected during the war—independently of any strategic considerations, no doubt—is Prof. Arthur Korn's *Transatlantic Tele-Photography.*

Our readers are, of course, conversant with the Professor's *transcontinental tele-photography,* which previous to the World War made part of the routine work of some prominent European dailies, enabling photographic pictures of people and events to be wired from Berlin to Stockholm, Copenhagen, London, Paris, etc., as well as vice versa. This process, because of the enormous capacity of transatlantic cables and the resulting inertia, could not be adapted for transocean service and a new process had to be devised.

A New Advance Toward Television

In its first stages it resembles the familiar method used for transmission on transcontinental lines. The picture to be transmitted, in the shape of a translucid film, is wound upon a glass cylinder performing a rotation round its own axis as well as a slow forward movement in the direction of the latter. All the elements of the pictures thus pass in turn at the spot where the beams of a Nernst lamp, of very constant luminous intensity are concentrated. After traversing a given film element, these beams will strike a selenium cell, whose resistance, of course, varies in accordance with their luminous intensity; these fluctuations of resistance being converted into corresponding variations of current intensity in the circuit comprising the selenium cell.

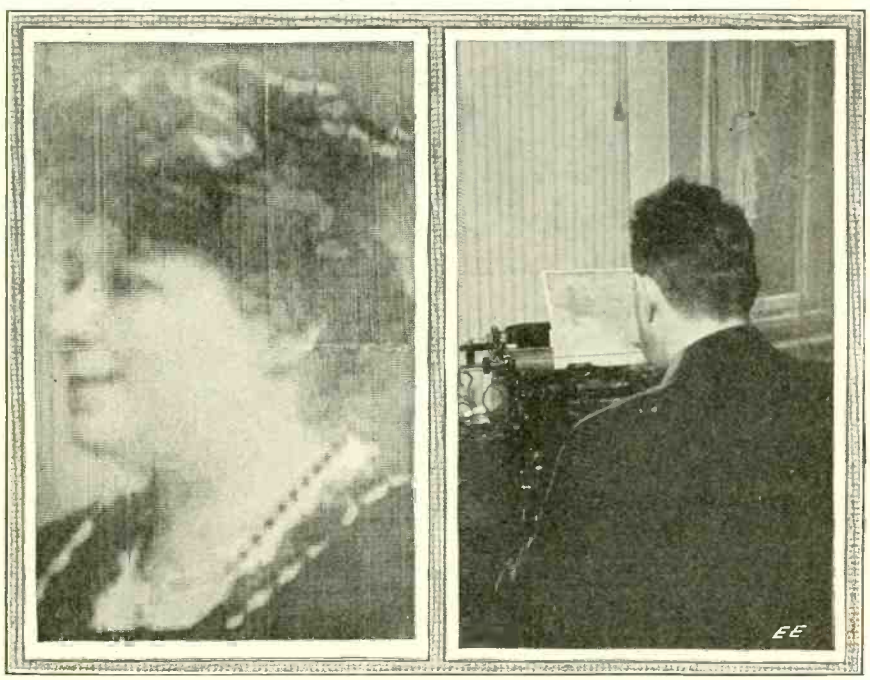
Now, whereas in the case of ordinary tele-photography these current fluctuations are transmitted over a telegraph line, in order at the other end, by an inversion of the same series of operations to be reconverted into variations of luminous intensity, and accordingly into shades reproducing photographically the original film at the sending station. This is not feasible in the case of transatlantic tele-photography.

Prof. Korn, therefore, designed a most ingenious relay, where all contacts are replaced by electric sparks and arcs, and by the intermediary of which the current fluctuations are made to act on a high-speed telegraph of the Siemens and Halske system where each current intensity, in the perforated strip, produces a given combination of holes. After converting these perforations in the same telegraph into a *series of letters,* where each of those chosen—fourteen in all—*corresponds to a given combination of holes and accordingly to a given current intensity and a certain shade of film element; these letters are, like an ordinary cablegram, transmitted across the ocean.*

What there is received at the other end, then, is only a series of several thousand letters, which at any time and any place desired, can be reconverted into a picture faithfully reproducing the original photograph. Several processes can be used in this connection, the most simple (already employed with satisfactory results) being based on the use of a *special typewriter,* which in the place of letter type *carries at the end of each lever a small circle or square of dimensions corresponding to the shade exprest by the letter in question.* The stronger the shade, the greater will be these dimensions, the intensity of the imprint on the paper thus varying in proportion. The letter "X" indicates the end of a line and the beginning of a new one.

By simply copying on this remarkable typewriter the cablegram received at the distant end the original picture is thus reproduced, element for element and line for line. The typewriter will preferably be operated by electricity or comprest air, thus accelerating operation and rendering it more uniform. By subdividing the cablegram into several portions, each of which is entrusted to another operator, further speed is had.

By augmenting the number of letters composing the scale of shades and accordingly the number of component elements of the picture there are obtained more delicate reproductions.



At the Left a Reconstructed Picture Is Shown, Which Was Telegraphed by Code Letters Over a Long Telegraph Line. The Right-Hand Photo Shows Dr. Korn Reconstructing This Very Picture From a Code Telegram on His Special Typewriter, Each Key of Which Has a Dot of Certain Size on It, Instead of a Letter, These Varying Dots Making Up the Picture.

Musical Electrization

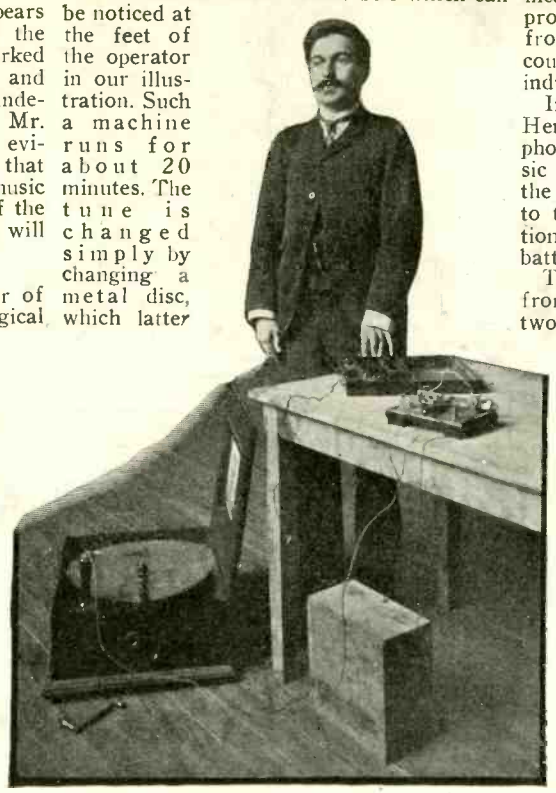
By JACQUES BOYER

While our April issue, containing the article by Mr. H. Gernsback, "The Physiophone" was still on the press, we received the following article from our Paris correspondent, Mr. Jacques Boyer. It appears that Mr. Charles Henry, Director of the Laboratory of Physiology, has worked along the same lines as Mr. Gernsback, and discovered the identical phenomenon independently. It should be noted in Mr. Boyer's article, that Mr. Charles Henry evidently has not come to the conclusion that the apparatus can be used to transmit music physiologically to the deaf. In view of the extraordinary co-incidence, our readers will no doubt be interested in the article.

MR. CHARLES HENRY, Director of the Laboratory for Physiological Sensations of the Sorbonne, Paris, has invented a novel means which he terms *musical electrization* and which he claims will find therapeutic uses. Our readers no doubt know that the d'Arsonval alternating sinusoidal currents are very much superior to the ordinary faradization of the induction coil. Furthermore, such sinusoidal currents are much better suited to the human system, and do not produce pain or great contractions of the muscles.

Also after Fourier's theory and the experiments of Von Helmholtz, one can consider every musical sound as the sum of simple sinusoidal variations which are 1, 2, 3 .....n times less great, and which constitute the harmonics of this sound. Mr. Henry thought that he could obtain interesting results if he could transform into alternating currents these harmonious sounds which the human system now receives by the sense of hearing, and which sounds produce a profound and greatly varied influence upon the human system.

To verify his idea, he rigged up a simple experimental outfit shown in the illustration. As an electrical generator he used a thermo-electric couple of sixty-six elements which furnishes a constant electromotive force. As a sonorous source he uses an old-fashioned music box which can be noticed at the feet of the operator in our illustration. Such a machine runs for about 20 minutes. The tune is changed simply by changing a metal disc, which latter has small metallic projections on the reverse side, and which in turn engage little prongs of a steel harp; thus, giving rise to the music.



Translation of Musical Vibrations Into Electrical Ones for Therapeutical Purposes Is Suggested by a French Inventor Here Shown.

Mr. Charles Henry recognized the physiological influence of the rhythm and compared it with the physiological effects obtained by electrifying his subjects by means of alternating currents. These he produced by means of a siren placed in front of a microphone. The current, of course, was stepped up by means of a small induction coil.

In furtherance of his experiments, Mr. Henry placed a 4 carbon Hughes microphone on the resonant chamber of the music box, and connected the microphone with the battery on one side, the other end going to the primary of a little telephone induction coil, the other wire returned to the battery.

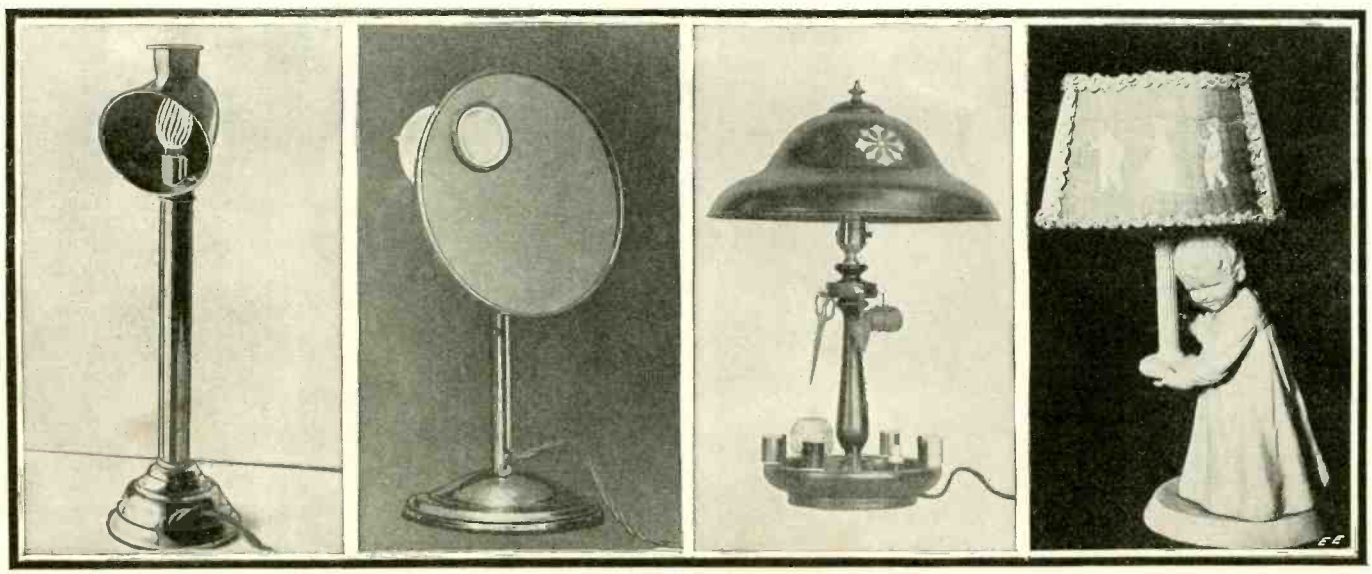
The electrization current was taken off from the secondary terminals by means of two wires, and the regulation electro-therapeutic handles or sponges as used ordinarily were then connected. A rheostat placed in circuit with the microphone regulated the intensity of the primary current.

The vibrations from the microphone interrupt the current of the secondary, and the small continuous shocks received by the muscles naturally reproduce the transformed musical sounds, and one can readily feel all the different variations of the sound.

In his experiments, Mr. Henry has been able to convince himself that all of the musical sounds are transmitted electrically due to the deep and rhythmical electrization of his subjects. The electrization is naturally strong or weak, all depending upon the character of the music. Mr. Henry also found that the intensity is greatest when the music is loudest, but when the musical sounds go above a certain heighth no further sensation is had, as here the currents probably become so rapid that they cannot be felt any longer physiologically.

Mr. Charles Henry also thinks that this original instrument will render great service in psychic medicine.

Unusual Electric Lamps



Here We Have a Nifty Electric Reading Light, Especially Suitable for the Bedside, the Small Reflector of Which Could Be Adjusted to Concentrate the Light Just on a Book, Etc. It is Inexpensive and Constitutes a Great Convenience.

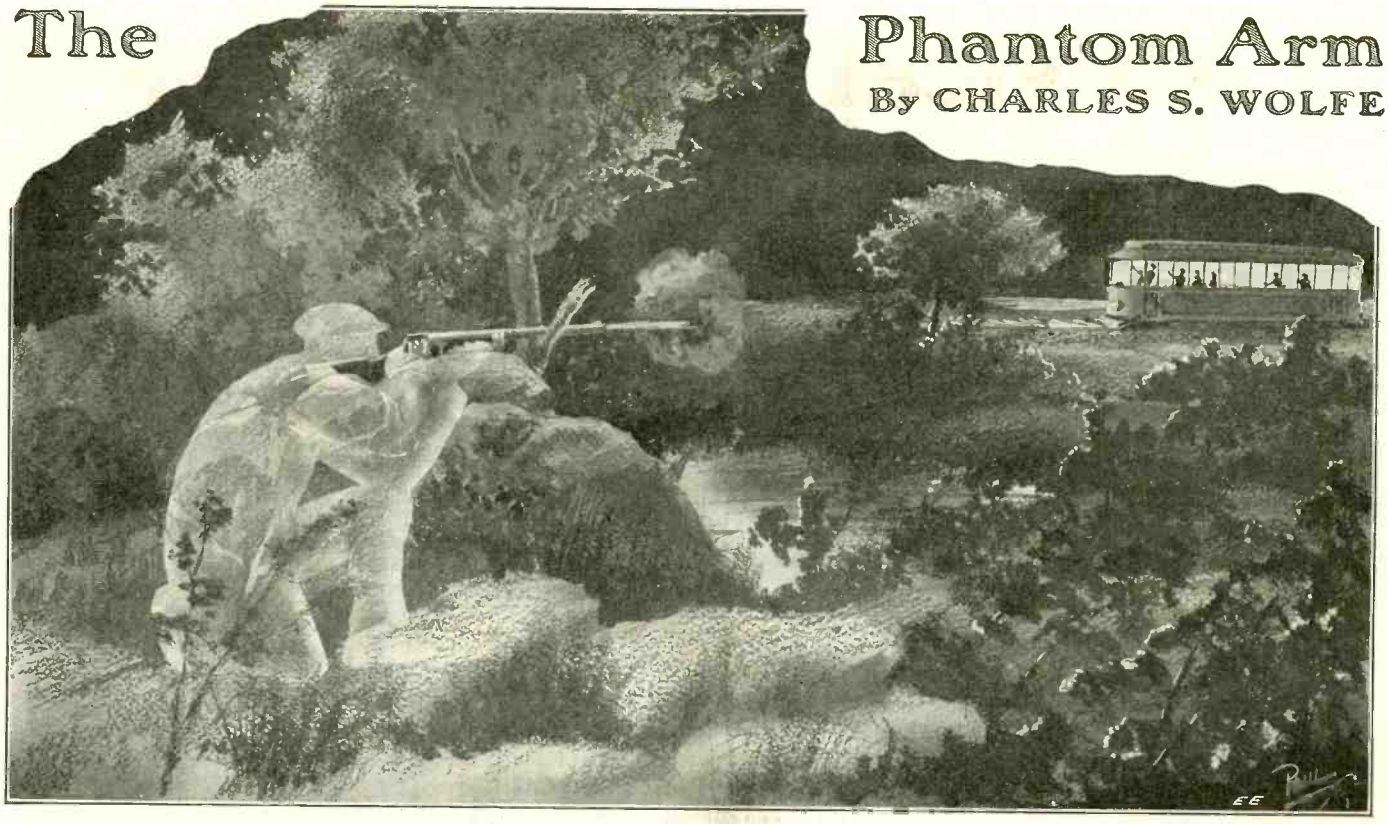
For the Man Who Shaves Himself at Home, There Has Recently Been Brought Out, This Latest Electric Shaving Mirror. A Strong Electric Light Behind the Mirror, Casts Its Rays Thru the Glass Bull's-Eye in the Manner Apparent, Giving a Well Diffused Illumination.

For Mother and the Girls, We Have This Latest Conceit in Electric Lamps—a Sewing Table Lamp. It Is Liberally Provided With Hooks and "Catch-Alls" for Holding Spools, Thimbles, Scissors, and All the Other What-Nots to Be Found in the Sewing Room.

And for the Children's Room, We Have This Delightful Little Design of a Small Child Holding the Pedestal of the Lamp, While the Shade Is Decorated With the Figures of Little Children. One of the Most Tasteful Bits of Lamp Decoration We Have Seen.

The Phantom Arm

By CHARLES S. WOLFE



"As a Matter of Fact, Coates Had Been Playing Pool Contjnuously All Evening;—Hadn't Been Out of Sight. The Shot Was Fired About 8:30. Still the Wounded Man Was Certain that Coates Shot Him. Can You Beat That for a Perfect Alibi?"

FENNER and I were seated side by side at the table which held Fenner's wireless set, enjoying a sociable "listen in." Many stations, commercial and amateur, purred and whistled pleasingly in our ears as we browsed up and down the tuner.

Fenner twirled the switch blade over the taps caressingly. I glanced at the profile of his face as he worked. Absorbed in his task, every line in his face relaxed, contentment fairly radiating from him. Fenner hardly looked capable of the things he accomplisht. Things which few dreamed he attempted, things of which I had an inkling since the night I gazed down on the work of the "Educated Harpoon."

To neighbors and friends, a college student in his senior year, dabbler in scientific research. To the police—a mighty useful, and a mighty successful detective.

The clang of a gong sounding right over my head startled me into an involuntary jump. Turning wide-eyed, I found Fenner smiling his amusement.

"Some one has just opened the front gate," he said, quietly. "We are about to have visitors, invited or uninvited, welcome or unwelcome, honest or dishonest, but not unexpected."

Before I could comment on the unusual arrangement, the noise made by some one mounting the stairs rapidly reached us, followed by quick strides along the hall toward us. The door was unceremoniously flung open, and Chief of Police Davidson stood framed in the doorway.

Fenner, apparently unmoved by the dramatic entrance of the head of the city's law enforcing system, grinned amiably. "Welcome to our humble hearth, Chief," he drawled; "Bill, pass our friend an extra pair of 'phones."

"I don't want to listen to any of that stuff," exploded Davidson, irritably; "I'm here to get you to untangle this thing for me."

"Calmly, friend Chief," said the imperturbable Fenner. "What thing? I don't number telepathy among my accomplishments, you know."

Davidson sank into an indicated chair. "Thoughts run ahead of my words," he mumbled gruffly, his way of apologizing. "Mind always full. Bad habit."

"Bad habit is right," gravely assented Fenner. "You know Bill here, I think. Unburden yourself freely."

"I'm completely up against it," confest Davidson. "Right up against a stone wall. Never met anything just like it in my whole career."

"Sounds interesting," murmured Fenner. "Somebody crib the mayor's crown jools, or has some joyous cuss eloped with the auto patrol?"

"There's been a man shot," said Davidson, bluntly.

"Killed?" sighed Fenner. "Murder again, eh? I hate murder cases."

The Chief permitted himself to grin—just a little bit. "Not so fast, young fellow. I didn't say killed, I said shot. He's very much alive, and he's occupying a nice, white bed down in the City Hospital. All he got was a bad flesh wound. But the guy that done the shooting's not to blame for that. He meant well, all right."

"Can't the man furnish any clue to his assailant?" I ventured to horn in.

Davidson actually chuckled. "Clue?" He told us just who he thought did it—and why."

"Then the man you're after has made a remarkable get away and left you up in the air?" queried Fenner.

"Well, not so you could notice it," growled the Chief. "He's down at the Hall right now telephoning for a bondsman."

"Then," said Fenner, politely, "I don't see what has so upset your usually mild and placid disposition."

The chief looked at us both in a sort of a helpless way. "That's the Hell of it," he complained, despairingly. "We've got everything. We've got the motive for the crime, we've got the weapon it was committed with, we've got the guy who simply *must* have done it, but——" He broke off dejectedly. "Well, here's the story, and you can judge for yourself.

"This shooting occurred on the lonely road between the outskirts of the city and Bloomeville, that little village up along the river. The man who was shot is a chap named Johnson. He is a motorman employed by the traction company. He was running his car when he was potted."

Fenner's eyes flickered almost imperceptibly. "Attempted hold up?"

"Nope," said the Chief, decidedly. "Just a grudge being settled. He got the ball right across the bridge of the nose. Talk about your close calls! That fellow shook hands with Death, blindness, and everything else, and got away with it. They got him into the hospital and I took his statement. He says that a few days ago he threw a man off his car because he was drunk and offensive. This fellow threatened to get him. There's about a dozen passengers ready to confirm this. Well, Johnson, it seems, knew the man. His name is Coates. He told me that he was certain that Coates shot at him. We threw out a drag and landed Coates within an hour."

"Yes?" drawled Fenner, as Davidson paused.

"Yes!" shouted the Chief. "Very much yes! We found him in Lowrey's pool room, playing pool with Franklyn, one of my own detectives. And Franklyn swears that Coates had been in that pool room since seven o'clock this evening. So does everybody else in the place. As a matter of fact, Franklyn was off duty, and he and Coates had been playing continuously all evening. Hadn't been out of his sight. The shot was fired about eight thirty. Can you beat that for a perfect alibi?"

"It sounds air tight," admitted Fenner, calmly. "Why not find out if Johnson has been indulging promiscuously in the gentle sport of bouncing intoxicated gentry. Possibly Coates was too busy to shoot him tonight and some rival beat him to it."

(*Continued on page* 213)

Oddities of Sound

By H. WINFIELD SECOR

(Concluded)

HOW THE PHONOGRAPH TALKS.

ASK anyone with a fair knowledge of high school physics how a phonograph talks, and he will tell you the answer in one word, *vibration!* In the language of the classics—

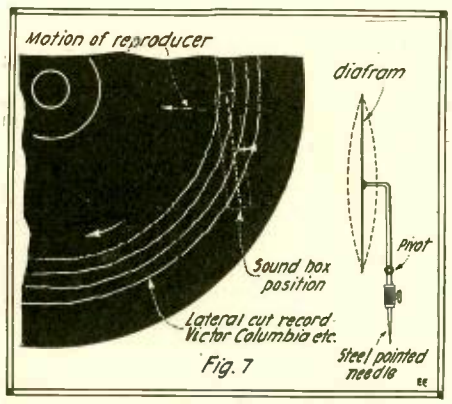


Fig. 7. This Shows How Vibration Gives Rise to "Sound" in the Talking Machine Record. The Record Shown Is the Lateral Cut Such as the Victor Record Embodies. The Undulations of the Grooves on the Record Run Laterally, or Back and Forth, and the Successive Positions of the Diafram Are Shown by the Dotted Lines. These Vibrations in the Diafram Are Transmitted Along Thru the Tone Arm and Out the Amplifying Horn.

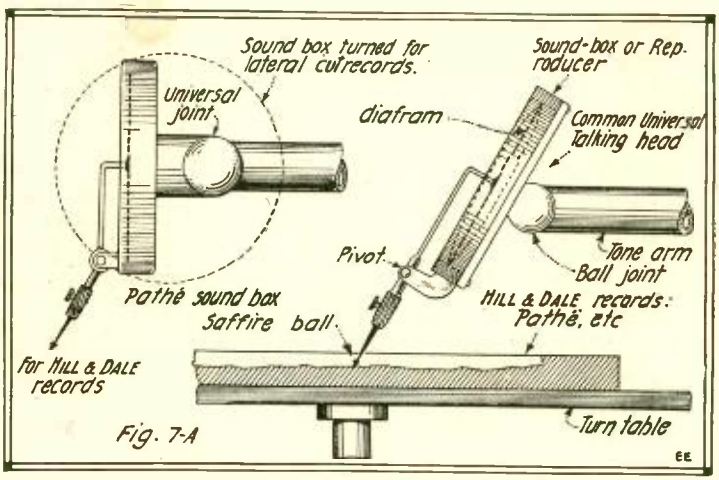


Fig. 7A. Here We Have the Vertical Cut or "Hill and Dale" Record, Such as the Pathé. The Successive Vibrations of the Diafram Are Indicated by the Dotted Lines and the Rise and Fall of the Saffire Ball Is Produced in the Manner Apparent, Which in Turn Causes the Diafram To Be Vibrated To and Fro, and Giving Rise to Sonorous Vibrations or Sound in the Tone Arm.

he "said a mouthful," but the study of phonography is indeed a very profound and complicated one, and in fact we know very little about it yet; altho we are learning more about the artificial reproduction of human speech every day, thanks to the wonderful research work being carried out by such indefatigable research investigators as Prof. Dayton Clarence Miller, of the Case School of Applied Science, Cleveland, O., and the acoustic experts on the staffs of the leading phonograph companies.

Dr. Nikola Tesla was once asked by the writer what he thought of the modern phonographs or talking machine, and his answer was both enlightening and characteristic. He said that the present phonograph was nothing but a very crude mechanical attempt at trying to imitate the human voice, or in other words to reproduce natural speech, and he felt sure that the talking machine of to-morrow would be a very radical and wonderful improvement on what we are pleased to call to-day man's most wonderful acoustic invention.

Inventors are, of course, busily engaged at the present moment, hundreds of them endeavoring to perfect a talking machine which will be free from all artificial sounds and harshness, and it seems certain, without one shade of doubt, that we will never have a perfect talking machine as long as we use any form of scratchy groove and needle arrangement. Not only is this part of the technique of phonography fallacious in its basic conception, but also the crude way in which the sound is reproduced by the diafram is impracticable. This might seem paradoxical, for one might object—is not the diafram sound box of the talking machine equivalent to the human ear? But the answer seems to be that it is *not*, with the accent on the "not"! This is so for a number of technical reasons, and laboratory experiments have proven that it is true that we cannot construct a sound box diafram of a given diameter which is universally suited to the proper and full reproduction of music or speech in all parts of the musical scale.

If you want to reproduce a record such as a bass solo, you need a large diafram. If you have a medium pitch rendition, then you will need a medium sized diafram, and if you have a high pitch selection—such as a tenor or soprano solo—then you will require a small, thin diafram. There has been recently patented an adjustable diafram, the diameter of which can be changed for different selections, but even this does not solve the many diversified problems met with in phonography. Before leaving this interesting subject, however, and its shortcomings—for we are told long and often "how good" the modern phonograph is by the various advertising writers of the respective companies—we might mention that the machine of to-morrow will very possibly be built on a principle similar to that of the *telegraphone*, as pointed out by Dr. Tesla.

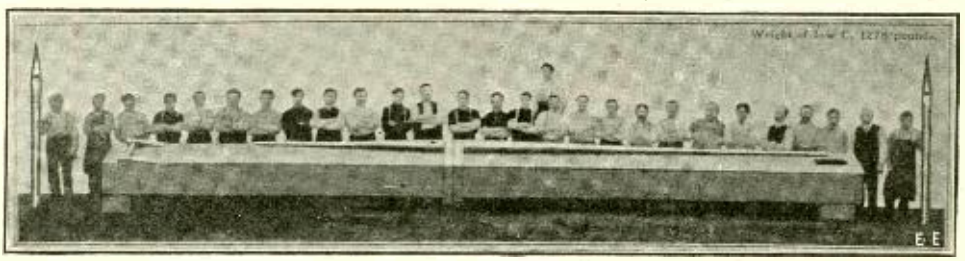


Fig. 8. One of the Largest Organ Pipes in the World. This Organ Pipe Vibrates 16 Times per Second by Comprest Air and Is Tuned to Low "C." It Measures 32 Feet Long, and Weighs 1,278 lbs. There Are a Few Organs in the World Having Pipes 64 Feet Long, Which Give Only 8 Vibrations per Second. But Such a Sound Is Hardly To Be Clast as a Musical Tone. The Range of Pitch for the Human Voice in Sound Is from 6 for a Low Bass Voice to About 1,300 for a Very High Soprano. The Piano Has a Range of Pitch from 27.2 to 4,138.4 Vibrations per Second. The Pipe Organ Usually Has 16 for the Lowest Pitch and 4,138 for the Highest Pitch.

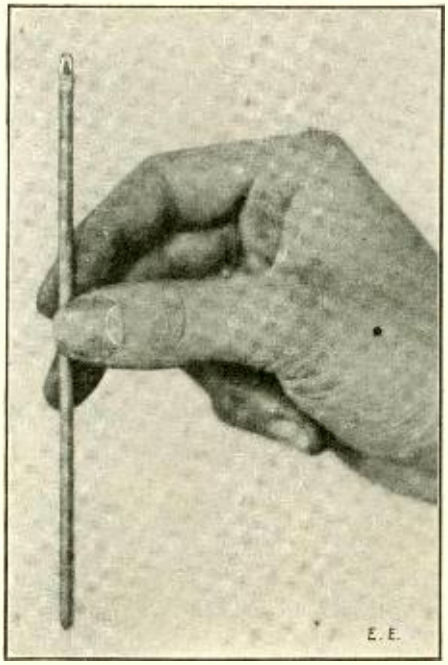


Fig. 9. One of the Smallest Organ Pipes Ever Constructed. The Pipe Itself Appears on the Upper End of the Stem, and Measures ¼" in Length. It Gives 15,600 Vibrations per Second and the Pitch of the Pipe Is B_8.

The telegraphone, invented by Valdemar Poulsen, of Denmark, embodies one of the most perfect principles of speech recording and reproduction ever devised by man, and only requires a little cultivating by some of our acoustic and electrical experts to convert it into a machine which will satisfy our highest aspirations in the production of a perfect talking machine. With the telegraphone you talk into the microphone and the fluctuations in a magnetic field are recorded on a moving steel piano wire, the size of a human hair, or possibly a little larger. To reproduce this speech the piano wire is reversed in its direction thru the machine, passing thru a reproducing coil connected to a telephone receiver. When you listen at the receiver you hear the voice perfectly and beautifully reproduced, but it is low. By the addition of an Audion or other readily available amplifier, this speech could be intensified to any desired strength. Amplifiers cost money and therefore the telegraphone has got to be further improved, i. e., its inherent design

features perfected to make it commercially valuable and acceptable.

The modern phonograph of the present flat disc type reproduces music and speech on the same principle as the first machine devised by Thomas A. Edison. That is, if you talk into a mouth-piece fitted with a diafram, this diafram carrying a stylus will inscribe a certain characteristic mark on a wax or other record. When the action is reversed, that is, when the record carrying this voice impression or groove is moved under a similar stylus fitted to a diafram, the latter will be set into vibration corresponding to the original vibrations of the recording diafram. Thus we obtain speech—after a fashion. The accompanying sketch, Fig. 7, shows the two principal types of flat disc phonograph record now in use, and just how the diafram and stylus reproduces sound from them.

The commonest type of record and reproducer is the *lateral-cut,* such as the Victor or Columbia use. On these records each sound has its characteristic and *different* form of wiggle or groove engraved or molded from the master metal die into the record composition. As the sound box moves over the record, while the latter rotates at about seventy revolutions per minute, the rapid vibration of the needle back and forth vibrates the diafram and causes the sound reproduction as we know it. In the *hill-and-dale record,* such as used by Pathé and other concerns, the groove runs up and down and not sidewise, so far as the irregularities are concerned, as shown in our diagram, Fig. 7. The sound box and the diafram are in this case held above the record in a position at right angles to the direction of rotation, and in the Pathé machine the saffire ball takes the place of the sharp-pointed steel needle used in most machines. This saffire ball point will play 1,000 records without changing, and it rises and falls as the hills and dales pass along beneath it. These rapid vibratory movements are transmitted thru the stylus arm to the mica diafram in the manner apparent.

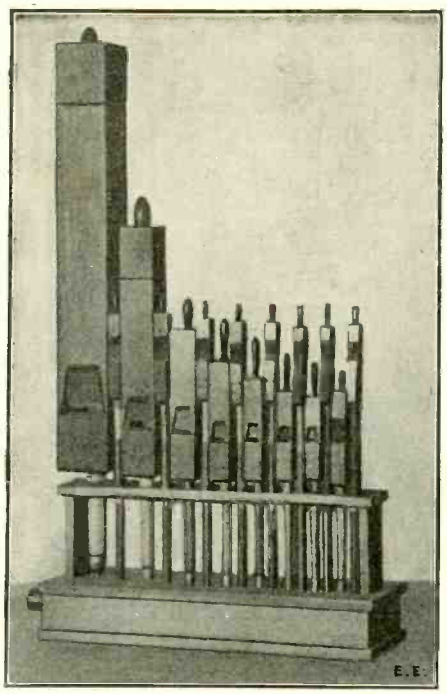


Fig. 10. A Group of Wooden Organ Pipes Which When Sounded Simultaneously, Produce the Vowel a as in "Mat"

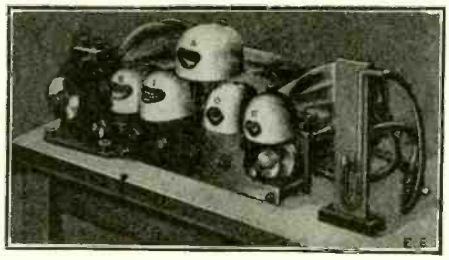


Fig. 11. A Set of Artificial "Mouths" for Emitting the Vowels a, e, i, o, u, by Means of Comprest Air. The Mouths Are Fitted With Artificial Lungs, Comprising a Series of Bellows Driven by an Electric Motor. These Are Used in the Scientific Study of Sound.

"HOLES" IN THE ATMOSPHERE.

A very interesting freak in the physics of sound is that known as "holes" in the atmosphere or vacuum pockets, or at least they appear to be such. It was found quite a number of years ago that when a large fog siren and horns situated along our coastal danger points was blown at a high frequency, a ship would perhaps hear the siren several miles off the coast and all of a sudden "lost it" and did not hear it again until it found itself hard and fast on the rocks but a short distance from the siren station. Much has been written on this subject by experts on sound, and the fact remains that this is a quantity over which man has no control. There seems to be practically no trouble from such freak actions of the atmosphere on radio signals, but these are transmitted thru *ether* and are not affected by air pockets, etc. But it is another question when sound waves such as those which solely rely for their propagation on the condition of the air, etc.

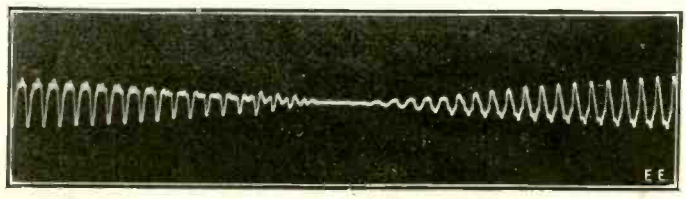


Fig. 12. A Remarkable Grafic Record Made by Prof. Dayton C. Miller of the Bowing of a Violin Showing Clearly the "Reversal" of the Bowing. Many People Have Argued That no Violinist Can Reverse His Bow But What an Expert Listener or Musician Can Detect It, But This Scientific Record Recorded Photographically, Proves That It Can Be Done, for There Is no Break in the Vibrations.

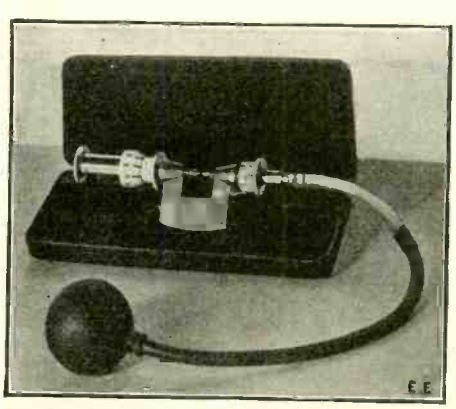


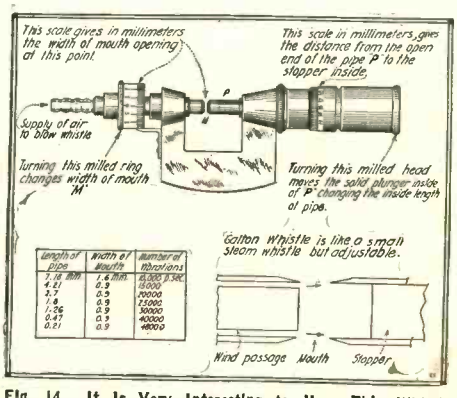
Fig. 13. The Famous "Galton Whistle," One of the Most Interesting Scientific Instruments Used In the Study of Sound. This Whistle Is Blown by Means of Air From a Bulb or Other Source, and by Means of a Micrometer Plug Fitted on the Whistle, the Length of Its Pipe Can Be Changed Accurately and Precisely.

The reason why the fog sirens have not been heard at all times and wrecks caused on account of this effect is claimed to have been due in some instances to peculiar fog disturbances existing between the ship and the siren stations, and as the same phenomenon has occurred in clear weather, it is also thought that some peculiar vacuum or other atmospheric formations have occurred so that the sound from the sirens could not be heard uniformly. The latter day development of the submarine telegraph, whereby signals are transmitted several miles under water by means of a submarine bell, or else by telegraphic dots and dashes, or even speech sounds, is to be highly commended, as these signals are very clearly transmitted thru water, even during storms, and the apparatus is quite rugged and dependable, indeed.

ACOUSTICS IN AUDITORIUMS.

The determination of the acoustic properties of auditoriums is of the very greatest practical importance, and it is also one of the most elusive of problems; the sounds which most interest us are of short duration and they leave no trace, and the conditions affecting the production, the transmission and the perception of sound are extremely complicated, says Professor Miller, in his "Science of Musical Sounds." The difficulties of the work are such as to discourage any but the most skillful and determined investigator. Indeed, the problem has been almost universally considered impossible of solution, and this opinion has been accepted with so much complacence, and even with satisfaction, that it still persists in spite of the fact that a scientific method of determining the acoustic properties of auditoriums has been developt by Professor Wallace C. Sabine, of Harvard University. This method, which is of remarkable practical utility, has been described in architectural and scientific journals. No auditorium, large or small, and no music room, public or private, should be constructed which is not designed in accordance with these principles. Professor Sabine's experiments have shown that the most common defect of auditoriums is due to *"reverberation," a confusion and diffusion of sound thruout the room which obscures portions of speech.* There are other effects, due to echoes, interferences and reflection in general, all of which have to be considered. In many cases these troubles can be remedied, with more or less difficulty in auditoriums already constructed. This is especially true in regard to reverberation which is reduced by the proper use of thick absorbing felt placed on the side walls and ceilings.

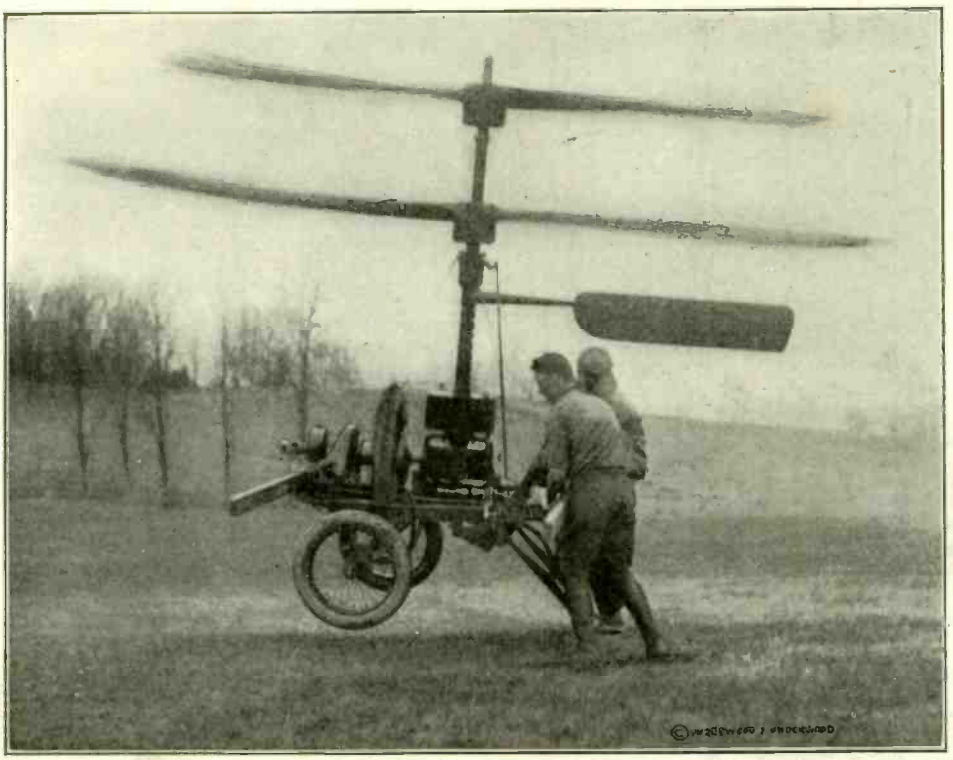
A soundboard placed behind the speaker may, in some instances, distribute the sound in such a way as to remedy certain defects as has been shown by the elaborate experiments of Professor Floyd R. Watson, but the more common faults are not removed by this method. An auditorium has been described by Professor Frank P. Whitman, which was practically improved by the use of a soundboard and was later made altogether satisfactory for public speaking upon the removal of reverberation by Sabine's method. The stringing of wires or cords across an auditorium cannot remove acoustical defects.



Length of pipe	Width of Mouth	Number of Vibrations
7.18 mm	1.6 mm.	6,000 P.Sec.
4.21	0.9	15,000
3.7	0.9	20000
1.9	0.9	25000
1.26	0.9	30000
0.47	0.9	40000
0.21	0.9	48000

Fig. 14. It Is Very Interesting to Hear This Whistle Gradually Change in Pitch Until It Passes Above the Range of Audibility, About 30,000 Vibrations per Second, the Limit of Audibility for the Average Ear, Altho Some People With Extra Sensitive Ears, Particularly Radio Operators, Can Hear Sounds as High as 35,000 Vibrations or More.

A Gyrocopter That Flies!



Here's the First Vertical Propeller Flying Machine to Actually Get Off the Ground with a Passenger. It Is Known as the Berliner Gyrocopter and Is Driven by an 80 H.P. Le Rhone Motor.

The accompanying illustration shows one of the most remarkable flying machines in the world—it is a picture of the very first gyrocopter, or we might call it a helicopter, to actually fly! To tell the truth, it did not fly very far—that is, not because the machine is not capable of keeping up a sustained flight, but because of the fact that very little is known about flying such a machine, and if the aviator here shown flew very far above the ground—the machine weighing 620 pounds alone—he might break his neck trying to land, for no one has ever yet flown in a gyrocopter type of heavier-than-air machine.

What experience Mr. Henry A. Berliner has had with his new machine, thus far, has borne this fact out, and he has not attempted to fly further than a few yards at a time at a distance of a few feet above the ground. However, there are many other ways of trying out the machine, and further extensive experiments are under way to determine its steering qualities and stability in the air.

It is all very well, as Mr. Berliner has pointed out, for inventors to state that they have had them on the testing table and demonstrated that they could develop tremendous vertical lifting power, but it is altogether a different matter to go up in the air with one of these machines, and perhaps instantly have the propellers stop rotating. No one has ever had this experience, and it must be remembered that the only buoyancy which the usual gyrocopter or helicopter type of machine has, when floating in the air, is that created by the rapidly revolving air, screws or propellers. It seems evident that the only way to make this machine reasonably safe would be to have engines in duplicate, arranged with a quick-acting clutch, so that in case one engine should fail the other could be thrown instantly into action to keep the propellers revolving and thus maintain the normal buoyancy. Otherwise there is some tall risk involved in attempting to fly one of these machines, as it is impossible to gamble your life stakes on any gasoline engine that was ever built. It may stop any minute, and you can't guess when!

In the accompanying photograph is shown the gyrocopter, Henry A. Berliner's new machine, which *when tilted forward will fly horizontally*, the tilting being accomplisht by changing the center of lifting pressure. The weight of this machine is 620 pounds, with a lifting power of 900 pounds. The lifting propellers are 13 feet in diameter and 10 inches in width. It is driven by an 80 H.P. Le Rhone motor. Besides being an independent machine, the system of the gyrocopter could be applied to an airplane and enable the latter to rise from a small area or to descend upon a very small landing field, it is said.

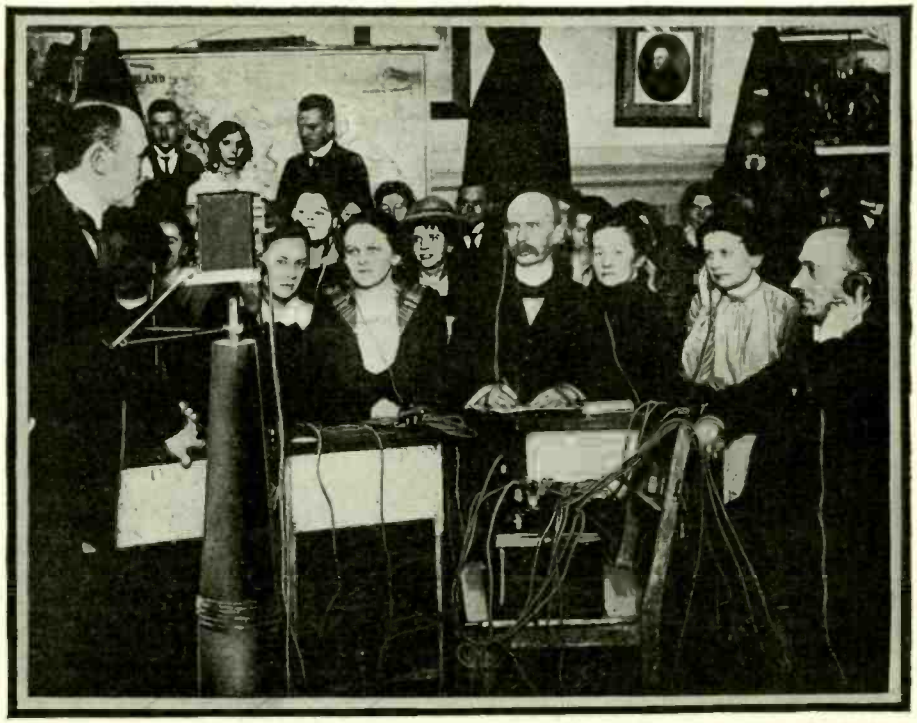
Lecture To Deaf Via Dictagraph

In England recently an interesting lecture was given to a large number of deaf people or those whose hearing was partially affected and who could not very well enjoy a lecture in the regular way. To enable the audience to hear every word clearly, use was made of the well-known supersensitive telephonic apparatus called a *Dictagraph*.

This apparatus comprised a very sensitive microphone which pickt up ordinary speech waves at a distance of several feet.

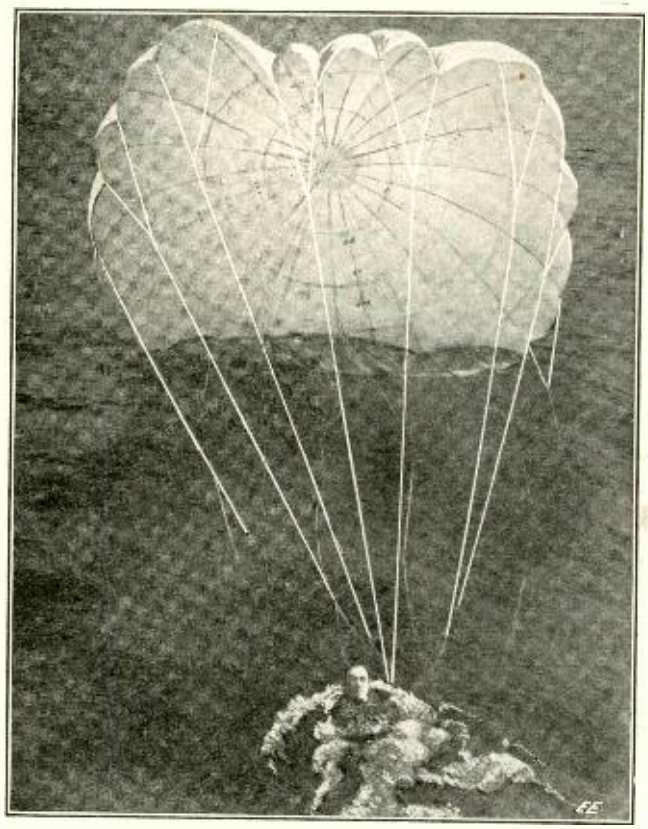
These lectures have become quite *de rigeur* in Europe, and undoubtedly they will come into fashion in America also, as there are many people who cannot hear very well, even tho they possess dictagraphs of their own, as when they do happen to sit fairly close to the lecturer or minister there is still such a great distance separating them that the dictagraph carried on their person cannot operate with the usual high efficiency.

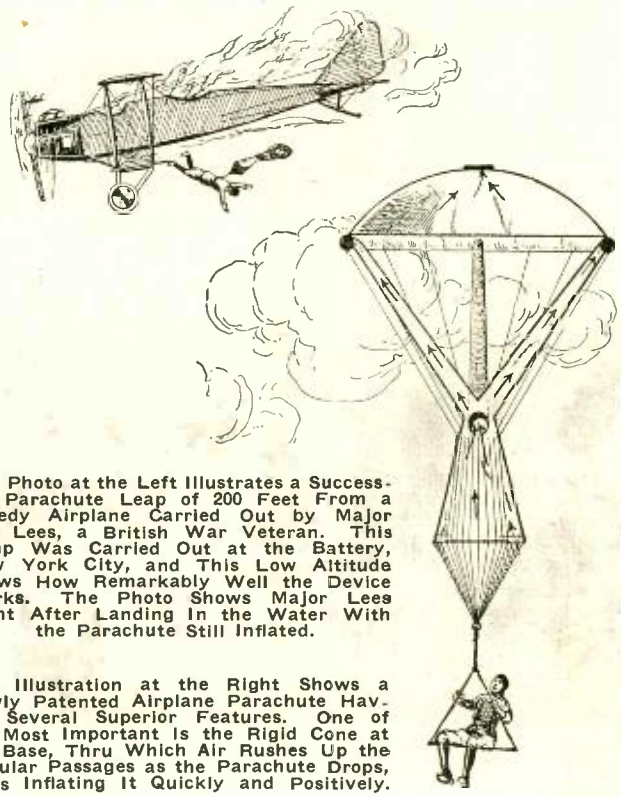
While dwelling on this interesting application of science, to those afflicted with defective hearing, it is interesting to mention that one of the great scientific dreams of the future will be realized on the day when lectures like this can be given and illustrated for the benefit of the blind. This may be accomplisht by developing such an apparatus as that devised by Prof. F. C. Brown, of the State University of Iowa, whereby specially sensitive synthetic selenium cells enable a blind person to read the ordinary printed page, by sound, each letter giving a different sound, in a telephone receiver held to the ear.



A Lecture to the Deaf! The Latest Thing in England Was a Recent Lecture Given to a Number of Deaf People Whose Hearing Was Only Partially Affected, and They Were Able to Hear Every Word Spoken at the Lecture Very Clearly, Thanks to the Highly Sensitive Telephone Transmitter Used in This Apparatus, the "Dictagraph."

Is this Airplane Parachute Practicable?





The Photo at the Left Illustrates a Successful Parachute Leap of 200 Feet From a Speedy Airplane Carried Out by Major Ord Lees, a British War Veteran. This Jump Was Carried Out at the Battery, New York City, and This Low Altitude Shows How Remarkably Well the Device Works. The Photo Shows Major Lees Right After Landing In the Water With the Parachute Still Inflated.

The Illustration at the Right Shows a Newly Patented Airplane Parachute Having Several Superior Features. One of the Most Important Is the Rigid Cone at the Base, Thru Which Air Rushes Up the Circular Passages as the Parachute Drops, Thus Inflating It Quickly and Positively.

MAJOR ORD LEES, late of the Royal Air Force, established a new low altitude jump record with a parachute at New York recently. Major Lee's drop into New York bay from a height of 153 feet near the Statue of Liberty. The previous low record was 157 feet. Experts generally rule that parachute drops at less than a thousand feet are dangerous.

Lt. William McCulloch, of the United States Navy, who was pilot of the NC-3 when it started across the Atlantic, took Major Lees up in a three-passenger Curtiss flying boat. They circled the Statue of Liberty three times and dropt two dummies from a height of 175 feet. The dummies hit the water safely and then Major Lees dropt.

When he left the flying boat he was seated on a trapeze attached to the "Guardian Angel," the name of his parachute. Later he hung from the bar with his knees and as soon as his hands struck the water, he swam out of the way and was picked up again by Lt. McCulloch.

One of the cleverest ideas in airplane parachutes that has yet been suggested is that recently invented and patented by a South Dakota genius, Mr. Knute S. Satre. Mr. Satre, in describing his invention, says among other things that it is a well-known fact that the efficiency of a parachute after it is once opened up can be accurately determined, and that the great trouble in the use of a parachute at all is that it may not always be relied upon to open up; or in other words, to start the opening action at all! He therefore suggests a clever scheme to build a parachute of a quick and sure-opening type, like that illustrated in one of the accompanying views.

The principal feature of the Satre parachute lies in the use of a so-called *charging head*, which is made preferably in the form of an inverted funnel, which has flexible air tubes made out of canvas or other suitable material, which extend therefrom up to the parachute proper. The parachute envelope is provided with a flexible perifferal tube and the air-charging tubes, extending upward from the charging funnel, admit the air under great velocity to this marginal tube.

As soon as the aviator or balloonist jumps over the side with this parachute in its normal rolled form a powerful initial charge of air is forced up thru the *charging funnel*, which is held diverged or expanded by a metal ring at all times. It will thus be seen that very powerful air currents are forced in thru this charging funnel, and as the parachute descends earthward at a rapid speed, it will be sufficient in any case, so it would seem, to cause the periferal hollow ring surrounding the parachute proper to expand rapidly and positively, thus causing the device to inflate in a very short period and to develop its full buoyancy in a minimum of time.

The main parachute head is provided with a central opening at the top, the size of which may be varied by an adjusting cord placed within the reach of the descending aeronaut. This is claimed by the inventor to increase the stability of the parachute and to decrease its tendency to sway in making its descent.

The inventor claims further that his design of parachute has been demonstrated in actual practise and its efficiency fully proven; and further, that this style of parachute is not subject to any severe vibration while descending.

Plans Trans-Atlantic Airship To Carry 150

Plans for an aerial passenger service which will exceed even the visions of a Jules Verne are being made by the Northern Aerial Syndicate of Great Britain, according to a recent report to the Department of Commerce from Trade Commissioner Henry F. Grady, in London.

Mr. Grady's report says the syndicate is said to be arranging an airship service to New York, the plans providing for craft that will carry 150 passengers in addition to staffs of cooks, stewards, and crew. At Liverpool, passengers from America will be transferred to smaller aircraft and taken to their destinations. Moorings for the large ships, according to the plans, will be provided at leading hotels. The program also provides for a service from England to Perth, Australia, seven days being allowed in the calculations for the trip.

Major W. T. Blake, writing in a London paper, gives the following specifications for what he considers would be ideal aerial cars for pleasure and for commercial purposes. His suggestions for the pleasure cars are:

Length, 22 feet; span, 30 feet; height, 7 feet; engine, 50-horse power, air-cooled, radial; accommodation, two abreast in partially enclosed cabin; top speed, 90 miles an hour; cruising, 75 miles an hour; landing, 40 miles an hour; rising, 40 miles an hour; range, 300 miles; duration, 4 hours; cost, $2,500; upkeep, 24 cents a mile.

His specifications for commercial aircraft are: Length, 45 feet; span, 100 feet; height, 15 feet; engines, two 400-horse power, stationary, water-cooled; passenger accommodations, 20, (plus 2 pilots); top speed, 100 miles an hour; commercial, 90 miles an hour; landing, 45 miles an hour; rising, 50 miles an hour; range, 350 miles; duration, 4 hours; cost, $25,000; upkeep, $1.80 a mile. At present firms are charging $100,000 for a machine of, roughly, those capabilities.

HOW TO KEEP UP A CAR

By HAROLD HOLLINGSHEAD

To Keep the Inside of the Motor Free from Carbon, the Valves Should Be Properly Ground, and All Carbon Removed from Inside the Motor, Periodically. A Teacup Full of Kerosene Poured Thru the Pet-cocks Twice a Week, Will Keep the Motor In Good Shape.

SOME people wonder why they are sick when they don't take a bath but once in two weeks, and some people wonder why their car won't run when they don't clean it but once a month, and then never touch the inside of the motor. What we need is not greater motors, but drivers who will study the construction of a car and treat it as tho it were human. As a chauffeur for six years—before I designed a tool of my own—I could drive a car year after year and have very little trouble. There are many mechanics who can repair a car after it is broken, but it takes a good one to keep it from getting broken. There is a great art in handling a car in the right way, and this knowledge is not obtained in one year.

I will state a few technical points which I believe will be profitable to any driver or owner of an automobile. The first one is to keep the inside of a motor *free from carbon*. To start with, this can be done by having the valves properly ground and adjusted, and all carbon burnt out. After this is well done, a teacupful of kerosene put thru the pet cocks twice a week will keep the motor in good shape. After the kerosene is equally distributed thru the various cylinders the motor should be given about ten turns over, either by hand or by using starter. This will soak the entire motor with kerosene. Then apply the switch, giving the motor a medium amount of gas. In cold weather this remedy should be applied after the motor is warmed up or in returning to garage in the evening, otherwise the motor will require some skill to start. After motor is started and gets warmed up, running at a medium speed, open one pet cock at a time, while motor is in operation, and you can notice the fine pieces of carbon coming out. This kerosene can also be applied by using a small oil can, applying the kerosene thru the air adjustment of the carbureter while the motor is warm and running at a medium speed, as it dies down. While kerosene is being applied, keep hand on the throttle of carbureter and increase speed. The reason for using kerosene is that *gasolene makes carbon while kerosene cuts its.*

A Good Point to Remember About Spark Plugs Is That They Should Be Removed Once a Week and Soaked in a Pail of Kerosene, Over Night. A Little Emery May Be Used to Clean Up the Spark Points and Also Adjusting Them so That the Spark Gaps Are Equivalent to the Thickness of a Dime. The Porcelain Bushing Should Also Be Carefully Examined for Cracks.

$50.00 In Prizes

Beginning with our July issue, we shall print on this page a new automobile department entitled "Automobile Stunts", and we will pay $50.00 in prizes for the three best articles received each month.

A great many of our readers have a car of their own, and any number of them have made certain improvements on that car. We want to know about these improvements. Almost every other automobilist some time or other invents a little device or does something to his car to make it better than it was before. "Experimenter" readers want to duplicate these stunts, and that is just what this new department will be for. In other words an exchange of ideas. Note that the idea does not necessarily have to be electrical in any way. You may have a new stunt or trick how to patch a blown tire that was not described before. You may have a new idea how to prevent your spark plugs from carbonizing, and thus short circuiting. You may know of a new stunt how to refill or charge a storage battery. If you have a town car, you may have thought of some simple trick how to signal to your chauffeur, so he will know where you will want to go.

There are hundreds of such ideas, and we will pay $50.00 a month to get them. Of course, we would like to have a photograph of the stunt showing that it was actually tried, but this is not absolutely necessary to win a prize. If no photograph can be furnished—altho we would like to have it—a simple sketch will do showing the essential parts, etc.

We will pay the following prizes:

FIRST PRIZE	**$25.00**
SECOND PRIZE	**15.00**
THIRD PRIZE	**10.00**

All other accepted articles, which win no prizes will be paid for at the rate of $2.00. Articles submitted should not be long ones. About one hundred to two hundred words will suffice. Address all manuscripts to "Editor, Automobile Stunts," care of this publication.

from outlet pipe becomes clear. You can very easily notice the collected rust and grit as it comes out of outlet pipe. Do this while motor is in operation until water becomes clear. This application once in two weeks, together with keeping cooling fan well *oiled* and in perfect running condition, will give you a perfect cooling system. Oil should be drained from crank case once in three months, and new oil applied. The same should be done in transmission and differential cases and these cases should at all times have the proper amount of a good quality of oil and grease. An occasional application of neatsfoot oil to the clutch will keep it in good condition together with keeping the grease cup well filled.

Next the brakes should be properly adjusted and by jacking rear of car up together with running motor in low gear, one man should operate foot brakes back and forth, while another applies kerosene to brake bands. This will remove all grease and grit, and give you perfect action on brakes. If the brake linings are badly worn, and you want to come down a steep hill without relining brakes, apply hose of running water for about five minutes, soaking each brake lining in water. This will expand the brakes and give you quick action for a short time. Keep all parts of machinery oiled, and tires inflated to the proper number of pounds. One drop of oil

(*Continued on page* 192)

One of the Troubles Which Often Causes Severe Heating of the Engine, Is a Clogged Water Cooling System. Every Two Weeks, a Stream of Water Should Be Run Thru the Radiator from a Hose, so as to Wash Out All Sediment, Grit and Rust Collected in the Bottom of the Radiator.

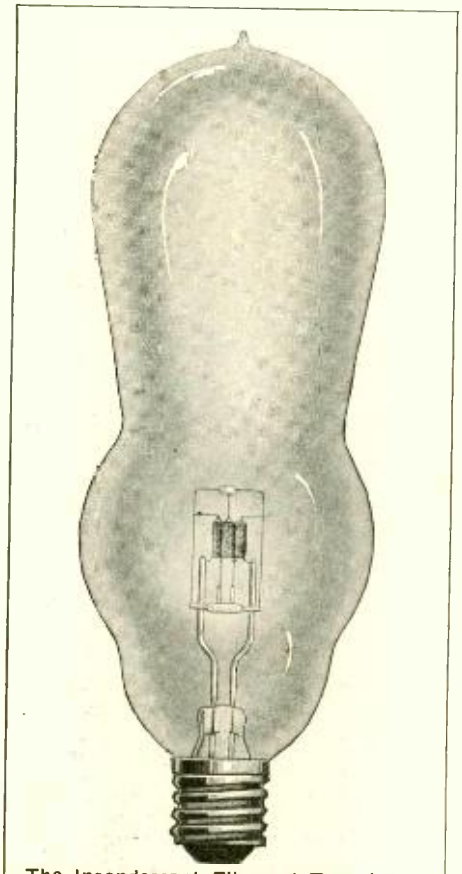
The second point is removing the plugs once a week and soaking them in a pail of kerosene overnight, then using a little emery on the points, drying them well, also adjusting all the points accurately to the thickness of a dime, then see that none of the porcelains are broken, which will cause a missing cylinder. Also see that all the porcelains are thoroly tightened by small nuts that are at top of porcelains. After this is done each plug should have a washer, and thoroly tightened in cylinder head.

Most people have trouble with their motor heating up, and it is no wonder when the water that is in the radiator has collected so much rust and grit that it has shut off the circulation of the water thru the various cylinders. This grit is removed by running the front of car over sewer, while motor is in operation. You will find a small outlet plug at the bottom of radiator on all makes of cars, take off cap from radiator water intake and apply hose with running water. Let motor run until water

The Top of the Automobile Should Be Watched as Closely as the Other Parts of the Car. A Good Coat of "3 In 1 Oil" Should Be Rubbed In With a Piece of Cheesecloth, Until it Is Well Absorbed by the Pantasote.

Curious Movie Lamp

The recent introduction of the gas-filled principle has caused a jump of some seven



The Incandescent Filament Type Lamp Is Rapidly Coming Into Favor for Motion Picture Projectors. The Concentrated Spiral Filament Used Gives as High a Candlepower as the Troublesome Arc. The Lamp is Gas Filled.

fold in the intrinsic brilliancy attainable with tungsten filaments, on a given life basis. The brilliancy of the filament under practical limitations could reasonably be expected to be of the order of 20,000 candle power per sq. in. (30 c.p. per sq. mm.) The crater of the d-c. carbon arc (with cored anode) was well known to have a brilliancy of 84,000 c.p. per sq. in. (130 c.p. per sq. mm.) almost irrespective of the current strength. The a-c. arc was found, as might be expected, to have a lower brilliancy while the limelight showed a brilliancy which was only of the order of 2,000 c.p. per sq. in. (3 c.p. per sq. mm.).

It looked as if the tungsten filament possibilities were quite in the arc class, especially if we could contrive to arrange the filament so as to constitute a light source of extension sufficient for the purpose and averaging up approximately to the brilliancy of the filament considered to detail. When this had been accomplished a trial was made in a projection machine, with results which were very encouraging.

The filaments, which are of thick wire. are wound in helical coils of very small pitch, and the inevitable separations between the coils are taken care of by a systematic arrangement of a concave spherical mirror mounted just behind the lamp. Thus the light source may be viewed in any direction, which is of practical significance; and it will show an almost unbroken assemblage of filament and mirror image. True the mirror image is appreciably less bright than the filament proper, but it should be remembered that much of the surface seen is substantially brighter than a simple tungsten surface at the same temperature. This is due to the high reflectivity of tungsten and what may be called the "perforated" character of the source.

The advantages of the tungsten filament lamp over the arc for motion picture projection are apparently as follows:

Where the a-c. arc is replaced, vastly more uniform screen results are obtained, noise is eliminated and continuous fussing with the light source is avoided.

Where the d-c. arc served by rectified or converted current is replaced there is a considerable gain in uniformity of screen results, the frequent "feeding" is avoided and the auxiliary apparatus is more simple and durable.

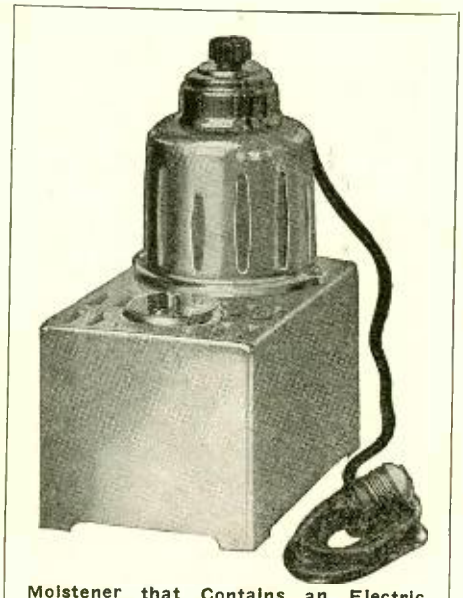
Whatever the style of arc replaced there are further advantages in the markedly reduced running expenses and lower first cost, freedom from cracked condenser trouble, fumes, and the intensely hard dust which comes from electrode cores (and causes film scratching, excessive machine wear and unsanitary conditions).

The color of the light is more nearly what is demanded to-day; the difficulties of the operator are greatly lessened, and the booth is much cooler.

(—Photo Courtesy Illuminating Engineering Society.)

A USEFUL ELECTRIC CIGAR MOISTENER.

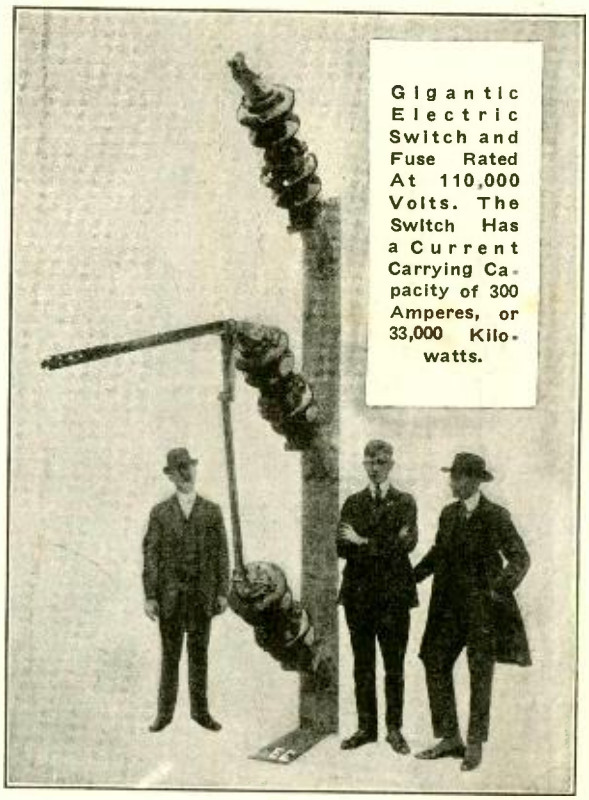
In the accompanying illustration is shown a moistener for use in cabinets and showcases to keep cigars and tobacco in good condition, which depends upon the evaporation of water caused by the burning of an electric light. A 50-watt carbon lamp is mounted in a socket under the dome of the device shown. In the front, a suitable receptacle is provided which contains a small amount of water. When the lamp is burning, the water evaporates and moistens the air uniformly thruout the case. The maker points out that so much moisture is given off when the lamp is in operation that it is only necessary to turn it on occasionally according to requirements.



Moistener that Contains an Electric Lamp to Evaporate Water Therein When Used in Cigar Cabinets.

A Giant Switch

A Chicago electric switch concern has recently designed and constructed several



Gigantic Electric Switch and Fuse Rated At 110,000 Volts. The Switch Has a Current Carrying Capacity of 300 Amperes, or 33,000 Kilowatts.

110,000 volt switching and protective equipments of the style here shown. These equipments consist of a disconnecting switch and fuse upon a common base.

A particular feature of this equipment is the arrangement of the insulating parts. They are made up of two 70,000 volt universal pin insulators stacked one upon top of the other. They are held together by a set of rugged clamps. To the bottom clamp of each insulator a malleable-iron pin is fastened, which is cemented into the pin hole. This type of construction makes an exceedingly strong unit and is far less expensive than a pillar type insulator for the same voltage.

The switch parts proper were made with the double blade type of construction, spring washers being employed to secure proper contacting. The switch was rated at 300 amperes. This unit when in use is mounted in the same position as shown in the cut, that is, with the blade vertical. It measures approximately 12 feet from lower end to top of lock-ring.

USE WIRELESS LAMP

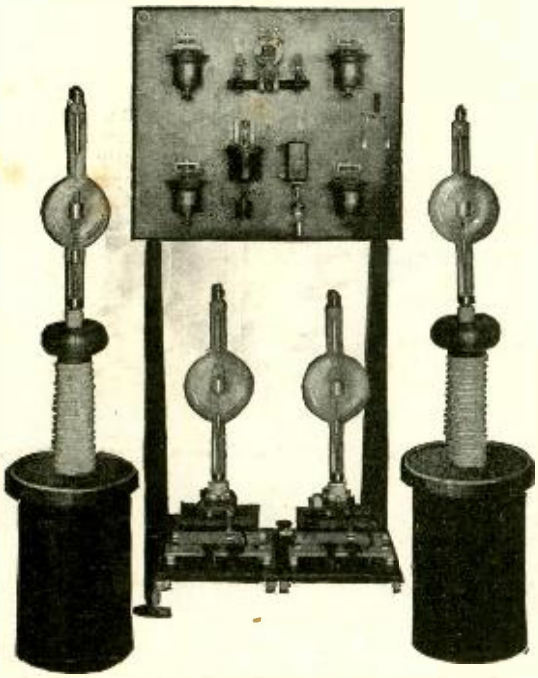
A wireless signal lamp has been devised for various kinds of war work which enables the users to keep up communication under conditions where it would be difficult or impossible to stretch telephone or telegraph wires. A barrage fire, for example, would be no hindrance to signaling by this new apparatus. It can be used between a ground station at the battle front and an airplane a considerable distance away, flying over enemy territory.

Electric light companies in Germany require their lamp trimmers to save scraps of old carbons, which are cemented together for further use.

A nickel-in-the-slot turn-stile has been installed in a New York subway station. If successful they will be adopted in all of the subway stations.

Kenotron Vacuum Rectifiers Stop Smoke

Smoke is one of the outlaws against which modern science has been directing its energies for a considerable time, but it has only been in the past few years that electrical engineers were able to design suitable high tension apparatus with which to precipitate the carbon particles suspended in the hot gases passing up the chimney. The first successful high tension rectifiers used to develop the 100,000 volts direct current required for the purpose were of the commutator type, driven by a synchronous motor in most cases. The high tension current in this class of apparatus is derived from step-up transformers, excited from a low tension alternating current supply.



Switchboard Panel With Protective Devices for Use On Kenotron Precipitation Outfits, With Filament Transformers for Kenotrons.

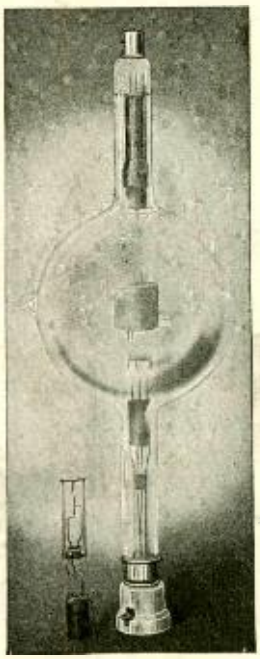
The latest, highly efficient rectifier for the smoke precipitation process, known as the "Cottrell process," is the *Kenotron* vacuum bulb type here illustrated. This device depends for its operation on the fact that a highly evacuated space containing two metal electrodes, one of which is incandescent and the other cold, possesses a *unilateral conductivity,* current passing thru the tube only when the heated electrode is *negative.* The amount of current which can be rectified by such a device increases rapidly with the temperature of the heated electrode, but remains constant as long as the temperature of the latter is maintained constant.

These characteristics render possible the use of the Kenotron as a rectifier for the production of high-voltage direct-current from an alternating-current source. At present, potentials up to 100,000 volts are secured with standard equipments.

When the Kenotron was first produced several practical applications were predicted for it, and two of these were realized commercially during the past year.

The first of these was in connection with the process of precipitation by means of high voltage direct-current for the reclamation of usable materials in gases or smoke, or the abatement of the nuisance caused by the emission of noxious gases or smoke from flues or stacks. The Kenotron equipment for this service is shown here.

The Kenotron is absolutely noiseless in operation, and the rectification is nearly perfect with maximum voltage fluctuations of less than 15 per cent when delivering *direct current at* 100,000 *volts!*

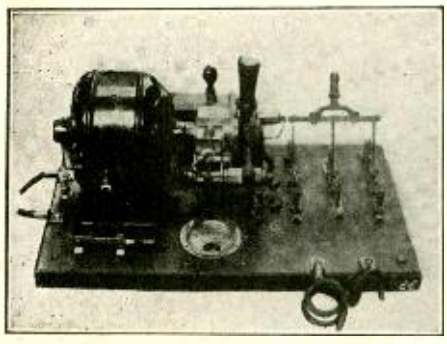


High-Voltage Kenotron, Maximum Voltage 90,000 D-C. On Half-Wave Rectification.

During the past year many installations were made.

New Synchronous Motor Rectifier

It has been found that to obtain the clearest, flickerless motion pictures, the arc should be operated on direct current. In many locations this is not available and recourse must be had to some form of rectifier, motor generator or a rotary converter. All of these are expensive which led to the development of the simple motor-driven rectifier here illustrated. It was perfected by C. J. Quill, of San Francisco.



New Motor-Driven High Capacity Rectifier.

It is said to be a 95 per cent efficient machine which charges your batteries and operates your motion picture machines at low cost. It has no tubes to break and no losses due to low efficiency nor expensive generator outfits. There are no contact points to burn out.

This latest product of science is a rectifier developed on an entirely new principle, consisting of a self-starting synchronous motor using only 75 watts, with a mechanical device for automatically rectifying alternating current for use in arc lights, motion picture machines or battery charging and for other uses of similar character which require direct current.

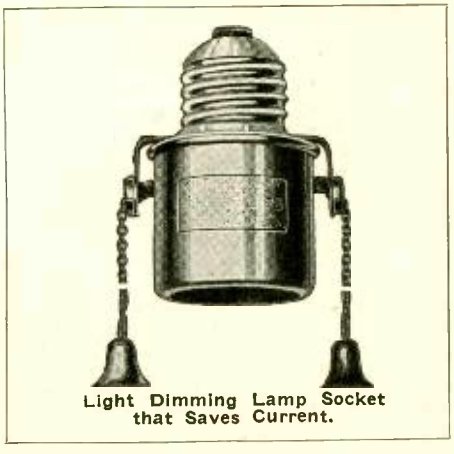
Different sizes for different classes of work from 10 amperes to 60 amperes are supplied. An auto-transformer regulates the voltage. It is ideal for storage battery recharging.

A NEW ELECTRIC LIGHT DIMMER.

Are you looking for economy in your electric light bills? Then here is a new pull-chain dimming socket which can be used with real economy, because this little attachment makes it possible to turn down electric lights when the full glare is undesirable or not needed, and save a proportionate amount of current.

Think of regulating electric lights, just as gas can be turned, "low or high." Think of the conveniences it affords to soften the lights when desired—to have a small fraction of a candle-power for continuous light in bath and hall, a dim glow in the bedroom or the nursery, a subdued light for cozy corner, fireplace or porch, and at the same time save from 30% to 80% of the full current.

Many electrical men, even experts and engineers, are of the opinion that these dimming attachments are a fake, but actual tests conducted by the U. S. Bureau of Standards, at Washington, D. C., prove that they do save current when the light is dimmed by such means. The following table shows the energy saved by the use of this dimming socket with a 40-watt 109-volt Mazda lamp.



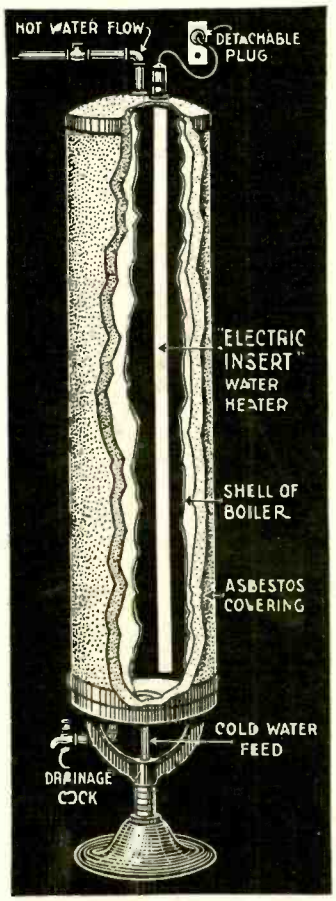
Light Dimming Lamp Socket that Saves Current.

Position	Watts Consumed	Percentage of Saving in Full Watts	Per Cent
1	39.9	100.0	00.0
2	27.7	69.4	30.6
3	10.9	27.3	72.7
4	7.7	19.3	80.7

HOME COMFORTS

ELECTRIC INSERT HEATER FOR KITCHEN BOILERS.

On those days in Summer when it is too warm to keep your heating system "going" sufficiently to provide hot water from the



An Efficient Electric Insert Heater for Kitchen Boilers.

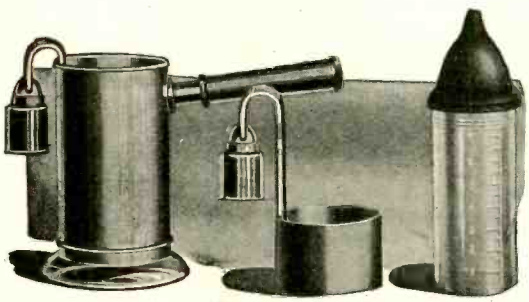
boiler; at any time when the heating of water involves distributing heat thruout the house; the *electric insert* water heater performs a service of great convenience at small cost.

This device is an *internal heater,* consequently no heat is lost by radiation, every unit being applied to the heating of water in the tank. It is essentially clean and it is inexpensive in its operation.

This heater is made in several sizes to accommodate a wide range of hot water requirements.

ELECTRIC MILK WARMER A GREAT CONVENIENCE.

The accompanying illustration shows one of the latest electric milk warmers, which should prove a boon to mothers. It consists of a water vessel, a standard eight-ounce Hygeia milk bottle with nipple, a removable immersion type heater, and a detachable connector cord. The complete outfit is well made and neatly finished. The immersion heater connects with a plug and is connected to any lamp or base outlet. It will warm the eight ounces of milk in a few minutes. The container and heating element being separable makes it possible to quickly and thoroly sterilize this apparatus. The electric milk warmer proves one of the greatest conveniences ever provided, especially for cold winter nights, when it is sometimes very inconvenient to heat the milk by other means.

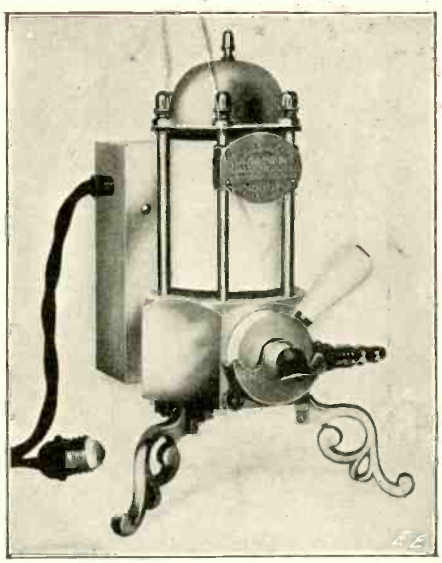


New Electric Milk Warmer, Consisting of a Water Vessel, a Standard 8-Ounce Hygeia Milk Bottle with Nipple and a Removable Immersion Type Heater.

A RAPID ELECTRIC WATER HEATER.

This new electric water heater requires no extra wiring of any kind whatsoever, and can be attached to the ordinary cold water pipe by simply making the connection and screwing the heater on to the cold water pipe.

The characteristic feature of this water heater is comprised of a cylindrical body of porcelain, in which are tubular passages from top to bottom; these ducts are connected progressively to each other by porcelain caps placed at top and bottom of cylindrical body. The water to be heated enters the first duct from the house piping (or rubber hose, as desired),

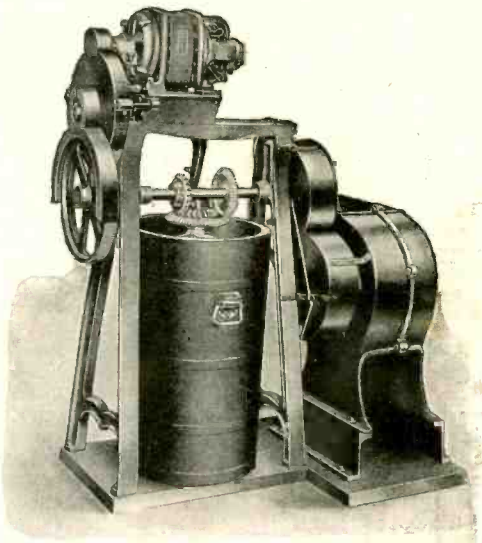


Instantaneous Electric Water Heater for the Home.

to the cylinder in the heater, and passes progressively thru the different ducts, from the last of which it is led to the discharge faucet of the heater. All these ducts are provided with non-corrosive metal coils. These coils are connected in series with each other and the terminals of this group of heating elements are connected by means of a snap switch to the source of the current supply; thus when the water flows thru the porcelain ducts, it passes directly over the heating elements, from which the water is progressively heated.

FREEZE ICE CREAM AND BREAK ICE BY MOTOR.

The hot summer days are now with us



Freezing Ice Cream and Breaking Ice by Electric Motor.

again, and then the family will want ice cream—but the old back-breaking way of freezing ice cream is not as popular as it was. There's a reason!

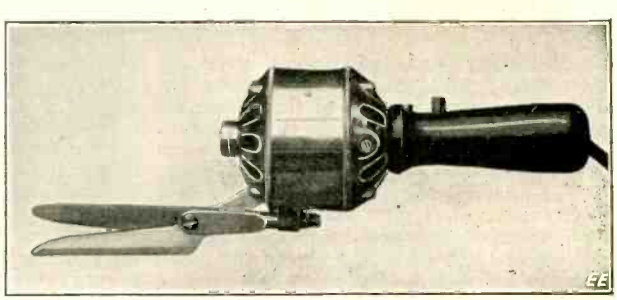
In the accompanying illustration of motor drive arrangement for an ice cream freezer and an ice breaker we have the "reason." Both the freezer and ice breaker are mounted on a solid iron base with a gear drive arrangement which permits the separate operation of either machine. The maker calls attention to the fact that no belts are used and that the outfit is one possessing sanitary features. The freezer has a capacity of 4½ to 10 gallons. An electric motor for operation on an alternating current or direct current circuit is used.

NOW THE "ELECTRIC SHEARS."

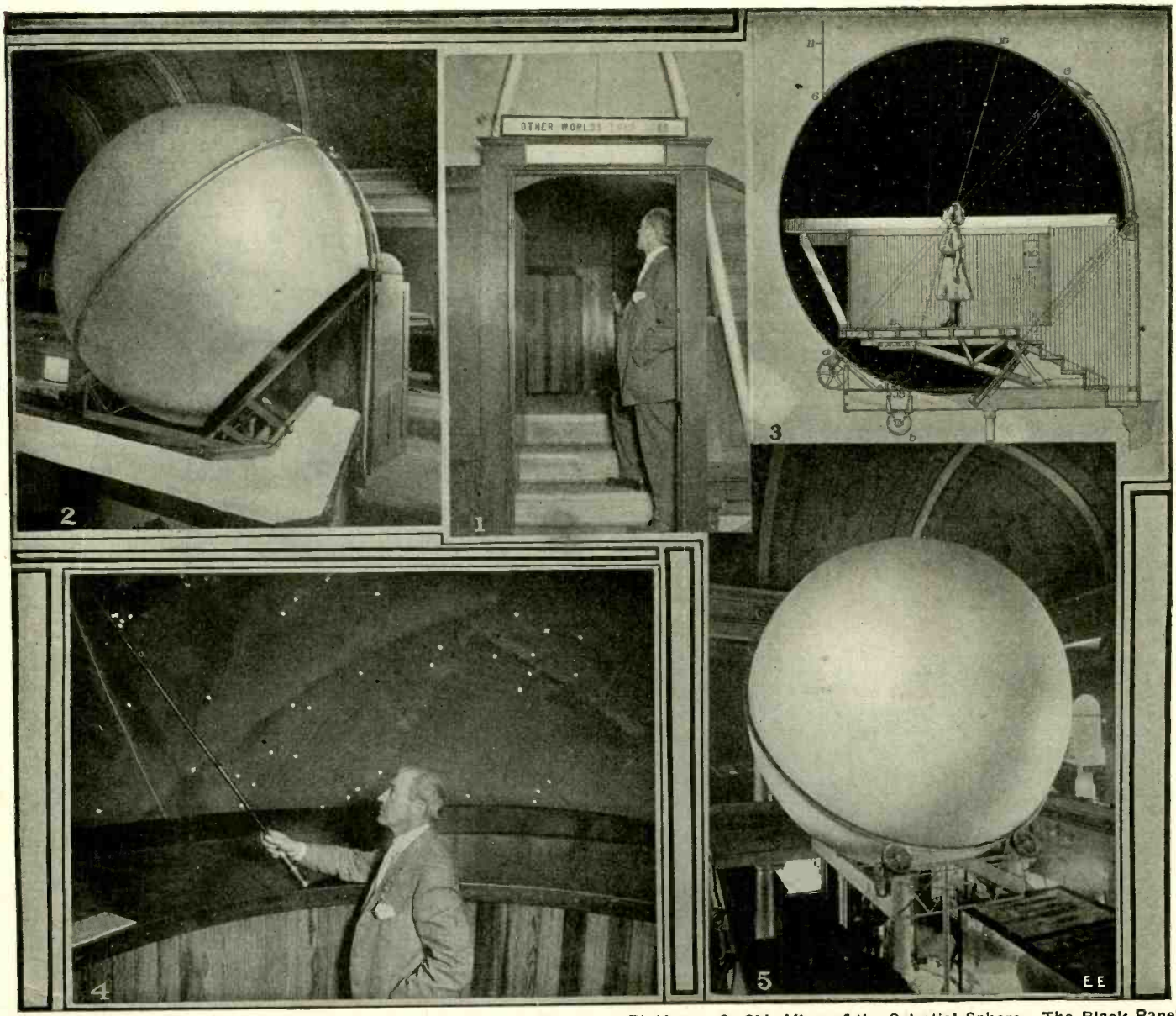
There has recently been developed and placed on the market an electric shears or cutting tool which has unique safety and labor-saving features. Several sizes have been developed, all of the hand or portable types are adapted to cutting sheet material from light cloth, netting or silk, up to sheet steel 1/16 inch thick.

The shears is equipt with an up-to-date electric motor of the universal type, adapted to run on either D. C. or A. C. circuits having a normal voltage of 115, which is usual for electric lighting supply.

It has a controlling push button switch in the handle, a separable attachment plug for connection to the ordinary electric lighting socket or a wall receptacle. The flexible cord is seven feet long from the handle to the plug. The shaft of the motor is fitted with an eccentric and connecting link for oscillating or vibrating the upper blade, only, of shears.



The "Electric Shears" the Latest—Cuts Rapidly All Thicknesses of Cloth.



1—Entrance Door to the Celestial Sphere, and Step Leading to Observers' Platform. 2—Side View of the Celestial Sphere. The Black Panel Running Around It at an Angle of 45 Degrees, Represents the South Polar Ring, and Includes That Part of the Sky Which Is Never Visible to an Observer in the Latitude of Chicago. 3—Cross Section View of the Celestial Sphere. 4—Interior of the Celestial Sphere. The Observer's Arm Is Rested on the Horizon Table, Which Corresponds to the Surface of the Earth. 5—The "Miniature Sky" as It Appears in the Chicago Academy of Science, Showing Wheels on Which the Sphere Revolves.

A Miniature "Sky"

By ROBERT H. MOULTON

A Wonderful 15-Foot Universe with Moving Stars, N'everythin'

TO give Chicago people a simple and vivid instrument for studying the heavens, Wallace W. Atwood, secretary of the Chicago Academy of Sciences, has constructed a miniature universe on the inner walls of a fifteen-foot sheet-iron sphere. This big hollow globe, placed in the museum of the academy, exactly and ingeniously depicts all the celestial phenomena regularly visible to Chicago.

The purpose of the Celestial Sphere is to arouse an added interest in the study of *Astronomy,* and by having the first one ever built installed in its museum, the academy has taken a new position among the museums of the world, for it has seemed impossible for such scientific institutions to make exhibits which had practical value in promoting an interest in this science.

All of the stars of the first, second, third and fourth magnitude, and a selected few of the fifth magnitude, are shown in the sphere. The full number of fixt stars thus shown is 692. Included in the exhibit are representations of the sun, the moon, and four planets, Venus, Jupiter, Mars, and Saturn, all of which are visible to the unaided eye. The *celestial equator* is also clearly marked in the interior of the sphere, and the *ecliptic,* or apparent yearly path of the sun among the stars is also shown.

The impression gained by looking out at night upon a clear sky is that of a hemispherical dome of infinite size, studded with stars. The Celestial Sphere gives a miniature reproduction of this surface which we call the "sky" and in which the stars are commonly supposed to be placed. Necessarily, the sphere is of almost microscopic size, as compared with the universe. If the earth were represented in proportion, it would be an infinitesimal ball located in the center of the sphere, while an observer standing on this ball would be correspondingly tiny.

The earth, as we all know, looks *flat* to anyone standing on its surface, and we can see only one-half of the heavens at one time; the half which lies above the plane bounded by the horizon. The same effect is gained in the Celestial Sphere by providing it with a so-called horizon table, which extends out from the inner surface of the sphere almost to its center, surrounding the observer and lying in the same plane as the center. There is thus exposed to a person standing in the center of the sphere a complete hemisphere, corresponding to the one we see above the surface of the earth, the other hemisphere being hidden by the horizon table, just as the earth conceals the other celestial hemisphere.

Not only is the Atwood Celestial Sphere a perfect pattern of the firmament, but in every other respect, with the possible exception of shooting stars, the idea is carried out in detail. In it the sun, moon and stars rise in the East and pass overhead, following certain definite paths, just as the real stars do in the real sky. Fortunately for the

(*Continued on page* 232)

The Amateur Magician

By JOSEPH H. KRAUS

The Mystic Roulette Wheel

SPRING had come, but very late, it being toward the latter part of May when I decided to take an unannounced trip to Professor Hargrave's home. Generally he was not to be found there, except by appointment, but this time I was willing to risk it.

The butler at Prof. Hargrave's home knew me by this time, so it was unnecessary for him to announce me when I eventually arrived at the Professor's estate. I was ushered into a room which had been changed somewhat since my last visit, and immediately my attention was centered upon a group at a pretty checkerboard-like table. Their attention was riveted to the center of the table where a roulette wheel was merrily spinning. Little had I ever thought or even dreamed that Professor Hargrave's home was used as a decoy to harbor roulette fiends.

Looking around the room in an attempt to find the Professor with his hypnotic smile, I could notice him nowhere, neither was my entrance observed by those at the game. A few minutes later I found myself just as interested in the merry spinning of Dame Fortune's wheel, perhaps even more so than my companions around me; so wishing to be in style, I placed my money on various numbers and took a chance with the rest, sometimes winning, but more often losing!

A few minutes at this and the Professor entered, altho I was not aware of his presence. Patting me on the back, he exclaimed, "So, there you are, old timer, why didn't you announce your coming? You see, now I have nothing ready for you. I cannot show you a thing and am attempting to entertain my guests, so I think you had better stop in tomorrow or perhaps the day following at this hour."

Wondering if this was a polite way of getting rid of me or whether he didn't want to see me lose my money, I answered, "All right, Professor, I will be very glad to see you on the morrow; I guess I will be going now". "Oh, no," he added, "you might just as well stay, now that you are here, and enjoy yourself for the rest of the evening. I did not mean that as a polite retreat." Then leaning over to the roulette wheel, he placed his money on number nine as winner, but much to his apparent dismay, he lost, and continued to do so until he became a very heavy loser. Meanwhile, I had begun to reap the benefits of his and the other guests' losses.

Later as the game progrest, the Professor won one round and then lost two again in succession. After that fate seemed to travel in his direction; every time he played, it seemed as tho the numbers would come out expressly for his benefit; until even I. O. U's were being past around the table.

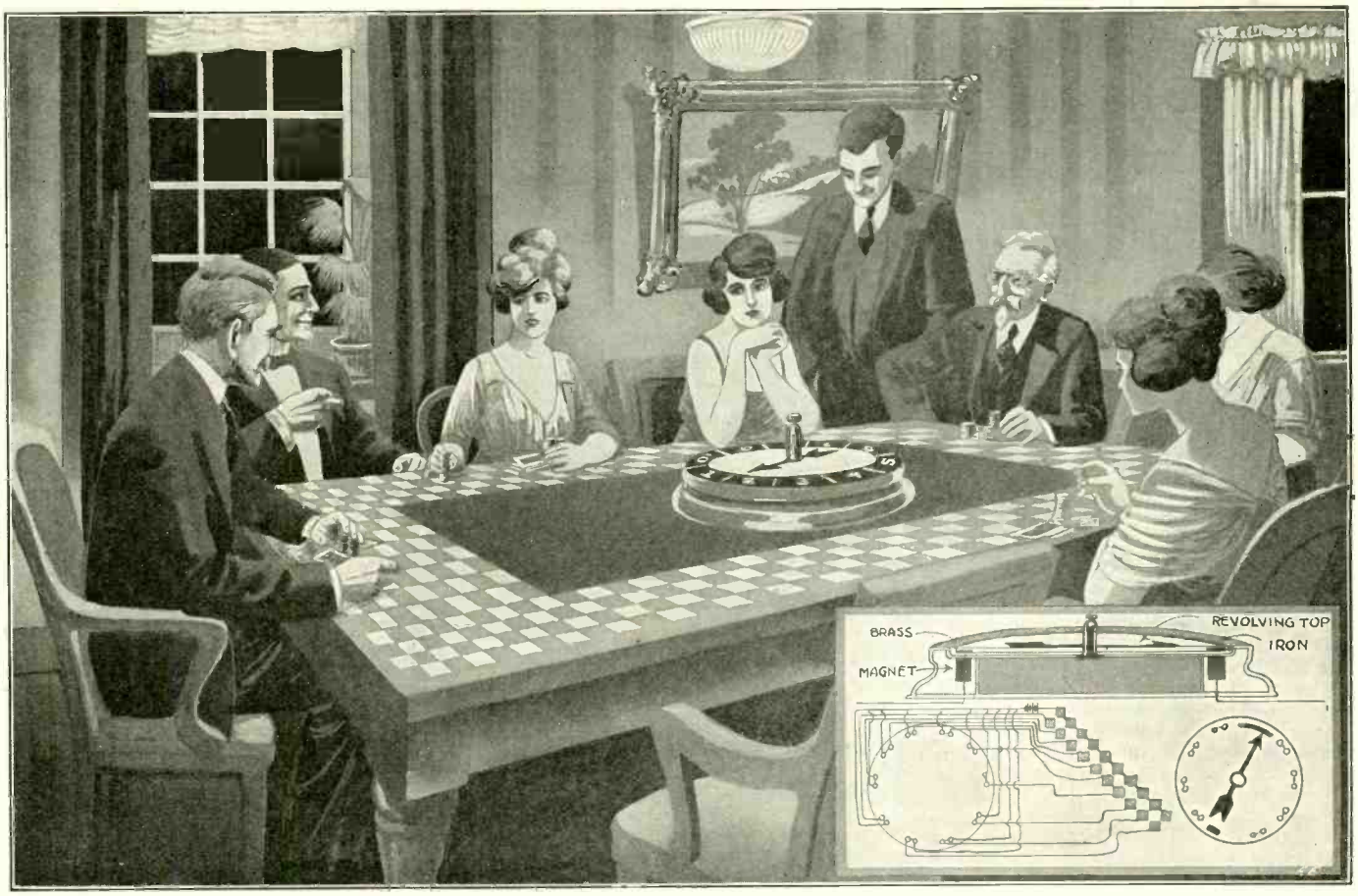
All the good luck which had beset me until this time, suddenly melted and I was only contributing to the popularity of the Professor's coin, heaped high at his corner of the table. At last to break the monotony of the silence which had ensued, the Professor said: "Come, we've had enough of this," and alloted to each one the same sum of money they had at the beginning of the game. We wondered what had happened, open mouthed with amazement, all refusing the money, claiming that he had won it and therefore had a perfect right to keep it, but our requests only fell upon deaf ears.

"You have all been a bunch of fools, dupes, easy victims to a clever contrivance," the Professor began. "Why, that table is faked, and I can make it stop at any number I desire. In order to prove it to you—you see that the disc now is absolutely stationary, yet by wafting a little air, like this, across its surface, (an appropriate movement of his hand reinforced his statement) I can make it move just as I desire."

We were awed by the disc moving, seemingly of its own accord. Immediately, I thought of strings, springs, or electricity, and lifting up the wheel, I examined it carefully, but there were no *two electrical contacts* anywhere similar to those in his other features. Replacing the wheel and spinning it, I requested that he stop it at figure "1." A short time later, when its momentum had died down sufficiently, it came to a stop at the number "1" desired.

On hands and knees, I crept under the fancy table to look for push buttons or other things which might give me a clue as to the operation of the mystic roulette wheel. Not a sign! A rapid scout thru the rooms skirting the one we were in convinct me that there was no external operator. How then could it work? I surely should have known enough of the Professor's apparatus by this time to attempt to see thru the thin veil of disguise which he used to conceal his instruments, but no such luck this time.

(*Continued on page 202*)



The Mysterious Roulette Wheel Kept Professor Hargrave's Guests On the Alert for Many Hours. Finally, After they Had All Lost Their Piles of Gold He Explained How He Could Stop the Wheel At Any Point Desired and Then . . . Returned Their Money.

The Secret of the Magnet Poles

By WALTER E. KEEVER

Laws of Motion Applied to Magnetism—

"UNLIKE poles attract; like poles repel." So reads the first law of magnetism—and the ordinances of the Medes and Persians were unstable compared with the laws of Nature. However, a few experiments with permanent magnets will arouse serious doubts in the investigator's mind, until he solves the mystery to the triumph of the law, when the letter will be more firmly fixed in mind than before it was seemingly violated.

Take a piece of soft iron wire about four inches long and fasten one end with a thread to an upright, allowing the free end of the wire to reach within one-quarter inch of the N-pole, say, of a strong permanent magnet. The wire is now floating in a magnetic field (fig. 1, a). Now take another piece of soft iron wire and hold it parallel to the floating wire; one end close to, but not touching, the exciting magnet. When the wire you hold is moved toward the floating wire, the latter is repelled (fig. 1, b). In picking up iron filings or tacks with a magnet you have learned to expect mutual attraction between the induced particles, yet here is repulsion between two soft iron wires influenced by the same pole.

No, the law is not violated. As shown in (c), fig. 1, *like poles are induced* in the two parallel wires; and "like poles repel." Very well. Next, hold the free wire in position shown in fig. 2 (a). The floating wire is now *attracted*. How can this be, when we have just proved that two wires attracted by the same pole repel each other? Note polarity. S-polarity is induced in the end of a soft iron wire brought near the N-pole of a magnet, or N-polarity if brought near the S-pole. When polarity of either kind is induced in one end, opposite polarity simultaneously appears at the other end. Trace the induced polarities shown in fig. 2 (a), and, bearing in mind that "unlike poles attract," the reason for attraction in this case is apparent. Once more the law is upheld. In (b) and (c), fig. 2, other instances of attraction are shown, illustrating the "sticking together" of small objects picked up by a magnet. In (b) the free wire is magnetized *through* the floating wire; in (c), partly through the floating wire and in part directly from the exciting magnet.

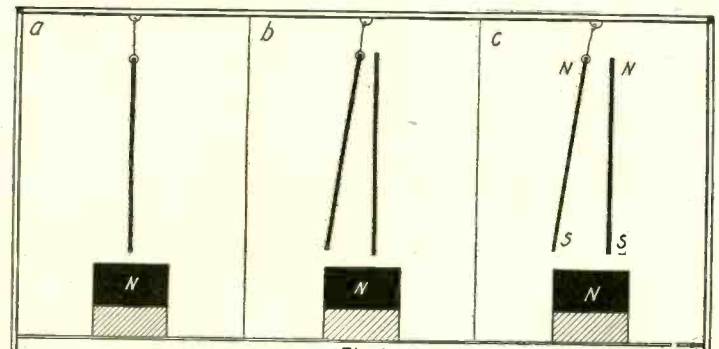


Fig. 1

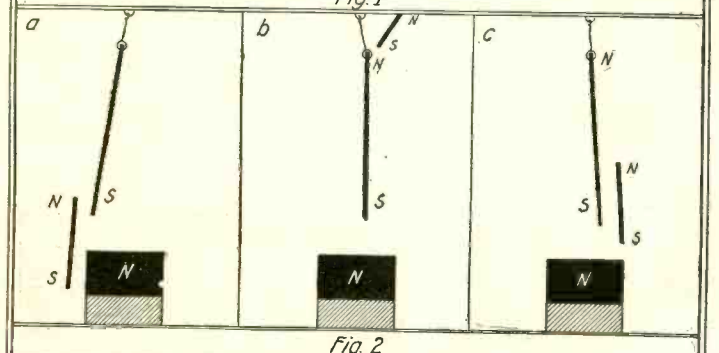


Fig. 2

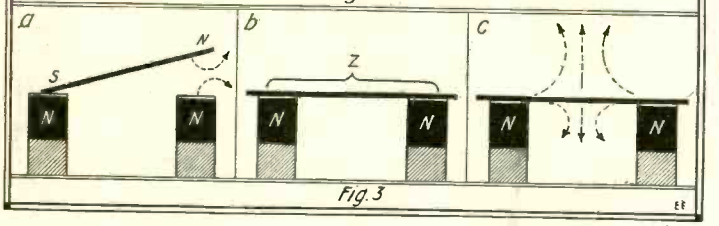


Fig. 3

Our next experiment requires two permanent magnets, for convenience, though one with a double branched pole-piece would serve. Lay one end of a soft iron strip on one N-pole. It sticks. Approach the other end of the iron piece with another N-pole; you would naturally expect the strip to be repelled. Well, it is—"to a certain extent," as Professor Fox used to say when not desiring to commit himself irrevocably. The condition is shown in fig. 3 (a), with polarities indicated. Broken arrows illustrate opposition of the magnetic forces. But when the free end of the iron strip is pressed down close to the second N-pole, at a certain critical point repulsion is *changed to attraction*, and in a trice we have *both* ends of the strip sticking fast to N-poles! (Fig. 3, b.) Now where is your law of like polarities? Aha! A mutual S-pole induced at the middle of the strip? Not so. *Test with a compass and the iron strip is found to possess N-polarity throughout.* Diagram (c), fig. 3, shows what has occurred—the strip has become a hub, from which the lines of force radiate like the spokes of a wheel, seeking S-polarity at the far ends of the permanent magnets. The mechanical principles involved will be dealt with further along in this article.

"Unlike Magnet Poles Attract; Like Poles Repel" — So Reads the First Law of Magnetism, and Several Interesting Variations of This Law Are Here Exemplified. What Is This Magnetism Anyhow? Magnetism Is Undoubtedly a Resultant of Continuous Ether-Movement; There May Even Be a Progressive Movement Outward, But the Author Believes This Flow Is Only a Consequence, More in the Nature of an Electric Current, and Not a Constituent Principle. Magnetism Is the Contraction Upon Its Axis of the Ether Vortex. This Article Opens Up a New Avenue of Reasoning As to the Real "What Is It?" of Magnetism.

What *is* this magnetism, anyhow? Conventional representations indicate streams or trains of ether-corpuscles issuing from the N-pole, circling around and re-entering the magnet of the S-pole—each stream a "line of force." Magnetism is undoubtedly a resultant of continuous ether-movement; there may even be a progressive movement outward, but in the writer's opinion this flow is only a consequence, more in the nature of an electric current, and not a constituent principle. Hear ye:

MAGNETISM IS THE CONTRACTION UPON ITS AXIS, OF THE ETHER VORTEX. The free ether in its normal, static condition, is very much like an exceedingly dense monatomic gas, whose particles are vibrating rapidly in all directions—a condition of repulsion or expansion. This condition is continually subject to local modifications due to solar rays, wind-friction, evaporation and condensation of moisture, etc., but it always exists between electrons free to vibrate. Discordant vibration is always repellent. Now, in the pores of magnetic substances like iron, there is no room for sustained vibratory motion, but there are narrow channels permitting circular motion. So the ether corpuscles lose their reputation, "join hands around," and go circling in rings.

Weak magnetism can be regarded as relatively few vortices; when there is one vortex-tube for each channel the iron is said to be "saturated" and its magnetic strength cannot be increased except by cooling (suppressing vibration of molecules), which allows greater freedom to the vortices.

Let us consider one unit vortex, as typical of the whole. In union there is strength: aggregate mass of its component rings gives the vortex tube such momentum that its effect extends some distance from the end of the iron channel. Farther from the iron, resistance of the free ether retards the whirl; the tube shrinks in diameter, tapering to a point; while *friction between succeeding rings* (due to retardation) causes a slight progression on the axis. The point of the tube is thus really a de-

In the Case of the Ether-Vortex, Centrifugal Force Counteracts the Pressure Upon the Radius, While at the Ends or Poles There Is No Centrifugal Force; Therefore the Ether Vacuum Can Be Closed Up Only By Shortening the Expanded Vortex Tubes.

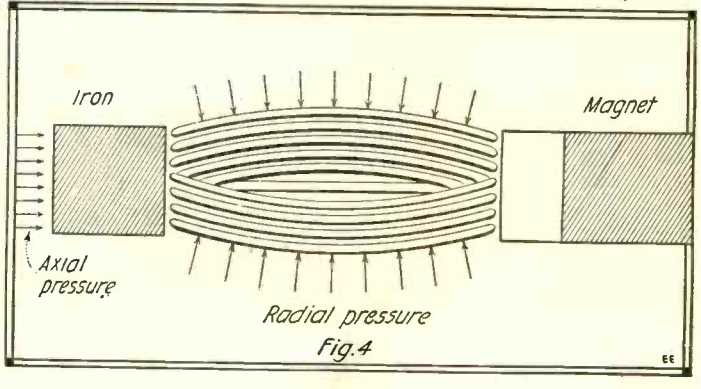


Fig. 4

creasing spiral, disappearing where centrifugal force becomes too feeble to resist the battering of the "free electrons."

The projecting vortices thus vanish "in thin air." But let a piece of soft iron be brought within their field and the "lines of force" find allies in the enclosed electrons, which join the whirls, further increasing momentum. With flywheels at each end, so to speak, the vortex tubes reach across the gap without deminution. Centrifugal force, limited in the rigid confines of the iron channels but free to act in the gap, causes the bridging tubes to expand against the elastic pressure of the surrounding ether, creating an *ether-vacuum* within the tubes. Nature "abhors a vacuum"—or, in other words, a container deprived of any part of its equalizing internal pressure tends to collapse under external pressure. In the case of the ether-vortex, centrifugal force counteracts the pressure upon the radius, while at the ends or *poles* there is no centrifugal force; therefore the vacuum can be closed up only by *shortening* the expanded tubes. (Fig. 4.) The metal pieces at each end of the tubes are thus *forced* together, not "attracted."

Wherefore we repeat, magnetism is the contraction upon its axis, of the ether-vortex.

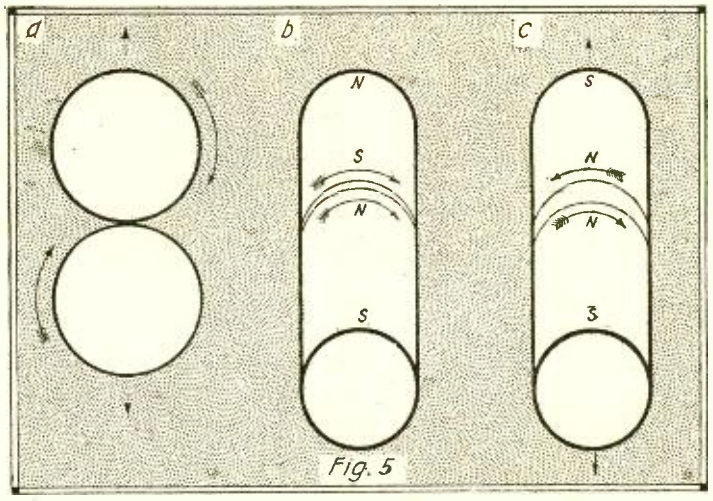
Polarity i very easily explained under this conception: it signifies simply *direction of rotation.* Take a piece of flexible rubber hose and consider it an ether-vortex. Have a friend rotate the tube in one direction while holding it horizontal. Face one end and you see it turning, say, right-hand or clockwise: call this the S-pole. Go around and look at the N-pole and you find it turning left-hand. It is the point of view that has changed—the tube is still rotating in the same direction as before.

Now take up a tube similar to the first; hold it parallel to the other, and rotate it in the same direction. The N- and S-poles of the two tubes are adjacent—like poles side by side. When the two rotating tubes are prest together, friction is felt. Two wheels revolving in the *same* direction *repel* each other when brought rim to rim (Fig. 5, a).

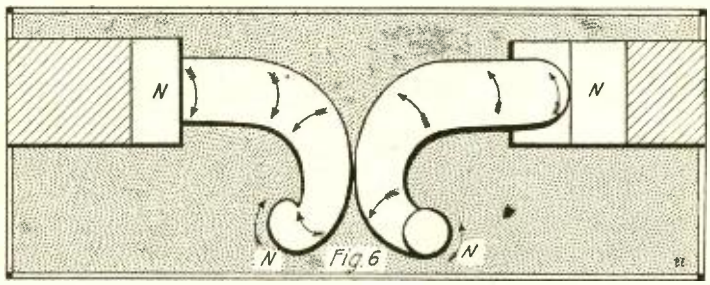
Join the S-pole of one tube with the N-pole of the other (Fig. 5, b). *No friction* results, because both are revolving in the *same* direction at the *same* speed. But when one of the tubes is turned end for end, and its N-pole placed against the N-pole of the other tube (Fig. 5, c), friction is experienced, because the two N-poles are now revolving in relatively *opposite* directions. (In performing these experiments the two tubes must be kept rotating in the original direction—both of them either right-hand or left-hand as at first.)

Bend one tube until its ends meet; the direction of rotation is the same for the two ends. Here is a "closed magnetic circuit," or a *closed vortex,* which contracts upon its axis by contraction of the circuit.

From the foregoing it will be seen that when two magnetic "like" poles are brought together the vortices are rotating in relatively opposite directions, causing friction; and when "unlike" poles are joined the vortices are revolving in the same direction, causing *no* friction. Let us see how these mechanical principles agree with the law of polarities. The analogy of the rotating rubber tubes of Fig. 5 is sufficiently clear as regards the experiments illustrated in diagrams 1 and 2. For the mechanical equivalent of Fig. 3, c observe Fig. 6, wherein one pair of the spoke-like lines of force is represented (exaggerated) as typical of the whole. The outer ends of all adjacent tubes rotate in the *same direction*—in this case the N-pole direction (as seen when facing the N-pole). Note rim-friction of adjacent tubes rotating in the same diretcion, causing a tendency for the tubes to spread apart, as becomes clear.



Polarity Is Very Easily Explained Under the "Direction of Rotation" Conception, Shown in Fig. 5. Two Rotating Tubes Are Used to Illustrate This Phase of Magnetism in a Practical Sense. Two Wheels Revolving in the Same Direction Repel Each Other When Brought Rim to Rim, Both Tubes Revolving in the Same Direction Give No Friction Between Them — the Same as North and South Polarity on Two Magnet Poles.



The Mechanical Equivalent of the Magnetic Phenomenon Shown in Figure 3 Is Illustrated Herewith. Note the Rim Friction of Adjacent Tubes Rotating in the Same Direction, Causing a Tendency for Tubes or Vortices to Spread Apart.

It is easily understood how collisions or glancing blows between particles cause repulsion, but how *lack* of friction permits so-called attraction requires some explanation. Here is the startling answer: THERE IS NO SUCH THING AS ATTRACTION IN THE UNIVERSE. What appears to be attraction is merely the removal, decrease or lack of compensating pressure between the seemingly attracted objects, permitting the constant pressure from without to *force* the two objects together and close up the *vacuum.*

Several other physical laws tend to operate upon these vortices, these lines or tubes of force extending out from a magnet. As observed, rim-friction of the parallel tubes rotating in the same direction tends to spread the tubes apart. Opposed to this spreading is fixity of the axis of rotation.* Due to inertia, a body set in motion resists any change in its direction; in a whirling mass this effect is resolved into planestability, or fixity of axis, strikingly manifested by the gyroscope.

Another effect, hardly so well known, is *precession.* When either pole of a spinning gyroscope (spinning in vertical plane, say) is prest down, the gyroscope seeks to turn at *right angles* to the disturbing force, so as to bring the descending side of its rim into the former position of the deprest pole. If the same pole is prest upward, the *ascending* side of the rim is brought around. This turning at right angles is called the *precession* of the gyroscope (Fig. 7). Precession is also a property of the magnetic vortex, which, mechanically considered, is simply a tubular gyroscope.

Applying this theory to the dynamo (Fig. 8), may we not say that as the lines of force are dragged out of their axis of rotation by the sweep of the armature, precession turns them at right angles, impressing the vortices upon the armature wires as a spiral with both rotation and progression — an electric current!

* Note.—But for this stiffness of the tubes, magnetic repulsion would be imperceptible. It is much weaker than contraction upon the axis.

MAGNETIC METALS.

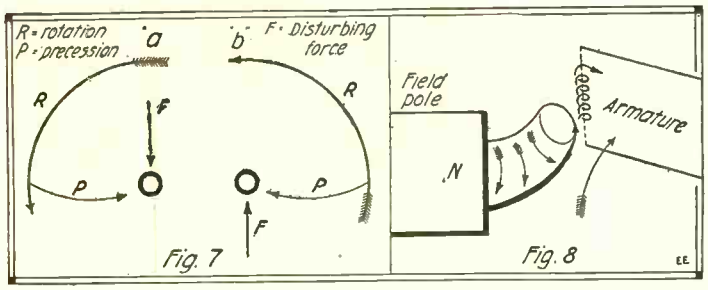
In the October issue of the *Electrical Experimenter* appeared a brief description, contributed by Mr. H. J. Gray, of a non-ferrous magnetic alloy. Mr. Gray gives the composition: 60% copper, 26% manganese, 14% aluminum.

The only simple metals possessing more than mere traces of magnetic property are iron, nickel and cobalt. The atomic weight of iron is 55.8, nickel 58.7, cobalt 59.0. No non-magnetic elements have atomic weights within this range. The nearest metal is manganese (54.9) and this, as Mr. Gray said, is feebly magnetic. Here, then, are narrow limits within which no element is non-magnetic and without which none is magnetic. Surely this is no mere coincidence.

Of course the magnetic alloy has no true atomic weight. A figure representing an *average* atomic weight if I may use the expression, may be easily derived by simply multiplying the atomic weight of each constituent by its percentage and adding. Thus:

Copper	60% : 63.6 × .60 =	38.2
Manganese	26% : 54.9 × .26 =	14.3
Aluminum	14% : 27.1 × .14 =	3.8
"atomic weight":		56.3

DAVID CLARKE COX, M.A.



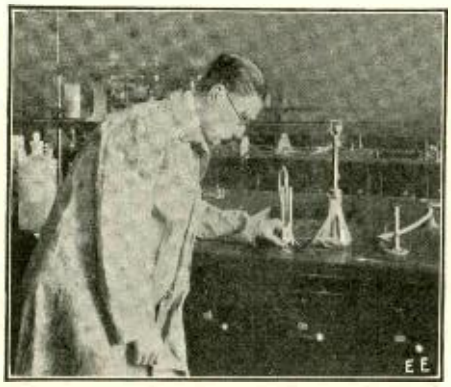
In These Two Diagrams the Author Attempts to Show the Comparison Between the Right Angle Forces of Precession Exhibited by a Spinning Gyroscope, and Those Occurring in the Magnetic Field of a Dynamo When an Armature Cuts Thru This Field.

Practical Chemical Experiments

By PROF. FLOYD L. DARROW

EXAMINATION OF WATER.

WATER is the universal solvent. It dissolves more substances than any other one liquid. Therefore, water is never free from dissolved mineral and organic matter. Even rain water contains gases washed



Detecting the Presence of Lead by Passing Hydrogen Sulfid Gas into a Concentrated Sample of the Water.

from the atmosphere, as it descends, and if it has fallen upon roofs, it will also be discolored from other substances in solution. But for industrial purposes, water must be free from many objectional compounds. Thus, iron in any form is very bad for dyeing, tanning, paper making, bleacheries and laundries. Hard water cannot be used in laundries, without softening, and is the chief cause of boiler scale. Highly colored water is objectionable in the textile industries. Chlorides are harmful in sugar refining and in the tanning of leather. And the list might be extended, for there is scarcely an industry that does not have its special requirements for the water that it uses. It will be seen, however, that the chemical examination of water with a view to determining its fitness for industrial purposes is a matter of great practical importance. It is also a matter of great commercial importance to determine methods of purifying water and to design plants for this purpose.

REMOVAL OF COLORING MATTER.

Water is frequently highly colored from having past thru peat beds or masses of decaying vegetation. Such water, however,

Preparing a Sample of Temporarily Hard Water by Passing Carbon Dioxid Gas from a Kipp Generator into Limewater.

never comes from great depths, for if it did such coloring matter would be removed by natural filtration. And this fact suggests a means of removing the color substances. For this purpose sand filters are in common use. They are called mechanical filters and contain a bed of sand mixed with lime and alum, thru which the water is forced under pressure.

To learn the action of such a filter prepare a dilute solution of "alum" by dissolving 20 grams of aluminum sulphate in a liter of water. Also have at hand limewater, made by shaking slaked lime with water in a stoppered bottle and allowing it to stand for several hours. Pour off the clear solution. Now to one-sixth of a test tube of the alum solution add twice that volume of limewater, warm gently and note the white gelatinous precipitate that forms. The precipitate may be formed in greater quantity by substituting ammonia water for the limewater.

To show the effect of this precipitate of aluminum hydroxide on coloring matter prepare solutions of logwood or alizarin. Then to one-sixth of a test tube of aluminum sulphate solution add some ammonia water and follow it with a little of either the logwood or alizarin solutions. Shake the contents and set the test tube aside. After it has stood for an hour, examine it again and you will find that the coloring matter has been carried entirely to the bottom, forming what dyers call a "lake". See Fig. 1. In just this same way the alum and lime in a mechanical filter unite to form the gelatinous precipitate aluminum hydroxid, which removes any organic coloring matter.

MAKING A SAND FILTER.

A sand filter that will illustrate this beautifully may be easily made as follows: Obtain a large jar of several gallons capacity, preferably of glass, altho an earthenware jar will be perfectly satisfactory. In the bottom of this jar place 9 small inverted beakers of about 150 cc. capacity to serve as supports. See Fig. 2. Over these beakers fit a piece of fairly fine iron wire gauze, or better still, copper gauze. Cover the gauze with filter paper. Before introducing the sand, bend a large sized glass tube into the shape of a siphon by softening in the flame of a fish-tail burner and bending in the usual way. On the outer end of this, place a short piece of rubber tubing and a pinch cock. Thru a previously made hole in the gauze insert the short arm of the siphon, and it should reach to the bottom of the jar.

Now put in a layer of sand and sprinkle over it a small quantity of slaked lime, mixed with pulverized alum. Continue this procedure until the jar has been filled within two inches of the top. Then pour enough water thru the filter to wash it out well, drawing it off with the siphon. Next prepare a gallon of colored water by dissolving a little of some soluble dyestuff, as alizarin or magenta, in it. Pour this thru the filter and you will find that the color has been completely removed. This makes a very striking demonstration.

Another Method of Removing Color: Set up a distilling apparatus similar to that used in the distillation of alcohol and place in the boiling flask a dilute solution of copper sulfate. Upon distilling this the deep blue copper sulfate will be left behind and the water will come over pure and clear. If it were not so expensive this would be the ideal method of purifying all water.

Removing Sediment: Natural water very frequently contains large amounts of solid matter held in suspension. To remove this by natural settling would take a long time. But the same substance that removes color-

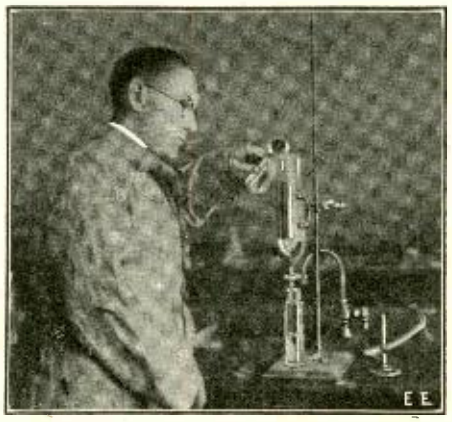
Making the Soap Test for Hardness by Pouring Soap Solution from a Dropping Bottle, into the Sample of Water.

ing matter also carries down the sediment with it. To show this fill a tall cylinder with water made turbid by the addition of a little fine clay. Then add a third of a test tube of the aluminum sulfate solution and mix it by thoro stirring. Follow with two-thirds of a test tube of lime water without stirring. Prepare for comparison another cylinder of water leaving out the alum and lime. Allow these cylinders to stand for several hours. The value of lime and alum as coagulums in city water reservoirs will be readily apparent.

HARDNESS IN WATER.

The terms "hard" and "soft" as applied to water originally referred to the difference in the "feel" of various kinds of natural water. Rain water, as everyone has experienced, feels soft and smooth to the touch and if used for toilet purposes will leave the skin in a similar condition. But much of the water from deep wells and springs has directly the opposite effect. Not only does it feel harsh to the touch, but it roughens the skin and makes necessary the use of large quantities of skin lotions.

One of the most noticeable and important



Pouring a Sample of Exceedingly Hard Water Thru a Permutil Filter. It Comes Out With Zero Hardness.

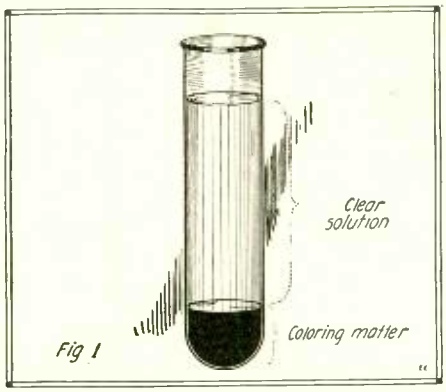


Fig. 1. Aluminum Hydroxid and a Solution of Logwood Demonstrates the Formation of a Dye "Lake". The Coloring Matter in the Latter Solution Falls to the Bottom.

effects of hard water is its soap consuming power. Therefore we make use of a soap solution in testing for hardness.

Testing for Hardness: First obtain some good liquid soap, as free from color as possible. Formerly an alcoholic solution of soap was used in these tests but a good quality of liquid soap will serve our purpose just as well. Obtain a dropping bottle, or make one by cutting a small notch in each side of a cork stopper and fit it into a small bottle. From such a bottle the soap may be poured in drops.

The softest water possible to obtain is distilled water. To learn the effect of soap upon such water, fill a test tube two-thirds full of it and pour in a few drops of the liquid soap. Note that no cloudiness appears and upon closing with a stopper and shaking a copious suds at once forms and does not disappear with standing. The suds are permanent. This is the test for soft water.

To learn the test for hard water add one or two cubic centimeters of a solution of calcium chlorid to half a test tube of distilled water and add soap. Note that a cloudiness at once appears and that large pieces of white precipitate separate out. Upon shaking no suds are formed. There may be froth and bubbles but no suds. This is typical of hard water, but of course no natural water is as hard as this sample. The white precipitate is insoluble calcium soap, useless as a cleanser, and which behaves as so much dirt. Not until all of the calcium salts in solution have been precipitated as calcium soap, can the cleansing action of the soap become effective. That is, the soap must soften the water and this is an expensive process.

Temporary Hardness: There are two kinds of hardness—*temporary* and *permanent.* One may be removed by boiling while the other requires the addition of some chemical, or distillation.

Prepare a sample of temporarily hard water by passing carbon dioxid gas into limewater for several minutes. (The carbon dioxid may be generated by the action of hydrochloric acid upon pieces of marble in an ordinary hydrogen generator) see Fig. 3. At first you will observe the formation of a white precipitate of calcium carbonat, but this very quickly disappears and a clear solution of calcium bicarbonat results. Divide the solution into three parts. To one add soap and note the formation of a precipitate and the absence of suds. Heat the second portion gently and at the same time hold over the mouth of the test tube a glass rod having on the end a drop of limewater. Note that the limewater becomes turbid, showing that carbon dioxid escapes. Then boil the contents of the tube and a white precipitate is formed. This is calcium carbonat. Filter off this precipitate and test the filtrate with soap. You will find that the water is very nearly as soft as distilled water. Because such hardness can be removed by boiling, it is called *temporary.*

In nature water always contains carbon dioxid and if it flows over limestone rocks, the limestone dissolves, forming calcium bicarbonat, held in solution by the excess of carbon dioxid. When this water is boiled in a tea kettle, the normal carbonat is precipitated and, since the calcium is removed from solution, the water is softened. Magnesium carbonat also behaves in the same way and is a cause of hardness.

Remove from the inside of a tea or water kettle some of the flakes of mineral matter that have been deposited there. Place them in a test tube and add a little hydrochloric acid. The very vigorous effervescence that results proves the presence of carbonat precipitated in the foregoing way. This is a common cause of boiler scale too.

To the third portion of the above solution add a little limewater and note that a white precipitate of calcium carbonat results. In the industrial use of water, temporary hardness is frequently removed by the addition of just the right amount of limewater.

Permanent Hardness: The more important kind of hardness and the most troublesome, because the most difficult to remove, is permanent hardness. This is due to the presence in water of calcium and magnesium sulfates and chlorides.

Shake a little of Plaster of Paris (calcium sulfate) in a test tube two-thirds full of water. Filter it and make the soap test. You will find it very hard. Now prepare another test tube of hard water in the same way. Divide into two portions. To one add a fairly strong solution of sodium carbonat—ordinary washing soda—and heat gently to nearly boiling. Filter off the precipitate that forms and test the filtrate with soap. You will find that the water has been almost entirely softened. This is the method by which water is most frequently softened in the household. See Fig. 4.

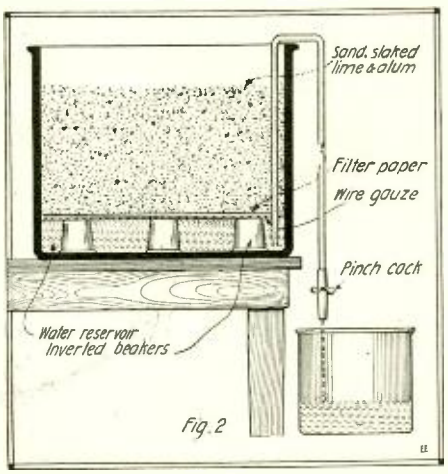


Fig. 2. A Sand Filter. Nature Uses a Similar Method of Giving Us Relatively Clean Water for Drinking Purposes.

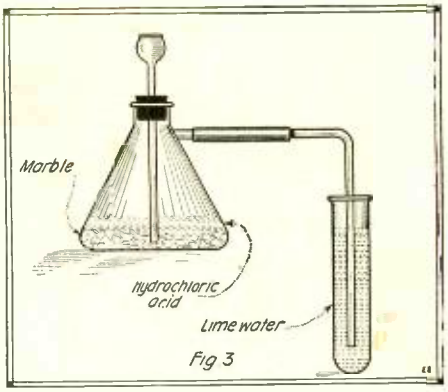


Fig. 3. Preparing Temporarily Hard Water By Passing Carbon Dioxid Into Limewater.

Heat the other portion of the hard water to boiling and note that a precipitate forms. Filter and test for hardness. The water will still be found hard, altho, owing to the fact that calcium sulfate is less soluble in hot water than in cold, some of the sulfate is thrown out of solution. This is a second very common cause of boiler scale.

A New Method of Removing Hardness: In recent years a unique and exceedingly efficient process of softening water for use in textile mills, private homes and wherever soft water is a necessity, has been placed upon the market. Large filters containing an artificially prepared sodium aluminum silicate are employed, and the water comes from them with absolutely zero hardness. The substance is called Permutit and the company handling it doubtless would be glad to give you a sample for experimental purposes. In using it, first prepare a sample of very hard water by adding to ordinary tap water some calcium chlorid solution. Pour it thru the Permutit filter and test with soap. The water will be found to have been entirely softened. It seems to be even softer than distilled water. What happens is this: The calcium *ions* in the hard water exchange places with the sodium *ions* in the filter, leaving the water soft. When the filter has become full of calcium ions and will no longer work, it may be regenerated by allowing a 10 per cent solution of ordinary salt to stand in it over night, followed by washing a few times with water.

TESTING TAP WATER.

To test tap water, or any other water, for hardness it is best to use a large sized test tube and measure out exactly 50 cc. of the sample. Then add soap drop by drop with shaking until a permanent suds results, counting the number of drops as you do so. Note, too, whether a cloudiness

(*Continued on page* 197)

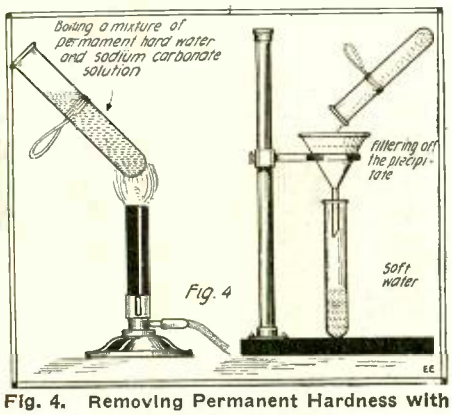


Fig. 4. Removing Permanent Hardness with Sodium Carbonat Solution.

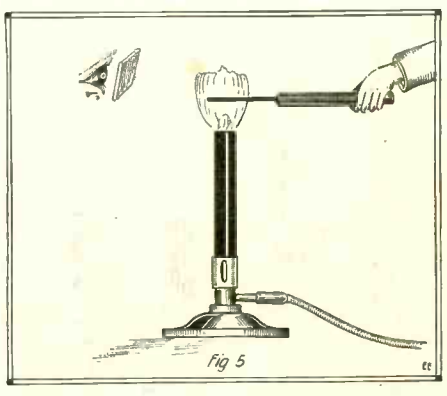
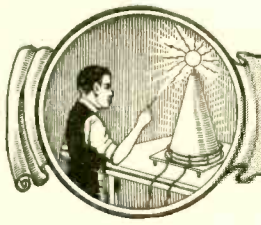
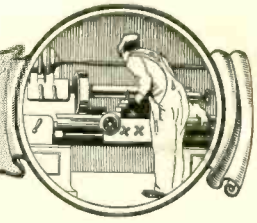


Fig. 5. Flame Test for Potassium. The Flame is Viewed Thru a Piece of Cobalt Glass. A Sodium Test is Made in a Similar Manner, But No Glass is Used.



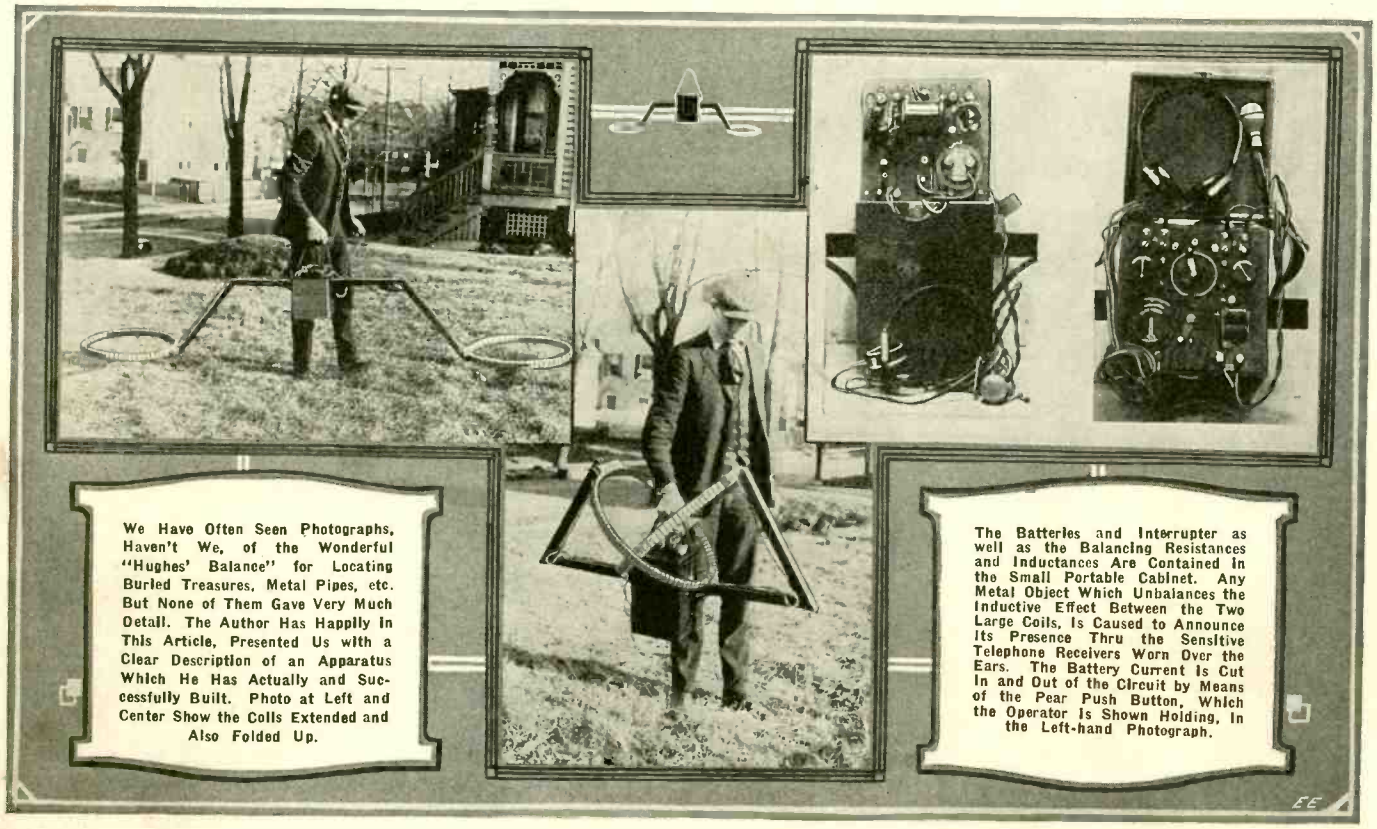
THE CONSTRUCTOR



Have You a Buried Treasure?

By VICTOR H. TODD

Consulting Electrical Engineer



We Have Often Seen Photographs, Haven't We, of the Wonderful "Hughes' Balance" for Locating Buried Treasures, Metal Pipes, etc. But None of Them Gave Very Much Detail. The Author Has Happily In This Article, Presented Us with a Clear Description of an Apparatus Which He Has Actually and Successfully Built. Photo at Left and Center Show the Coils Extended and Also Folded Up.

The Batteries and Interrupter as well as the Balancing Resistances and Inductances Are Contained in the Small Portable Cabinet. Any Metal Object Which Unbalances the Inductive Effect Between the Two Large Coils, Is Caused to Announce Its Presence Thru the Sensitive Telephone Receivers Worn Over the Ears. The Battery Current Is Cut In and Out of the Circuit by Means of the Pear Push Button, Which the Operator Is Shown Holding, In the Left-hand Photograph.

HERE is another one of those buried metal locaters which have been described in the ELECTRICAL EXPERIMENTER from time to time, this particular device however being designed to locate a buried treasure supposed to be resting peacefully somewhere in an island in Florida. Some months ago an advertisement appeared in the classified columns of the ELECTRICAL EXPERIMENTER asking for a mechanical or electrical device for locating a buried treasure. The writer answered this and the very sensitive piece of apparatus shown in the accompanying illustrations is the result.

In the past there have been many fake inventions for this purpose, but when prest for their principle of operation, their inventors would always say, "I can't tell why it works, but it does!" Unlike these, however, this instrument operates on sound, basic principles of electricity and its theory is in keeping with the latest principles of electrical engineering; nothing mysterious, magical or supernatural about it.

There are two large coils about two feet in diameter wound with copper wire and both coils are identical. These coils are connected in parallel, but each one is in series with a primary winding of a differential current transformer, the secondary of which goes to the telephone receivers. This is shown in the rear view of the instrument board. There is a buzzer which has two heavy silver contacts and these open and close the main circuit. As will be seen from the diagram of connections, there is a small rheostat for accurately balancing the ohmic resistance of the two coils, and two adjustable inductances for balancing the inductance. The main current is supplied by dry batteries located in the bottom of the instrument box. When the currents are equal in both coils, the two primary windings "buck" each other exactly and no sound is heard in the receivers; but the least unbalancing, as might be produced *by any metal coming under the influence of either coil,* will produce a sound. One winding alone will produce 1200 volts on an open circuited secondary so to balance out the sound, 1200 volts must be "bucked" against 1,200 volts until *no sound* is heard in the receivers. From this it will be realized what an infinitesimal change in the field of either coil is required to produce an audible buzzing in the receivers.

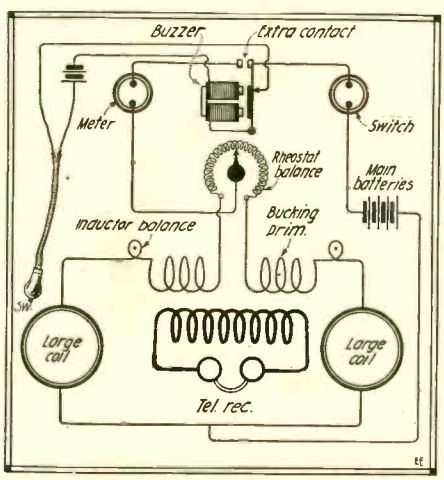


Diagram Showing the Connections of the Electric Treasure Locating Apparatus, Described By Mr. Todd. This Apparatus Was Actually Built and Proved Very Successful, Locating a One Foot Square Block of Iron, Five Feet Underground.

To locate any buried metal, the outfit is merely carried along very closely to the ground, the user listening intently for any sound which denotes the proximity of buried metal.

The apparatus is so sensitive that even a small screw driver placed in one coil will give a sound. *From actual tests, it will detect a quart of metal washers one foot underground; a 2-quart can at 1½ feet, and a block of iron about a foot square, it will locate five feet underground.*

From this it will readily be seen that Captain Kidd's dead men sitting on the chest of gold may well rattle their bones in fear, as they will no longer be safe from detection once the services of electricity are enlisted in the search.

Low Voltage Soldering Irons

By H. H. PARKER

A SOURCE of electric current of low voltage but fairly high amperage, such as supplied by a small step-down transformer or a starting or lighting storage battery may be put to good use in operating soldering "irons" of simple and rugged as well as cheap construction; other heating devices would be equally practicable but will not be discust here. So many articles have appeared describing the construction of small transformers that it seems hardly worth while to bring up the subject again; it need only be said that the building of such a piece of apparatus is not at all difficult and when completed it may be put to a wide variety of work. For soldering, one of about 200 or 300 watts capacity would be plenty large enough; for a resistance heater unit 10 volts is enough and for an arc heater about forty. As the resistance types are the most easily managed they will be described more fully, though the arc type is interesting to experiment with or to use where a large amount of heat is required.

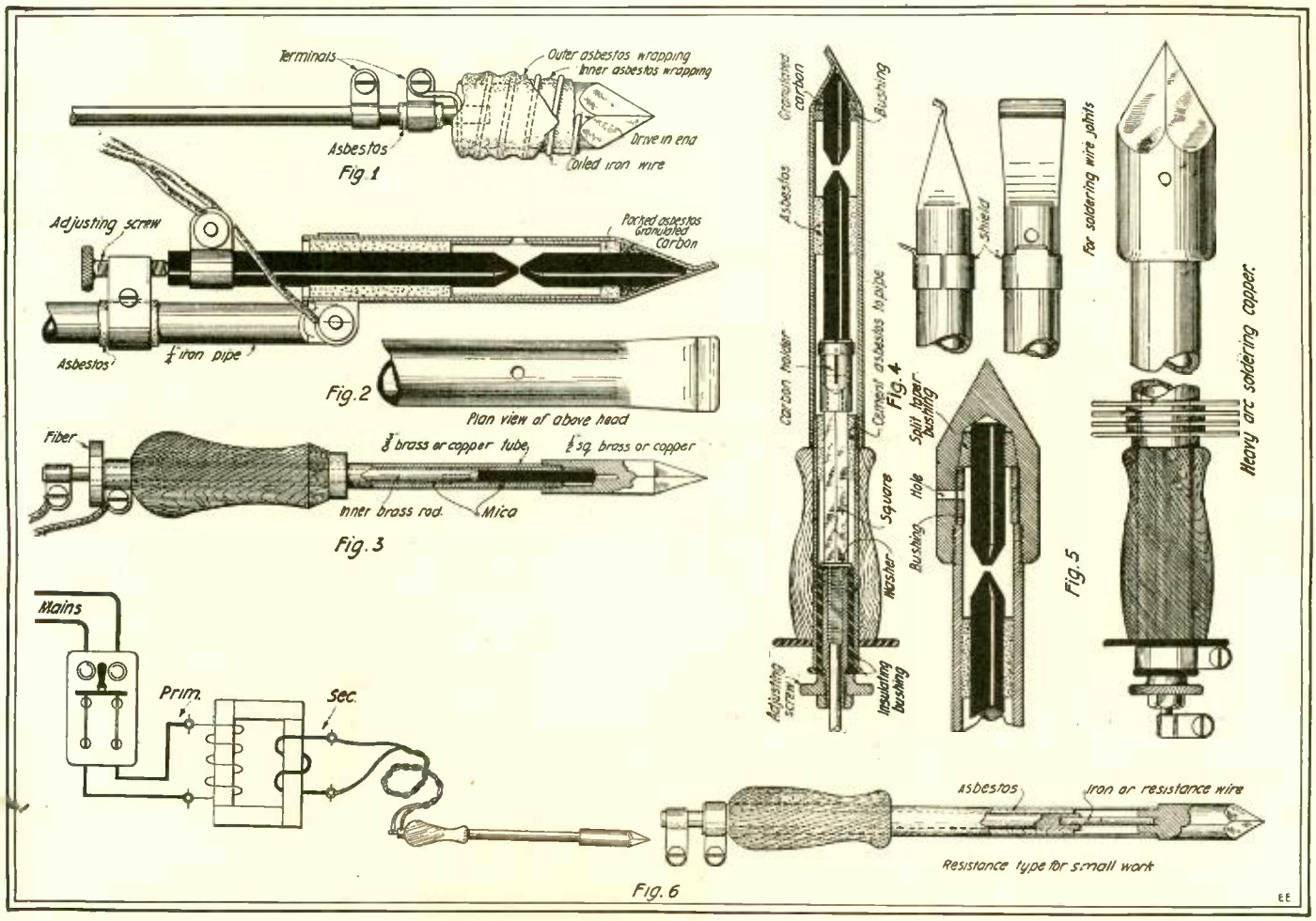
The simplest contrivance is to adapt a regular soldering copper as shown in Fig. 1. Take about sixteen inches of iron telephone wire, No. 12 gage, drill a hole near the point end of the body of the copper and drive in the end of the wire. Then cement a layer of sheet asbestos around the body and wind the wire over this, securing the other end in a brass clip bolted to the shaft of the tool but insulated from it with an asbestos sheet. A similar clip in contact with the shank forms the other terminal. Use heavy flexible cord, preferably asbestos wrapt, to connect the copper to the source of supply. The wire will quickly become red hot and heat the copper; one an inch in diameter and about three inches long will heat enough to run solder at the point in three minutes, using an E.M.F. of ten volts and about twenty amperes. A layer of asbestos around the outside of the coil will conserve the heat and a brass tube slipt over the whole will protect it from mechanical injury.

Fig. 2 shows an experimental appliance built up from brass pipe or tube hammered out to a chisel point; this is good for practical use as well, and is very easily made. A short half inch carbon electrode is bevelled off and driven into the point, inside the tube; it is then packed with granulated carbon and asbestos to hold it in place. A longer carbon electrode fits into the open end of the tube and is insulated from it with a wrapping of asbestos. One brass clip secures the tube to its handle, a piece of one-quarter-inch pipe in the illustration, and also acts as a terminal. The other terminal is a clip around the outer end of the long carbon. A third clip, insulated from the handle by asbestos, holds an adjusting screw. A small peep hole drilled thru the side of the tube is necessary to observe what is going on inside.

This device may be used either as an arc heater, or with the electrodes prest together, as a resistance unit. A small arc at 30 to 40 volts requires but little regulation and the carbons burn slowly; the proximity of the arc to the point of the copper causes it to heat quickly; 45 seconds, on the average, will run solder. At 10 volts, with the electrodes prest together, the ends at the point of contact quickly become red hot and the copper heats sufficiently in less than a minute.

In Fig. 3 is shown a small soldering "copper" intended for light and delicate work, the point being half-inch square brass. This also is of simple construction; a three-eighths brass or copper tube screws into the body and a quarter inch brass rod slips into this, being frictionally held with asbestos wrapping. One form of heating unit could be an inch or two of iron wire, but a carbon unit about five-sixteenths inch in diameter, made by filing or grinding down a flashlight cell carbon, gives as much heat and uses less current. The carbon rod should be from 1¾ to 2 inches long and wrapt in thin asbestos, or preferably mica, to insulate it from the tube. Ten volts and 15 to 20 amperes will cause the carbon to become red hot, and the point will run solder in two minutes from cold. A medium sized pencil lead of about the same length grows white hot immediately and heats the point in less than one minute, but such a resistor is fragile and easily broken. It would, however, be suitable for an extremely small soldering point. A slight dif-

(*Continued on page* 235)



Several Practical and New Ideas Are Here Illustrated in the Realm of "Soldering Irons." Low Voltage Irons of the Arc and Resistance Type Are Described by the Author, as Will Be seen from the Illustrations. Electric Irons Are Gradually Superseding the Gas-Heated Types, In Both Experimental and Commercial Repair Shops.

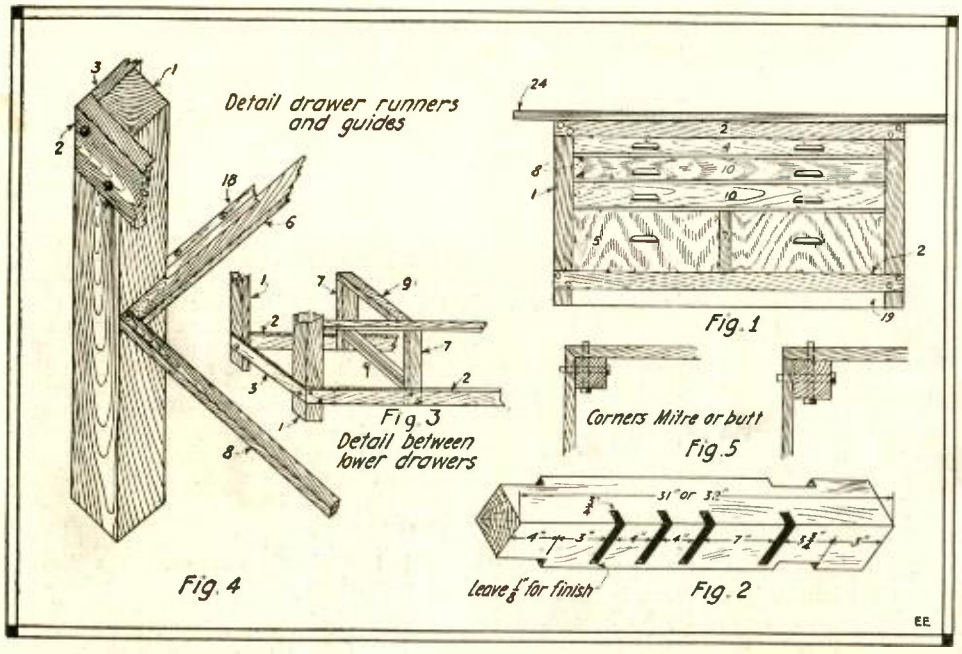
An Experimenter's Work Bench

By C. R. MULLIN

HERE is a work bench that is large and yet does not take up much space. The tool drawers, instead of being deep and small, are large shallow trays that keep the tools where they belong, rather than piled a foot deep. At first inspection, it may look rather wide and not very long, but after working on one, you will like it much better than a long narrow bench.

The writer has used one this same size, under a large switch board and found no difficulty in reaching the switches. It gives plenty of room in back to place material or apparatus on, and still leaves space enough in front to work on. The materials needed are as follows:

No. of Pieces	Width	Thickness	Length	Name	No.
4	4"	4"	31"	Legs	1
4	4	2	48	Side Rails	2
4	4	2	30	End Rails	3
1	3	1	40	Drawer Fronts	4
2	7	1	19	Drawer Fronts	5
2	4	1	40	Drawer Fronts	10
2	4	1	40	Drawer Backs	11
2	7	1	19	Drawer Backs	12
1	3	1	40	Drawer Backs	13
4	7	1	26	Drawer Sides	14
4	4	1	26	Drawer Sides	15
2	3	1	26	Drawer Sides	16
2	3	1	22	Fillers between end legs on floor	17
2	3	1	32	Fillers between side legs on floor	19
10	2	1	30	Drawer Runners	6
2	3	1	30	Drawer Runners	9
8	1	1	22	Drawer Guides	18
1	1	2	22	Drawer Guides	19
3	2	1	44	Fillers between drawers	8
2	4	2	10	Fillers between small drawers	7
3	12"	2"	5'	Top	24
2	22x20"			Laminated Wood end Panels	
1	42x20"			Laminated Wood Back Panels	
9	5/16"			Lag Bolts 2½" long for top	
4	5/16"			Lag Bolts 3" long for top to frame	
16	5/16"			Carriage Bolts, length according to construction, but about 6" long is about right.	
8				Drawer Handles	
4				Pieces of ¼" Laminated Wood, 42"x 26" for drawer bottoms.	



Full Details are Here Given for Constructing a Substantial Experimental Work Bench, Fitted with Drawers and Two Lower Compartments for Holding Small Tools, Drills, etc.

The above dimensions are approximate, that is ¼ to ½" waste, except rails and legs. 1" lumber means ¾" or ⅞" stock. All tool drawers and small drawers are full size of bench. Bolts are used, as they are cheaper and preferable to lag bolts.

CONSTRUCTION—The legs are cut for lap joints for rails and the notches are cut nearly thru, except for about one-eighth of an inch for finish. These notches take the guide rails and filler strips as per Fig. 4 (6 and 8 of Fig).

The top is cleated together with three 2" x 4" pieces, lagged on from under side, one lag bolt to a piece. The two end cleats should fit snugly between end rails, then lag bolts are placed thru rails into cleats.

When bench is finished it should be given two coats of hot linseed oil.

NOTE: Care should be used in heating this; set vessel containing oil into pan over water and keep bottom of oil container off pan by using a small block. It is better to heat out-of-doors, for a very hot flame is produced from burning linseed oil. Two coats well soaked in makes a good finish, and the surplus should be well rubbed off.

Before bench is used a heavy angle iron, the length of the bench, should be set in flush with top to protect edge.

A "Tomato" Can Ruby Light

It sometimes happens that one suddenly finds himself without that all-necessary dark room article—a ruby light. The usual way out of such a predicament is to wait until one may be purchased, or, if fortune smiles, to borrow one from your neighbor.

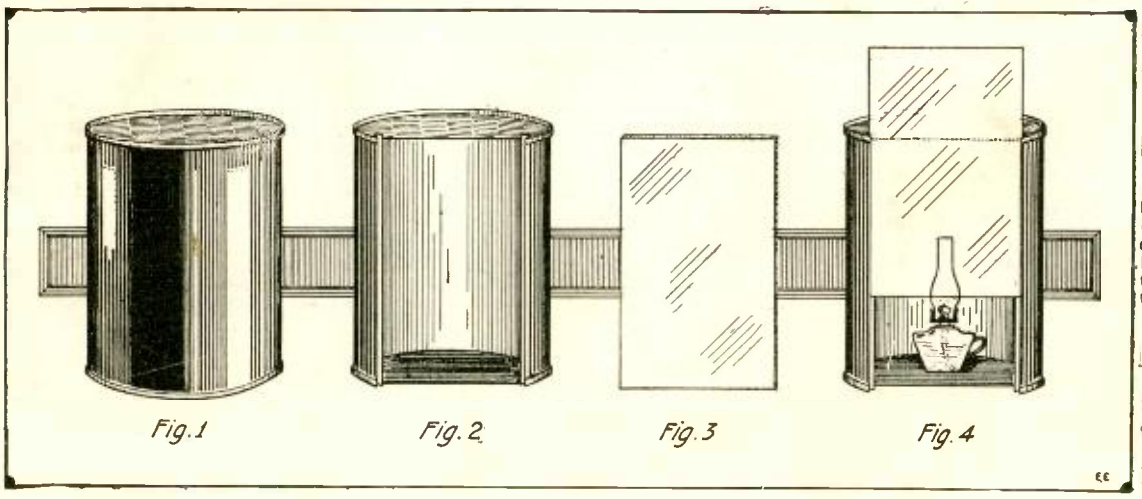
But recently I found that no nearby friend or relative possest such a thing, and being in dire need of a dark room light at once, I set about to meet the situation.

Securing an old tomato can, I melted off the rough open edge, and then cutting an opening in one side, the entire length, I bent the vertical edges to form a groove, after cutting away a small arc of the top, as shown in Fig. 2. I took care to see that this opening was just wide enough to accommodate a four by five plate, and when fitted, it slid snugly in the grooves at either side of the opening.

The glass, Fig. 3, was cleaned with alcohol, or hot water. In this instance I used a length of the red paper which comes in film rolls, and after wetting it, prest it against the surface of the glass. It adhered nicely.

All that was then left to do was to procure a small lamp (one out of my small brother's magic lantern) and "go to it."

I later found that a solution of the red transparent water color, or even red ink, if several coats are applied, will work nicely for the ruby glass.



Here's How to Make a First Class Photographic Ruby Lamp Out of a Discarded Tomato Can. The Best Ruby Lamps Contain Two Glasses—One Orange and the Other Red.

Long ago I purchased a real light, but this one works so well that I have bought a ruby glass to fit it, and often use it in place of the other one.

Contributed by DALE R. VAN HORN.

Radium—The Bad Boy of Science

By HAROLD F. RICHARDS, M. A.

1. AN ALPHA PARTICLE SIGNS ITS NAME.

WHEN Henri Becquerel drew the curtain from a hitherto unknown corner of Nature, and forced the world to admit that the Atoms of Radium are constantly exploding, he caused science more trouble than all the Huckleberry Finn's had made for the psychologists in a dozen decades. Up to that time the scientists had needed to deal only with self-respecting Molecules and Atoms, but now they found that a thimbleful of radium was shooting out high-velocity projectiles of *sub-atomic matter* in such numbers, that if each one were a dollar, a few seconds would suffice to pay the national debts of all the governments of the world! It was quite evident that an atom couldn't explode unless it were composed of parts, so it became necessary to take account of the *parts* of an atom, and that is where the whole trouble started. That was the beginning of the *Electron theory,* and everyone who has followed the course of science during the last twenty years, knows that it has been necessary to reconstruct *almost completely* the theories of electricity, magnetism, heat, light and radiation. Even the foundations of classical mechanics have been swayed and remolded under the pressure of this flood of new ideas. But just as a giant may not realize the extent of his own strength until somebody kicks him on the shins, just so science needed the urge of these baffling new phenomena, and the amazing *practical* developments of wireless, radio-telephony, radioactivity, electrical amplification and X-rays stand as an immortal monument to what science can do *when it is troubled with a new idea.* Multitudes of excessively ingenious and delicate experiments in the research laboratory make possible these practical advances, and it is one of the most beautiful of these experiments that I wish to describe now. A *single alpha particle* shot from radium—a piece of matter *so small that one thousand billion particles like it would have to be collected at one spot in order to make a speck visible to the eye*—this lone *alpha particle* is made to

Two Unusual Experiments

record its arrival with *pen and ink on paper.*

HOW THE AUDION IS USED.

Mr. H. Winfield Secor has given, in the February issue of the ELECTRICAL EXPERIMENTER, a comprehensive account of the possibilities of that versatile instrument, the Amplifying Audion. Recently Kovarik has put the Audion to a new use, and by this means was able to effect the *automatic registration of a single alpha particle.* The apparatus employed in this experiment is fully diagrammed in Figure 1. The alpha particles from the radium enter the brass *ionization vessel* thru a small opening. The brass chamber is kept charged to 2,000 volts by a battery of storage cells, and the insulated metal *needle* supported centrally inside the vessel is charged to 80 volts. Thus there is a strong *electric field* inside the vessel, and when the *alpha rays* break up the molecules of air into *positive* and *negative* ions, the positive ions are driven to the needle, and add their charge to it. The electric force on the ions is so strong, due to the high voltage used, that they move fast enough to produce many other ions by *collision* with molecules of air that have not been directly affected by the rays. Thus the electric effect due to a single alpha particle is enormously magnified. This is the first *amplification.* The needle that receives the charge from the ions is connected thru an insulated battery to the grid of an *audion amplifier.* The voltages on the grid and the plate of the audion are adjusted so that no appreciable current flows between them, when no alpha particles enter the ionization chamber. However, as soon as the voltage of the needle is raised by the ions, an *amplified* current flows in the plate-grid circuit, and this current passes to earth thru a sensitive electro-magnetic relay, as shown in the illustration. This closes the circuit in the magnet of the recording device, and the pen attached to the armature makes a distinct nick in the ink-trace which it is producing on the revolving drum. It is very important to ensure that the electrical charge carried by the ions is not allowed to build up continuously on the needle, for, in that case, there would be a steady current flowing thru the audion, and the recording pen would be unable to oscillate so as to produce a separate nick for each alpha particle that enters the ionization chamber. For this purpose the needle is shunted to ground thru a *high resistance* of one million ohms. A stroke of india ink on paper makes a convenient resistance. This resistance is so high that the charge communicated to the needle by the ions due to a single alpha particle *does not leak off to earth immediately,* but remains long enough to actuate the relay and thus produce a "kick" of the pen. It then leaks to ground, and the pen is ready to receive the impulse of the next alpha particle. By this means many hundreds of alpha rays may be *automatically* recorded in one minute, whereas in the method of counting the particles by the sparks which they produce on zinc-sulfide, only about fifty can be recorded per minute, and this registration is not automatic, but very laborious and trying.

It is interesting to trace the amplifications to which the current due to a single alpha ray is subjected. The first augmentation occurs in the ionization vessel itself, where the ions directly due to the particle produce many others by their collisions with air molecules. This increase of energy takes place at the expense of the electric field between the needle and the walls of the vessels. The second amplification is produced by the Audion, and the third by the *sensitive relay,* which brings into action the energy of the batteries connected to the recording device.

Thus the alpha particle acts merely as a *trigger* to set off the whole train of actions, just as the electric spark causes a mixture of hydrogen and oxygen to explode. There seems to be no limit to the magnitude of the actions which an alpha particle could be made to start. The electro-magnet that operates the writing pen might just as well be used as a relay to operate the *elevator* in

(*Continued on page* 199)

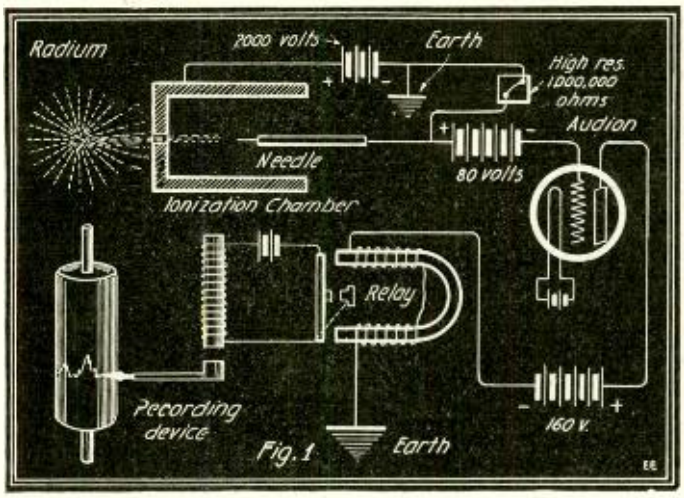


Fig. 1. Automatic Registration of Individual Alpha Particles Shot from Radium. The Audion Amplfies the Ionization Current, and Each Alpha Ray Records Its Arrival with Pen and Ink On Paper.

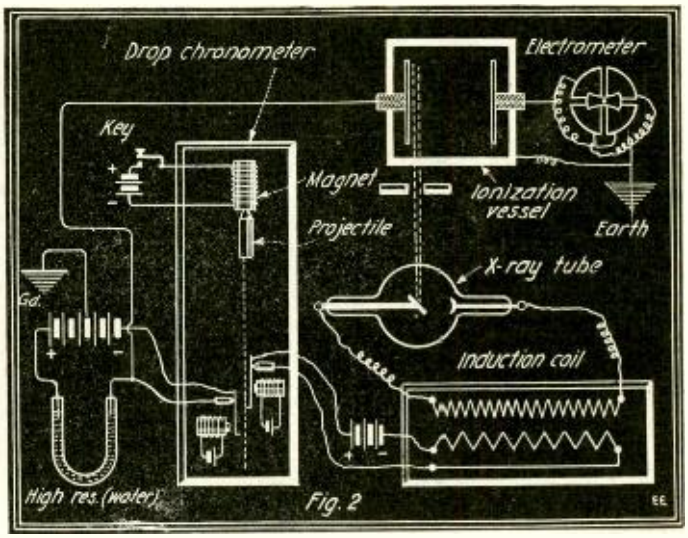


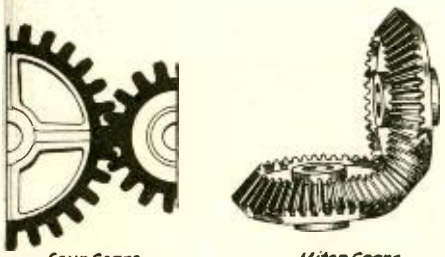
Fig. 2. A "Speedometer" for the Ions Produced in Gases By X-rays. The Apparatus Starts and Stops the Experiment in the Space of Seven-Thousandths of a Second, and Tells How Fast the Ions Traveled In the Meantime.

The Electrical Machinist

By H. WINFIELD SECOR

No. 8—GEARING AND VARIABLE SPEED CONTROL.

THE machinist who does much electrical work will sooner or later find that he has to be familiar to quite a fine degree with the various mechanical and also electrical features of speed control. The majority of electrical machine and millwright work today is connected with motor installations, and practically all large factories are electrically motor-driven at the present time.



Typical Spur and Miter Gear Drives. With Gear Drives There Is No Slippage, the Two Shafts Being Locked Together or Synchronized, Owing to the Interlocking Teeth. The Speeds Are Proportional to the Number of Teeth On Each Gear.

In the present article we shall consider some of the features involved in various types of gear, friction and belt transmission, which we started to discuss in the last paper.

VARIOUS TYPES OF GEARING.

Different forms of gear drive are illustrated at Figs. 1-A to 1-D. The commonest form of gear drive between two shafts utilizes what are known as "spur" gears, shown at Fig. 1-A.

To design or determine correctly the proper width of spur gears to transmit any given amount of horse-power, reference should be made to machine design manuals wherein the usual rules are there given. Some of these books contain tables showing the various widths of gears to transmit definite amounts of horse-power at any given speed. The higher the speed of a gear, pulley or belt, the more horse-power can be transmitted, other things being equal, and the slower the speed of these moving parts, the less the horse-power that can be transmitted.

One of the most important things to know about gears in any case, is, of course, the relative speeds of two or more gear wheels meshing together. We have seen in article No. 7 in the May number how the relative speeds of two belt pulleys are calculated. For tooth gearing such as we have here, the relative speeds of two gears, for example, vary directly as the number of teeth in each gear.

Thus, suppose we have a large gear or driver with 100 teeth meshing with a small gear or pinion having but 10 teeth. The speed of the driven or smaller gear is then found by dividing the number of teeth in the larger, by 10 or the number of teeth on the small wheel, and in this case the multiplying factor for the speed ratio is $100 \div 10$ or 10. Thus for every revolution of the large gear we see that the small wheel will make 10 revolutions; or the speed in R.P.M. of the large wheel multiplied by the factor 10 gives the speed in R.P.M. of the smaller gear. Also, if we wish to find the speed of the large gear, when the number of teeth and R.P.M. of the small wheel are known, then we divide the R.P.M. of the small gear by the tooth ratio factor—in this case 10, which gives the relative speed of the larger gear wheel, which in this example is one-tenth the speed of the smaller wheel.

Gears for use on electric motor drives are frequently made of cast-iron and sometimes of steel, but where too much noise is occasioned by such a drive considerable vibration and noise are markedly reduced by putting a rawhide or fiber pinion on the motor. The rawhide gears are usually made with brass flanges on either side, between which the hide discs are tightly riveted.

In making such gears, the brass and rawhide discs are firmly riveted or bolted together, and form a blank drum or cylinder, and this blank is then placed in the milling or gear cutting machine and the teeth milled out.

In emergency, it has often happened that gears have been cut out or rather milled out in the lathe, fastening the gear blank rigidly to the carriage, and with a little care the teeth can be milled out by placing a regular gear cutter on a mandrel mounted between the lathe centers and driven with a dog in the usual way. The spacing of the teeth should, of course, be accurately marked out on the edge of the gear blank before starting to cut the teeth.

At Fig. 1-B a *miter gear* is shown. This is familiar to practically everyone and serves the purpose of accurately driving or inter-connecting two shafts which happen to be placed at right angles. Miter gears may each have the same number of teeth or each may have a different number of teeth. If the number of teeth on each gear is the same, then the speed of both shafts will be alike. If otherwise, then the speed of the shafts will be related according to the ratio between the respective number of teeth on each, as previously explained for the speed of spur gears.

Miter gears are often improperly called *bevel* gears. A miter gear can always be told by placing a steel square or miter on the teeth, which will form an angle of 45 degrees with the shaft on which it is mounted. Beveled gears may have the two respective shafts on which they are mounted at different angles, but in general they resemble miter gears, excepting that they may be of different angular pitch with respect to the shafts, etc.

At Fig. 1-C a *worm gear* drive is shown. The worm gear is extensively used, especially where a smooth slow motion is required. This form of drive permits the motor, for example, to run at fairly slow speed, depending upon the number of teeth upon the wheel. The speed of the worm gear drive is figured as follows:

For a single pitch worm, each revolution of the worm, which is usually mounted on the motor shaft, will cause the worm wheel to advance one tooth. Thus, if the worm gear has 100 teeth on it, one revolution of the worm on the motor shaft would cause the wheel to rotate one one-hundredth of its perifery, or one tooth.

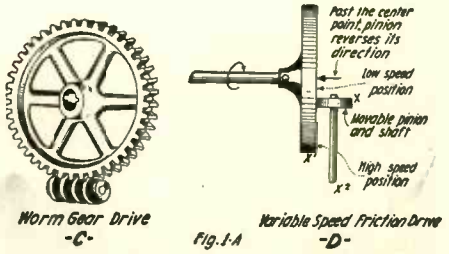
In other words, every time the worm on the motor shaft makes 100 revolutions the worm gear would make but one revolution. If the worm is made of double pitch, then for each revolution it makes the worm gear will be advanced the pitch of two teeth, and if the worm is made of triple pitch, then the gear will rotate the pitch of three teeth.

Or again, if the worm is made of quadruple pitch, that is, having a pitch equal to the pitch of four teeth on the worm gear, then the gear wheel will rotate a distance equivalent to the pitch of four teeth.

FRICTION GEARING.

Friction gearing has been adopted at various times for certain forms of drives where other gearing was not desirable.

In shop work, especially in the mechanical laboratory, friction drives have many excellent features to commend them. The writer recollects one mechanical laboratory with which he was connected, where this form of drive served its purpose perfectly.



Worm Gear and Friction Drive. The Worm Gear Advances One Tooth for Each Revolution of the Worm. The friction Drive Usually Has Leather Faced Pulleys In Contact, the Speed Varying With the Position of the Pinion.

Referring to Fig. 2, we will take a closer look at this particular friction drive, but before leaving the elemental type of pure friction drive illustrated at Fig. 1-D let us see how the speed is changed by this means. It is usually found the best practise to have the surface of the large disc X-1 covered with leather, but fiber and rubber and finished iron have also been used. The small pinion X can also be covered with leather, but is sometimes covered with fiber or rawhide, and in some cases rubber has been used for the facing.

The shaft X-2 is made movable or else the pinion has a keyway so as to permit the pinion sliding along the shaft under the action of a shifting device, a steel feather or key in the shaft, insuring a positive drive between the pinion and the shaft at all times.

As the smaller wheel is moved toward the outer perifery or increasing diameter of the large disc, the speed of the small disc and its shaft X-2 is increased proportionately. As the small disc is moved toward the center, the speed reduces, and if it is moved past the center then its direction of rotation is *reversed*.

This form of drive was tried a few years ago in the Winton touring car, and has been very extensively used in several small light weight cars, including the Metz runabout and the Metz touring car, at the present time. In any case, ordinary care and inspection should be made of such friction drives to see that the surfaces have not become unduly cut or worn, or low spots develop, which would cause an unevenness in the driving speed.

The small friction wheel is in some cases mounted so close to the large disc X-1 that it will be held sufficiently tight against it, to drive properly; in other cases, the shaft carrying the small pinion is held against the large disc by springs or other means.

(To be Continued)

HOW-TO-MAKE-IT

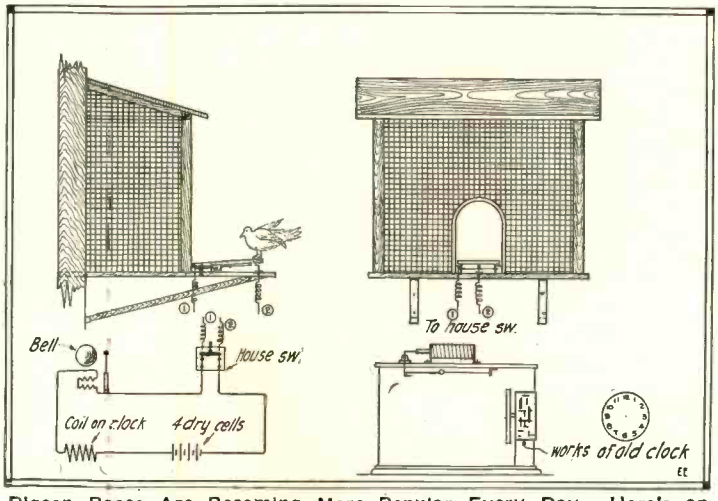
This department will award the following monthly prizes: First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00.
The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea 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.

FIRST PRIZE, $3.00

ELECTRIC PIGEON RACE RECORDER.

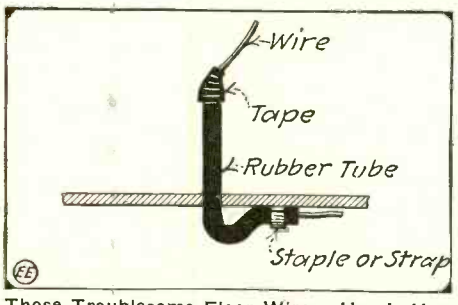
I have used this device for some time, and it has given very satisfactory results. When the pigeon comes in, the time is marked on the clock-face, thus avoiding the trouble of watching the pigeon loft all day. The sketch herewith illustrates how the device works. Pigeon flying on platform No. 1, goes thru the hole, and his weight presses down spring, which is made from 1/32 x 1/2 brass, and closes circuit, causing marker coil (A) to release marker, and mark correct time on face of clock, which is made of card-board. It also rings single stroke bell at the same time, telling you how many pigeons pass thru the hole.

Contributed by M. C. KUHN.



Pigeon Races Are Becoming More Popular Every Day. Here's an Electric Pigeon Race Recorder Which Will Help to Keep Track of the "Homers."

WATERPROOF FLOOR LEAD FOR ANNUNCIATOR WIRES.



Those Troublesome Floor Wires—Here's How to Effectually Insulate Them, So That Even Water Won't Phase 'Em.

To overcome dampness slip an eight or ten-inch length of soft rubber tubing over the wires and fasten as shown in the illustration. The tube effectively protects the wires from water and abrasion, any water getting down alongside the tube dripping off the loop.

Contributed by THOS. W. BENSON.

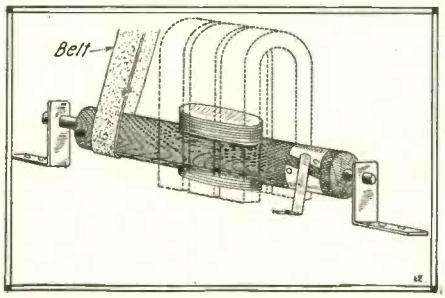
SECOND PRIZE, $2.00

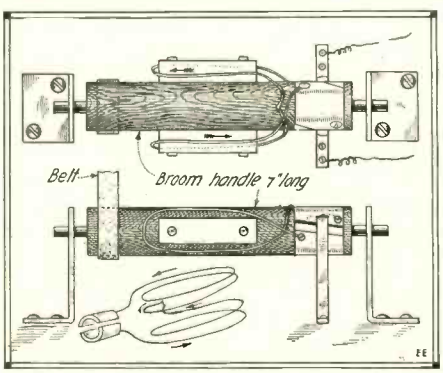
A SIMPLE SHOCKING DYNAMO.

This simple shocking dynamo is easy to construct and costs almost nothing, except the wire and some sheet copper. The armature is made by driving a ten-penny nail in each end of a broom handle 7" long. On this is nailed two tin boxes on opposite sides, each 3" x ½" x ½", filling them with small iron wire about ½" long, or iron filings (see illustration). Next cut two strips of copper 1" wide, long enough to reach around the wood and leave two spaces ⅛" wide where the strips meet. Cut the strips as shown in figure, so the timing can be varied by moving the brushes sidewise. Tack these strips on and wind on the tin boxes about ¼ lb. of No. 22 insulated magnet wire, connect and wind the wire as shown in the top view of the dynamo.

Fasten three or four U-shaped steel magnets over the tin box part of the armature.

Contributed by ARMAND MOTSINGER.





A Shocking Dynamo with a Wooden Armature.

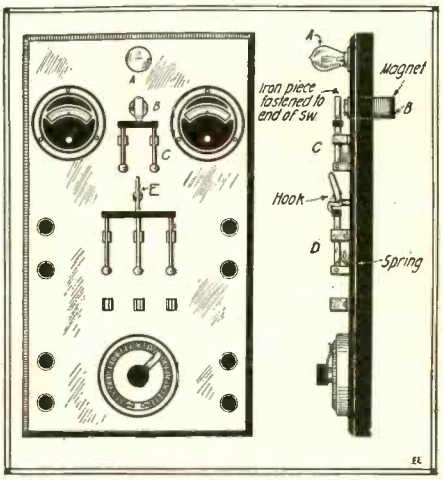
THIRD PRIZE, $1.00

AUTOMATIC TRIP FOR BATTERY SWITCHBOARD.

I have an automatic brake on my engine that runs the battery charging dynamo. The lamp A, is directly in series with the dynamo thru the electro-magnet B. When the brake shuts off the spark for the engine and the current dies down, the magnet is no longer strong enough to hold the switch C. which has a spring tending to disconnect it.

The switch B is for the battery charging circuit and when it falls, tripping switch D the battery supplies the current thru the lower part of D.

Contributed by HENRY KLAUS.

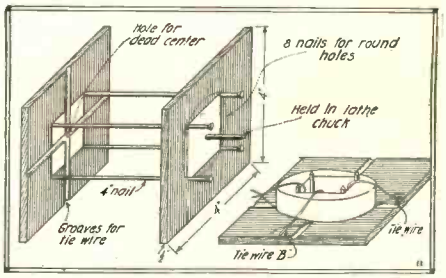


A Clever Wrinkle for Battery Charging Switchboards. The Magnet Trips the Switch When the Engine Stops, Closing the Battery on the Lamp Circuit.

UNIVERSAL WINDING JIG.

In making this jig drill the holes for the nails about 10% undersize, and the form will be securely held at all positions, consequently giving any width. By drilling other holes, different sizes and shapes can be wound on the same jig. No taper is necessary; just draw out the nails. The big advantage with this jig is that, coils can be wound without waxing. Put on the tie wire (A), remove the side, put on ties (B) and pull out nails. Now the coil can be taped, removing the tie wires of course.

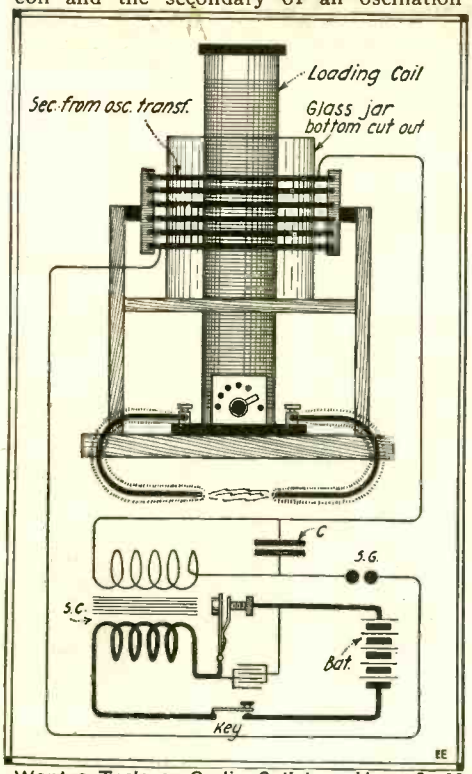
Contributed by H. V. PFEIFFER.



A Universal Winding Jig of This Type Will Greatly Facilitate Coil Building.

HOW TO MAKE A "SIMPLE" TESLA COIL.

This "emergency" Tesla coil, as will be noted from the accompanying diagram, is composed of the "stand up" type loading coil and the secondary of an oscillation



Want a Tesla or Oudin Coil in a Hurry? If You Have a Discarded Loading Coil Available, the Solution of Your Problem is Easy, as Shown Above.

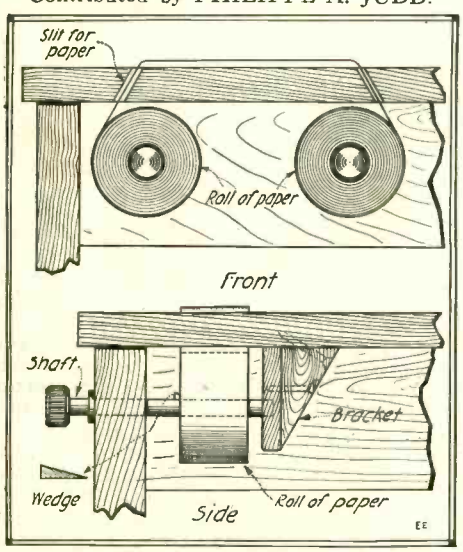
transformer, both of which are found to be included in a great many "dead" radio sets, altho there are *some* sets which lack an oscillation transformer. As to the glass jar, this may, of course, be substituted by hard rubber, a shellacked paper tube, or if the outer coil is very large, there need be no dielectric placed between the coils.

Contributed by ALFRED B. O'HARA.

TABLE MEMO PAD FOR LABORATORY.

While making experiments and doing research work liquids are sometimes spilled on the formula or memorandum. I have found the device shown in illustration very satisfactory. It cannot be misplaced and may be referred to at any time. The drawing is self-explanatory. The paper is the same as that used on cash registers.

Contributed by PHILIPPÉ A. JUDD.



An Ideal "Memo Pad" for the Laboratory Table. Turn the Knob and a New Writing Surface is Instantly Presented.

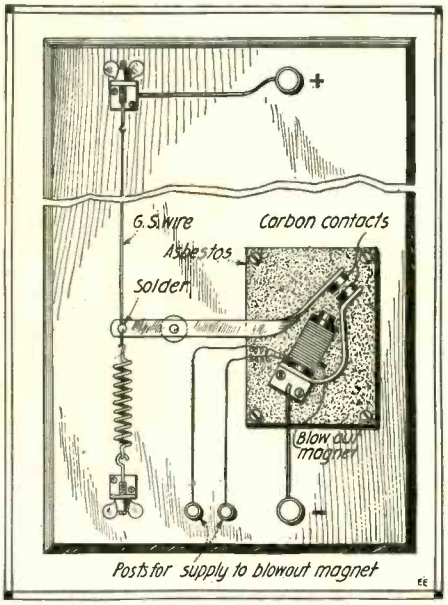
AN INTERMITTENT CIRCUIT CLOSER.

During some recent tests, it was necessary to start a small motor, run it a few seconds and stop it again, for a period of some hours. The following device was rigged up and performed this operation very successfully.

The size of the German silver wire employed depends naturally upon the load to be carried, tho it is quite safe to use a number 20 wire for the average laboratory work. The contact lever is made from strip brass bent as shown, and has a small carbon disk screwed to its extremity. The lever should have about a ten-to-one ratio and the wire should be at least three feet long in order to properly magnify the expansion and contraction. The stationary contact arm is made of sheet brass, carries a carbon contact, and is so bent that it serves at the same time as a support for the *blowout magnet.* This electro-magnet may be operated either from line voltage or from a six-volt battery. In the latter case it should be wound with 400 turns of number 24 S.C.C. magnet wire, using asbestos paper between layers. The spring was of the variety used to suspend canary bird cages.

The period of opening and closing can be regulated within wide limits by adjusting the thumb screws and, if necessary, the blowout magnet voltage.

Contributed by ERNEST ZADIG.



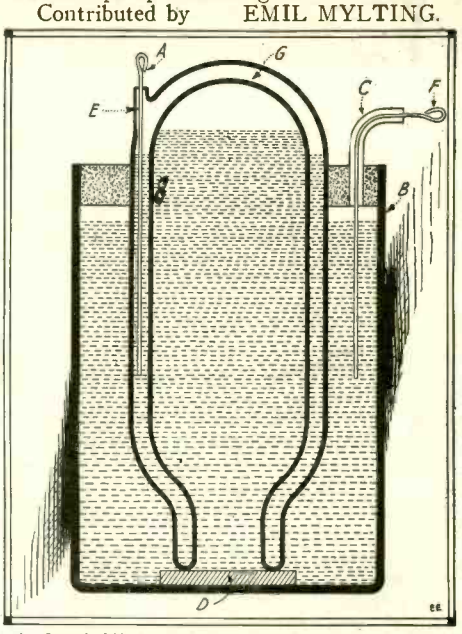
This Intermittent "Circuit Closer" Depends for Its Action Upon the Contraction and Expansion of a Piece of Resistance Wire Thru Which Current is Past. It is Fitted With a Blow-Out Magnet at the Contacts to Reduce Arcing.

A "THERMOS BOTTLE" H. T. CONDENSER.

Procure a vacuum bottle, remove the metal shell and break the tip A off, holding it below the surface of a salt-water solution, thus causing the vacuum G to fill with the afore-mentioned solution. A piece of thick felt D is placed on the bottom of a glass jar, slightly lower than the vacuum bottle and about one inch larger in diameter. Now fill both glass jar and vacuum bottle with salt water, and plunge the vacuum bottle upside down into the glass jar. Remove such a quantity of salt water from the jar so that the level will reach within one-half inch of the top. Place the tube C in the position as indicated in the drawing before filling the space B with a sealing compound. Shake some water out of the jar (after the compound has cooled), leaving an air space between the bottom of the sealing compound and the surface of the salt water. The two copper wires E and F, passing down into their respective solutions, are the terminals.

If any "radio-bug" should have a yearning desire for a variable high-tension condenser, he should be able to fix up some sort of pumping device to draw the water out and pump it back again.

Contributed by EMIL MYLTING.



A Good High Tension Condenser for Spark Coils, Tesla and Radio Outfits, Can Be Made From a Discarded Vacuum Bottle in the Manner Here Illustrated.

PHONOGRAPH BATTERY LIGHT.

The present device consists of a block of wood about 4" long, 1½" wide, a small push-button, a flash-light globe and a small socket to fit it. The latter is mounted on the block of wood as shown in the accompanying sketch. The battery and wires are concealed inside of the phonograph cabinet and in no way interfere with the mechanism of the machine.

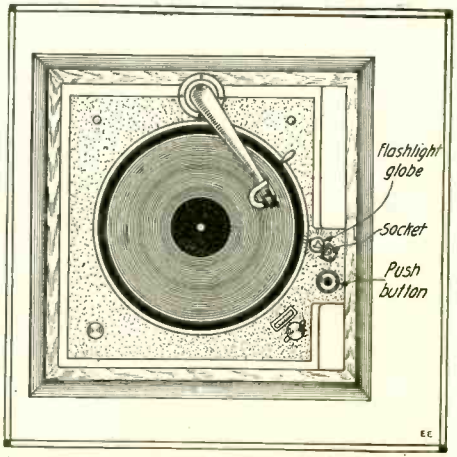
The object of this device is to cast a ray of light directly on the reproducer, thereby enabling the operator to place the point at the beginning of the record being played, also prevent scratching.

The push-button was given preference over the switch for the reason that the operator would quite likely forget to turn it off, close the lid of the machine, and thereby allow the light to burn uselessly. It is just as simple to start the machine and press the button as turning the switch on and off.

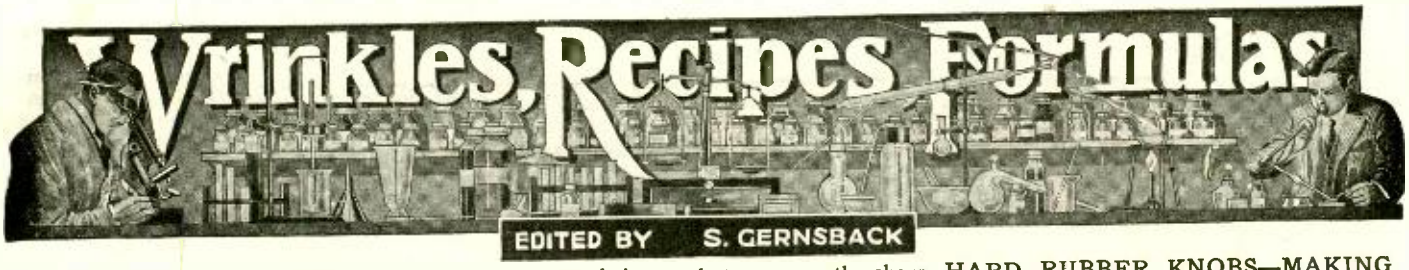
The block of wood lies inside the cabinet, and it is not necessary to put a nail or screw into the cabinet, as the light and button are mounted on the block of wood.

The device can be used on other machines in different ways by "doping it out" to suit.

Contributed by EDWIN KAMUF.



"Another" Electric Light for the Phonograph! This One is Very Neat in Appearance and It Does Not Mar the Talking Machine.



UTILIZING OLD "JUNK"—AND SAVING MONEY.

From personal experience, I can say that the things that eat up the small change in the average electrical-chemical Bug's pocketbook and which prevents him from buying sorely needed apparatus is supplying himself with test bulbs, flasks, fuses, etc. This is where the old burnt out Mazda globes "come back"; likewise old worn-out dry cells, ad lib, ad infinitum.

Presuming that you have on hand a blown-out Mazda bulb—any size—take a file and file the glass where it joins the base, then gently break it off. File the support which holds the filament, also, just below where it flattens out. And there you are. The detached globe is your flask, the filament support, after detaching all wires, makes a small stirring rod, and as for the base, break off the glass, separate the wires, and loop a small piece of tinfoil over them, and you have a fuse. Simple, what? (And, by the way, when you blow out a fuse, don't buy another one; just bend a piece of tinfoil over the outside, so that it touches both contacts, and it is as good as new!)

The long, "skinny" kind of globes that telephone companies use, make quite respectable test tubes, and as for the little battery lamps, just shove them under water, break off the point with a pair of pinchers, and the water will rush in and, presto—a magnifying glass!

And those old dry cells—how they break our hearts. Well, split them open carefully, take out the carbon, and use it in your arc lamp, or make a balanced microphone. Save the binding posts, too. Run the dirty, black stuff in the middle of the battery thru water and wash several times, and you have some manganese dioxid (or peroxid, either) with which to make some wet batteries. In a wet battery you can also use the carbon and zinc. Or if you don't want a wet battery, melt the zinc and run it into rods, or cut it up and use it for making hydrogen. And the manganese dioxid can be used for making chlorin, too.

One more—I almost forgot—use the sealing wax on the top of the battery for making instrument cases, or as an insulator or any other things that it will come in handy for. That's all, fellow "muckers."

And that'll be about all for this time. That's the way to save the spare cash. When you learn to do those things, you'll get along with the efficiency manager swimmingly.

Contributed by FRED C. DAVIS.

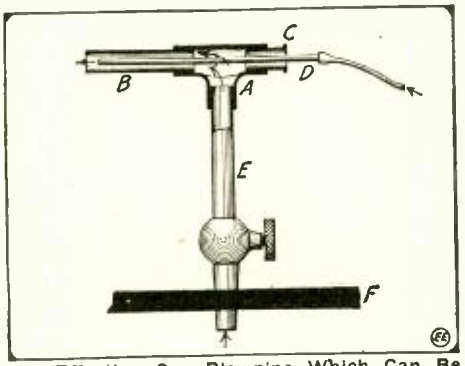
TEST PAPER.

By dissolving the coloring tablet that comes with gelatine in one-fourth ounce of water and spreading this liquid on filter paper and drying, you have a test paper that will turn purple in alkalies and back to pink in acids.

Contributed by EDWARD NEWBURRY.

A SIMPLE GAS BLOWPIPE

A ¾-inch iron T-piece has a 3-inch length of brass tube, B, tapt into one end, and a gland, C, at the other. Thru the center of this latter, and adequately held by the packing—or by a perforated cork—a length of glass tube, D, a quarter of an inch inside diameter, is past. It has been found better to leave the end of this tube that comes inside B as sharp as it is left by the process of cutting to the required length, no attempt being made to remove the sharp edge with a file or flame as is generally done in the case of a glass tube for safety.

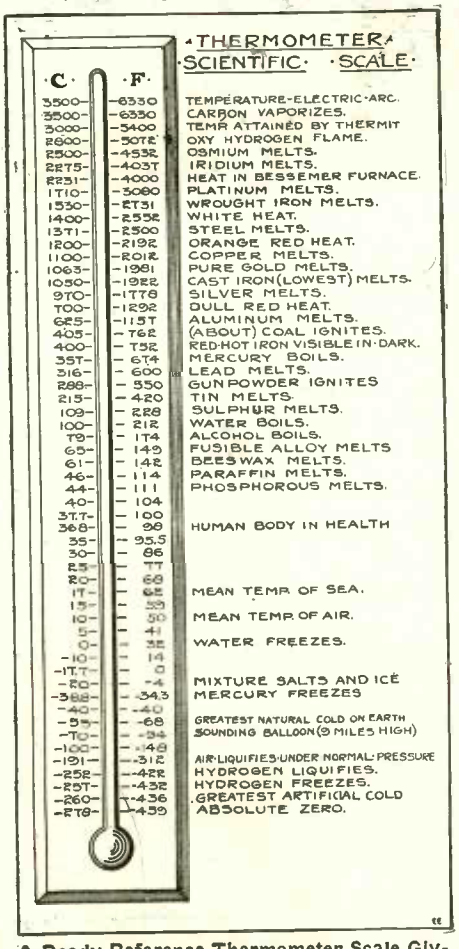


An Effective Gas Blowpipe Which Can Be Easily Made from Odds and Ends Found About the Laboratory.

The other end is smoothed and serves for connection to an aspirator or bellows supplying air by means of a length of indiarubber tube.

The blowpipe is fixt upright to the bench by means of a 6- or 8-inch iron gas tube, E, having a tap or valve at the other end. The gas enters from a tube that passes thru the bench top, F, and is regulated by means of the tap. Moving the glass tube, D, in or out as required, modifies the character of the flame.

Contributed by H. J. GRAY.



A Ready Reference Thermometer Scale Giving the Critical Points in Temperature, Above and Below Zero. Cut It Out and Paste in Your Memo Book.

HARD RUBBER KNOBS—MAKING YOUR OWN.

One day I needed some hard rubber about ½" thick, and not having any on hand I devised the following method to suit my needs. I had some old hard rubber storage battery jars on hand, so I cut them up into flat pieces with a fine saw and thoroly washed them in hot water.

I wanted to make some knobs 2" by ⅜", so I cut several squares a little larger than the desired knob, while they were hot, with shears. When they were dry I sanded each piece and gave one side of several pieces a thin coating of the rubber compound used to seal storage batteries. This may be done by heating the compound in a flame and dropping several drops on the surface of the hard rubber and spreading these with a hot case knife.

The pieces are now built up to the desired thickness by placing the first piece on a flat surface with the coated side up. Another one is put on, and so on until a little more than the desired thickness is reached. The last one should be prest firmly down on the others, but it does not require any coating of rubber compound.

Two iron or steel plates one-fourth to one-half inch thick and somewhat larger than the hard rubber pieces are heated to a temperature that will melt the compound but not hot enough to injure the hard rubber. The surfaces of the plates should be as flat and smooth as possible. One is placed on a hardwood board and the pile of hard rubber is put on next, then the other iron plate, both of them being hot. After putting on another board it is all transfered to a press or vise to put under high pressure. It should be left until cold, when upon removal some of the wax will be found on the edge of the hard rubber, but after this is scraped away the piece of rubber will have the appearance of one solid piece, so well is it cemented together under the combined pressure and heat.

My method of making knobs is to screw an inch piece of hardwood to the face-plate of my lathe and turn it down true. The rubber to be turned is secured to the face-plate by some of the rubber compound. The turning should be done carefully and the rubber may be polished with sandpaper, pumice and water, and rotten stone and oil. The center hole should be drilled before removing the knob.

Moderate sized panels may be made with the sides of large sized rubber jars that have been assigned to the junk shop heap at battery service stations. So get chummy with your local garage men, boys.

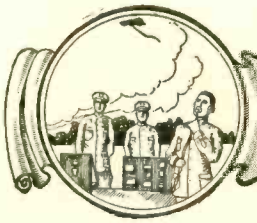
Contributed by LEA M. LAFAVE.

FREEZING A TUMBLER TO A BLOCK OF WOOD.

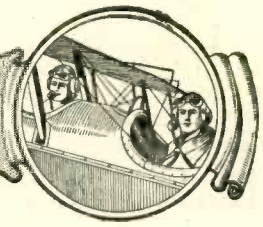
Place a little water on a smooth block of wood and on it set a tumbler. In the tumbler place a little ether. Now blow thru the ether with a glass tube. This will cause the ether to evaporate very rapidly, thereby producing a low temperature and freezing the tumbler to the wood. Pick up the tumbler and the block will cling to it.

This may also be accomplished by placing a little water in the tumbler instead of ether and then stirring into it powdered ammonium nitrat. The solution of the nitrat absorbs heat and quickly freezes the tumbler to the block.

Contributed by FLOYD L. DARROW.



RADIO DEPARTMENT



Secretary Daniels Speaks by Radio

AN announcement of the radio-telephone speech by Secretary Daniels was looked upon with great favor by the editors of the ELECTRICAL EXPERIMENTER, and immediately a reporter was sent to investigate, on the day before the pending speech, so that a good idea of the apparatus to be employed could be obtained.

Mingling with the crowds at the top of the tower in the Times Building, we inspected the instruments intended for the actual work in hand. The room itself about 25 by 30, was cris-crost by web-like antennae and lead-ins, the photograph clearly shows this. On the table are hosts of instruments which would please any "ether dabbler" if they were in his own laboratory instead of littering the tables and shelves of the radio room of the *Times*.

Variable condensers of every size and description, some of them advertised and some perhaps never heard of, were seen in the room. On the table in formidable array, a ten-step audion amplifier, resistance coupled, and right along side, a three-step amplifier with the necessary transformers were in readiness except for the insertion of a few tubes. No wonderful box of beautiful design covered them, the sockets merely being screwed to a pine board and the resistances, grid leaks and grid condensers all mounted upon the same board.

Variometers were connected into one circuit and a small "Magnavox" the lion-voiced telephone, also appeared on the table. Interest centered however, upon a very neat and compact receiving unit, commercially known as the United States Navy Standard and the regular two-step amplifier. On another table and just in the process of being made ready for a test, was the Magnavox, with its incumbent bank of six vacuum tubes for use in amplification.

It was with this Navy set and the Magnavox that the crowd which would naturally congregate on the north side of the Times Building, were expected to hear the Secretary speak as he was steaming up the Hudson River on the deck of the flag-ship, the U. S. S. "Pennsylvania."

A few steps to the door, and we were on the roof looking at the aerial, but we found this quite difficult, as there seemed to be so many of them—down the sides of the building, across to the flag-pole in three or four directions, ad infinitum.

The most admiring aspect of it all being a magnificent loop pivotally-mounted, and about 14 ft., square, the loop itself having a double coil of wire on each of its lateral sides, and truly a work of art, aside from the fact of its great value. It is from this that the Secretary's voice was heard, this being received by aid of the Navy tuners and then amplified by the Magnavox on the following day.

While there, a "pitched battle" raged between the large and small Magnavoxes—and of course the larger one had the decision, even from the start.

The greatest difficulty met with in the test was interference. Invariably signals would be superimposed upon others and tuning out rendered difficult. This was found so in the test carried out on the following day, when the Secretary's voice was actually heard. The Secretary's voice being naturally low, great difficulty was sometimes experienced in hearing it, and music by the band on board the battleship, as the Atlantic Fleet steamed thru the Narrows on its way here from winter maneuvers at Guatanamo Bay, Cuba, was very often interrupted by the incessant da-de-da radio-telegraphic signals of the regular radio stations.

The first effects were received by the radio station at the Navy plant in Rockaway and relayed directly to the Times Building over a special wire, the voice was then intensified by the "Magnavox."

During intermission between signals and voice the hum of the audions was clearly heard above the din of the street crowds and traffic.

Left: View of Loop Antenna Used to Pick Up Secretary Daniels' Wireless Telephone Speech Transmitted from the U. S. S. Pennsylvania, Flagship of the Atlantic Fleet. Center: N. Y. Times Radio Station and Small "Magnavox." Right: Secretary Daniels Talking to the Crowd in Times Square.

Radio 100 Words a Minute

With the cessation of hostilities comes an explanation of transatlantic radio communication which was perfected during the war, but could not be described on account of being a military secret. E. F. W. Alexanderson, of the General Electric Company, told an audience composed of members of the American Institute of Electrical Engineers and the Institute of Radio Engineers recently that the transmitting speed in the future will average 100 words a minute, instead of twenty words a minute.

It is now a matter of history that radio was largely used for communication between the United States and its armies in Europe and that the great war was brought to a close by negotiations conducted by radio which led to the armistice. Now we are ready for an international commerce of unprecedented scope, but lack adequate means for communication. By extending the range of wave lengths down to 10,000 and up to 20,000 meters and following the same system of intervals there would be room for about seven more stations or a total of twelve first-class transmitting stations.

He also said that the selectivity for direction of the waves will multiply by five the number of stations that may be operated on one wave length; and that the selectivity with reference to wave length will be improved so that the wave lengths of messages will be within 1 per cent. of each other, instead of 7 per cent., which is the spacing of the stations at present.

"These prospects, taken in combination, give us an optimistic picture in which the possible capacity for transoceanic radio traffic of the world is 175 times as great as it is with the practice of today," he said.

A War-Time Radio Detective*

Part II

By PIERRE H. BOUCHERON

Three More Unusual Experiences With a Radio Background

THE work of the "Radio Detective" was often augmented and sometimes seriously complicated owing to the fact that some of the cases would manage to fall into the hands of newspapers. Particularly was this true during a certain period of "radio hysteria" which prevailed in the Spring of 1918. Here are a few of the glaring headlines which greeted Mr. and Mrs. Average American in the morning papers while they blinked over their first cup of coffee:

The "Singer Building" Signaling Mystery Seemed On the Face of the Initial Evidence—Thoroly Bona Fide—But . . . and More BUTS—the Mysterious Flashes Turned Out To Be Something Entirely Unexpected.

"German Radio Plant Seized by Government Officials."

"Enemy Radio Station Unearthed."

"Secret Wireless Discovered in Old Grist Mill in Catskill Mountains."

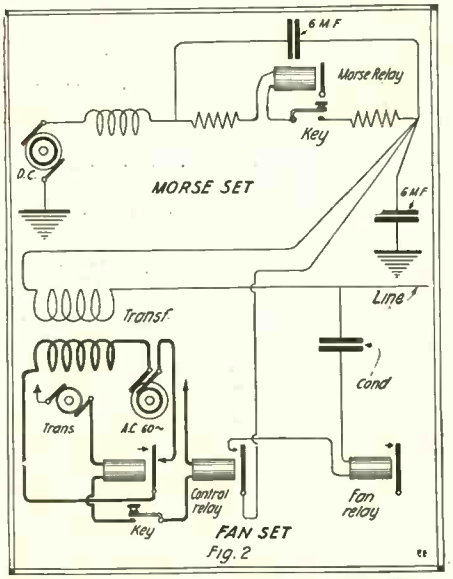
"Government Experts Scour Mountains in Search of Radio Outfits."

"Spy Wireless Located on Roof of New York Skyscraper."

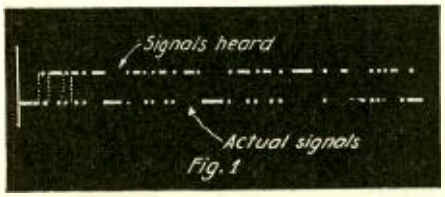
The immediate effect of this "newspaper publicity" was that many otherwise conservative citizens would at once set the genius of their own particular imagination at work and such commonplace things as a clothesline, telephone wire, burglar alarm system, or a lightning rod would now take the concrete form of a "secret radio plant." This was particularly so in rural districts, and a few days after these spurts of journalistic brilliancy various governmental departments would receive an avalanche of letters from all parts of the country, describing in detail and enclosing maps and sketches of suspected localities. The larger cities, however, were not without their share, and the following experience is one which caused a master detective and myself to lose a perfectly good night's sleep. I have in mind the case of the Singer Building.

THE SINGER BUILDING SIGNALING MYSTERY.

An observing young man in Jersey City was star-gazing one evening or looking at the Lady in the Moon, I don't know which, when he happened to glance in the direction of downtown New York. Presently he was attracted by what seemed to be a series of short and long flashes at the very top of the Singer Building tower. He noted that these flashes seemed to occur at frequent intervals. Now it happened that this young man had attended a summer naval camp of some sort where he had been taught Morse Light Signaling. This, as some of our ex-Army and Navy readers know, is nothing more than a system of signaling employed at night, whereby the dots and dashes of the Continental Morse Code are flasht with an electric lamp controlled by a Morse key, and it is a rather common method employed at sea between vessels for short distances. This same young man put two and two together and decided there and then, that the flashes on the skyscraper were nothing more, *or less,* than the clever scheme of alien spies, enabling them to send military information to Spanish and Scandinavian vessels lying at anchor in the Hudson; this information, of course, to be eventually transmitted by radio to enemy countries when the vessels went to sea or had reached neutral ports. Incidentally, this same deduction was arrived at by several other persons almost simultaneously, and in a few days our office was furnisht with the "makings" of a typical case.



The "Phantoplex" Circuit As Officially Doped Out After Months of the Most Gruelling Investigation By Naval and Civilian Electrical Experts.



This Code Diagram Shows How, In the "Phantoplex" the Puzzling Signals Heard On Another Circuit, Are the "Opposite" of the Actual Signals Sent. It Looked Like "Spy" Work, All Right!

Medical Supplies Were Being Shipt to Mexico Very Suspiciously At the Start of the War. Finally An Investigation Of One Of the Packing Cases Verified the Suspicion That "Wireless Apparatus" Were Being Smuggled Into That Country.

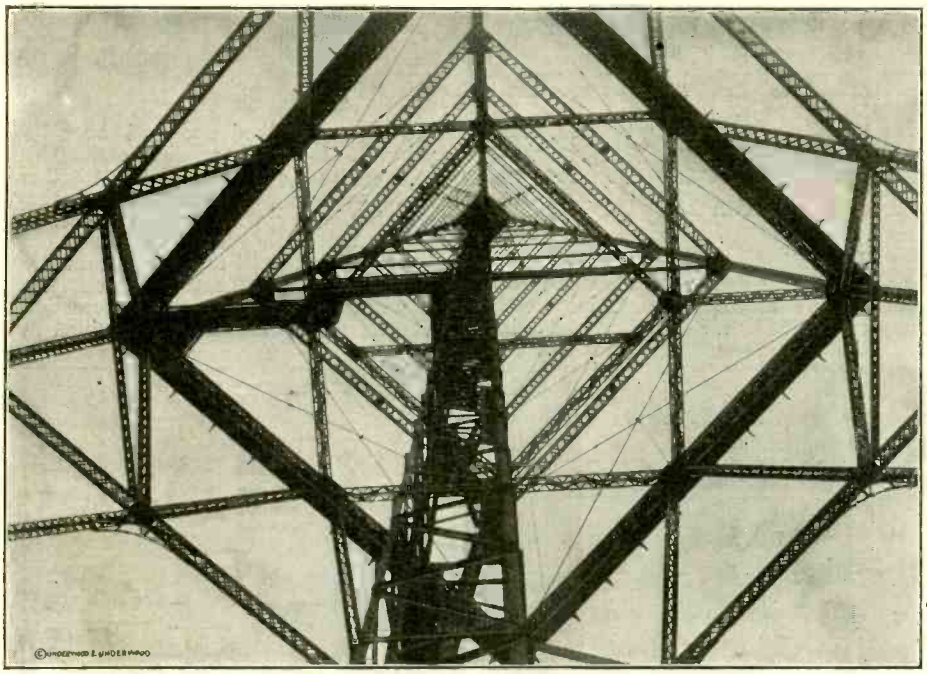
After due consultation we failed to arrive at a satisfactory explanation for the flashes, so a special investigator and myself were assigned to the case. That very night found us on the roof of a structure close to the Singer Building, from which we had an excellent view of the various night lights of New York, as well as of vessels anchored in the two rivers. During the consultation it had been decided that such a method of signaling might well be resorted to by persons unable to reach closely watched neutral vessels, and it was therefore a factor worthy of serious consideration. The reports had intimated that the signals occurred at frequent intervals during the night, so that shortly after nightfall found us keeping a careful watch of the various lights with the aid of two pairs of excellent German prism binoculars.

Up to 11 P. M. no suspicious flashes had yet been noted, so, as usual, I began to have my doubts. Finally the tenseness of the occasion failed to keep my eyes from blinking so we decided one would stay on watch while the other secured "forty winks." I won the toss of the coin, after which I retired to a convenient corner of the roof and finally dozed off. I must have been asleep an hour or so when I was suddenly awakened by my friend with the exclamations, "Look! Look! There they are—read them!" I looked in the direction of the Singer Building and there sure enough were the flashes, but altho I have had considerable experience in the dot and dash line, both oral and visual, I could make no sense or connection between these strange dots and dashes. O-ho, I thought, they are using a code of their own. The flashes continued for a few minutes and then finally stopt completely. After this

(*Continued on page* 203)

*Part I of this series appeared in the May issue.

600-Foot Radio Tower, Looking Skyward



Looking Skyward Up One of Arlington's (N.A.A.) Giant Steel Masts, Towering 600 Feet Into the Ether. No Wonder the Messages Fly Across the Atlantic Ocean.

The accompanying photograph shows a very remarkable view, looking skyward 600 feet, to the apex of one of the giant masts of the United States naval radio station at Arlington, Va. It was from this station that the major portion of all "radio traffic" was handled during the World War.

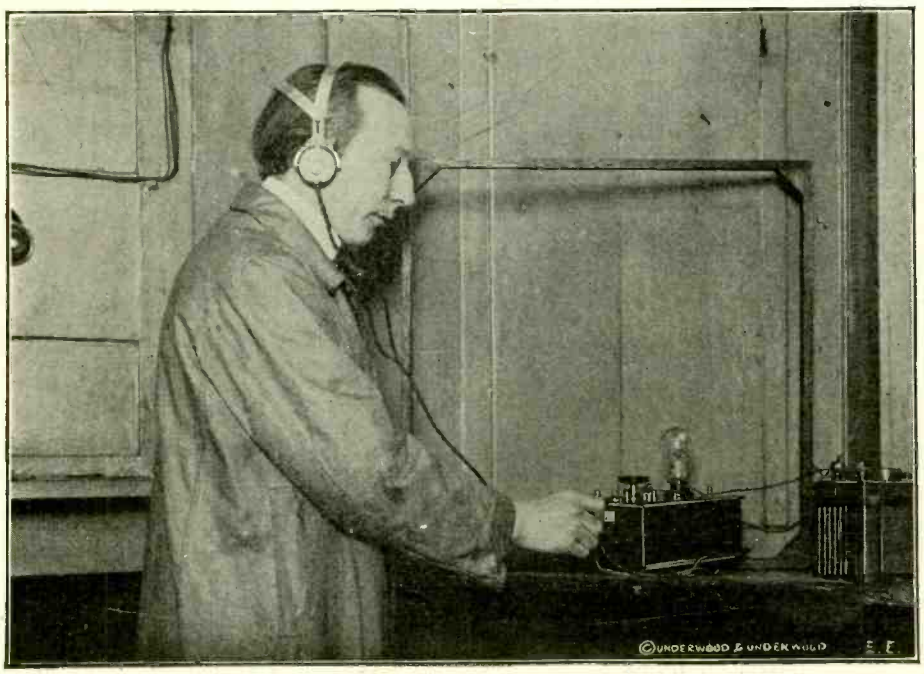
Increasing interest in the Arlington wireless has been recently aroused by the Senate's approval of a joint resolution to operate naval radio stations for commercial uses. This bill will authorize the Navy to continue its war-time ship-to-shore radio message business, and to accept for transmission commercial news messages at tolls not less than cost. Publishers claim that unless the navy system is continued it will be impossible to get news dispatches from the Far East, Porto Rico and other island possessions of the United States. Thousands of youthful radio aspirants who have rigged up little rival radio stations on parental roofs will be greatly interested in this unusual view of the aerial installation of the great United States naval high-power radio station at Arlington, which they know better perhaps as "N. A. A."—headquarters in the East for standard time, twice daily—at 1:00 P. M. and 11:00 P. M.

One of the old jokes in the radio game, used to be, "How would you like to be a lineman for the wireless company?" Of course, the answer was obvious—for, in the language of the classics, "there wuz no such animile!" but when we come to such wireless stations as that at Arlington where the gigantic steel towers lift their heads skyward 600 feet, the man who fills the job of what we might usually call the "lineman," has no sinecure you can bet. At most high power radio stations where these steel masts are used to support the lofty antenna, there is a steel ladder running up the side of the mast, and when the aerial wires need overhauling or have been broken by heavy winds, the maintenance gang have to climb these ladders to the top of the mast. In some cases, instead of climbing the mast, or up to various positions on the mast where a guide wire or two may need repair, the men are hauled to the top in a boatswain's chair, as it is called, which comprises a small seat or piece of wood with a rope back, or else a small seat made from canvas, and sitting in this, he is hauled rapidly to the top by a mule, engine, or man-power. A young lady radio enthusiast once made a trip in a boatswain's chair to the top of a 400 foot steel mast at the New Brunswick trans-Atlantic station, and described her experience as wonderful! We'll say it was. She couldn't help it.

New Wireless Portable 'Phone

The new wireless telephone instrument shown in the illustration herewith was invented by Mr. F. O. Read. It is said that this apparatus is so small and compact that it could be carried in the hand, as it measures 11 inches by 5½ inches by 4 inches.

The instrument is particularly intended for the reception of wireless telephone and telegraphic messages either on the spark system or the continuous wave or undampt system. Experiments are to be tried out presently with this apparatus in an attempt to receive messages in England, which have been transmitted from stations in Africa and Australia. Thanks to the audion or vacuum tube detector and amplifier, such long distances with extremely compact radio receiving apparatus has been made possible.



New Portable Wireless Telephone With Which It Is Claimed that Messages from a Distance of Several Thousand Miles Can Be Accurately Intercepted and Read. The Receiving Set Shown Utilizes the Electron Valve or Audion.

The experts of the Marconi company have from time to time intimated that in the near future we shall be able to pick up long-distance radio signals, such as the "time signals" from the Eiffel tower in Paris, if we happen to be in Europe, or from such powerful stations as that at Arlington, Va., in the United States, by the aid of a simple little wireless receiving set carried in our vest pocket. Some time ago there was described in the ELECTRICAL EXPERIMENTER a very small wireless receiving set which was capable of picking up the time signals flasht from Arlington, at 2500 meters wave length, at a distance of about 300 miles. This set could be held in the palm of the hand and had inductance coils wound with extra fine wire and especially made switches, with small contact points. A miniature crystal detector was fitted to the apparatus, and it could be used with a wireless 'phone of 1000 to 2000 ohms resistance. The apparatus devised by Mr. Read is said to cost about fifty dollars.

Radio Controls This Torpedo

THE accompanying photograph shows a new wireless control torpedo invented by a New York inventor, Mr. E. F. Galvin, who recently demonstrated successfully the operation of this latest engine of war, at the 12th Regiment Armory in that city. The model torpedo used for this demonstration, was mounted on wheels, so that it could readily move over the floor.

By means of a wireless transmitting set, Mr. Galvin, seated at a table, directed at will the course of the model torpedo back and forth over the floor of the armory.

The inventor claims that by using this device, it will be readily possible to retrieve a torpedo that fails to hit its mark or that fails to explode. Mr. Galvin has been working on the details of his invention for the past six years. He is here shown in the photograph, together with the latest model of the torpedo which he demonstrated.

The science of *radio-dynamics* is undoubtedly one of the most interesting in the whole realm of wireless—just as much and even more so than it was in the early days of Dr. Marconi's early researches, when the immortal and always interesting coherer, decoherer and relay held sway.

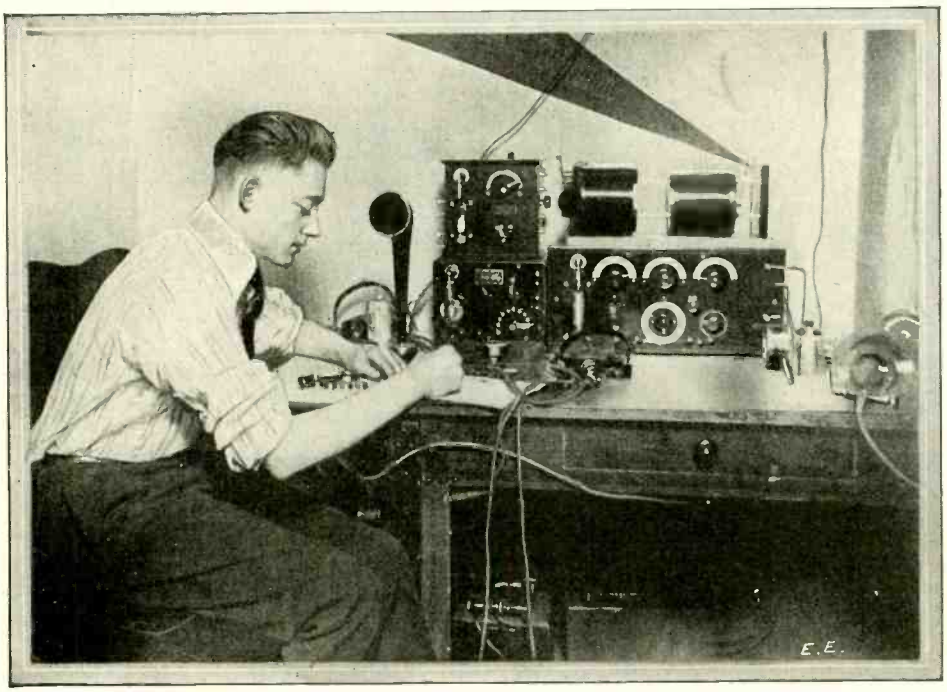
We have not advanced very much along the line of coherers suitable for working relays and actuating various controls in a device such as this, but, however, due to the flexibility and several other good features of the audion amplifier, it has become possible to use a number of these bulbs, connected in cascade and to thus boost the weak incoming signals on the antenna to such an extent, that they will operate a sensitive relay, so as to close a local circuit controlling any desired amount of power—from a small signal or battery motor up to a 500 H. P. motor, or for that matter, several hundred or thousand horsepower.

New Radio Controlled Torpedo, Devised by a New York Inventor, Mr. E. F. Galvin. The Radio Waves Are Intercepted by the Antenna Wires Supported from the Mast.

There is still a great deal of research work, however, which can be very well carried on for the benefit of radio-dynamics—toward the development of a reliable and yet sensitive coherer device, which shall be both low in cost and absolutely positive in its results. When confronted with this problem today, every radio expert will howl "*Audions*" to you, and, of course, they are right, but only partly so! They forget that audions cost money and plenty of it, and that the circuits and apparatus associated with audion amplifiers are always delicate and subject to considerable instability, mechanically and eletrically. Audions are a delicate proposition where severe vibration takes place, especially in such a small and rapidly moving object as a torpedo which travels with express-train speed, or sixty-miles an hour, thru the water, pitching and rolling like a teacup on the ocean. A positive coherer should be much more satisfactory than audions for this purpose.

Lost Sister Found By Radio

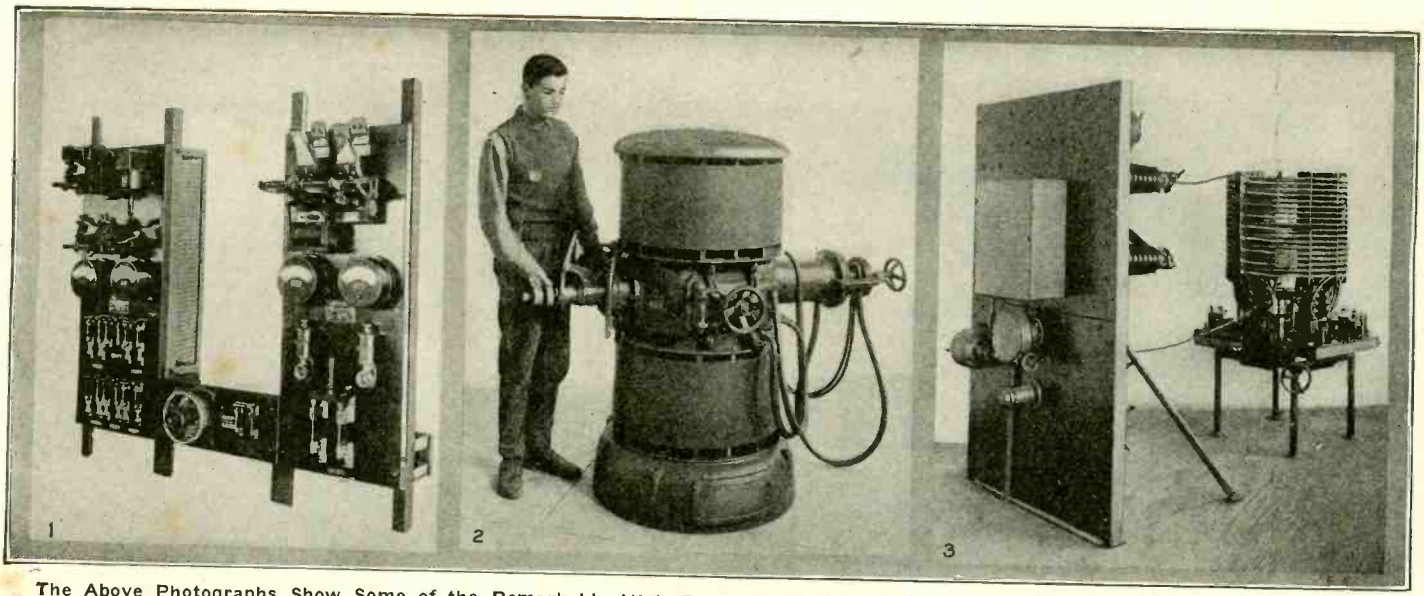
AMATEUR radio has proven once again that it is well adapted to perform deeds of service to mankind in more ways than one. One of the latest exploits of Radio Amateur science, is that of Mr. Lester Leroy Archer of Toledo, Ohio, who recently located his 17 year old sister, Miss Cleo Archer, by wireless calls sent out from his station. Mr. Archer and his mother had been searching for his long lost sister for thirteen years. No trace could be found of the girl since she had been placed in the Allen County Children's Home, near Lima, Ohio, until one of the many wireless appeals of Lester Archer succeeded in locating her. Her identity was established thru the aid of a brother amateur radio operator on a farm near Rockford, Ohio.



Lester LeRoy Archer and His Wireless Station, Located at Toledo, Ohio, Located His Sister Who Had Been Lost 13 Years, "Via Wireless." Great Work, Lester. And When We Get Some New Medals, You Get First Pick.

The apparatus here shown is Mr. Lester Archer's wireless set, which he has built in great part by himself.

This shows the versatility of radio telegraphy. One amateur delights his family circle by hooking up a "gang of audions" to his receiving antenna, so that they can hear phonograph records being played several hundred miles away, perhaps, while still others rend the nightime ether with their chit-chat talk about their "latest girl" and heaven-knows-what-else! while every now and then we run into a real hero like Mr. Lester Archer, who has shown us not only a new application of radio but also that he possesses originality and initiative in attempting to fling his wireless call over such a considerable territory, bent on what we would usually call an almost "hopeless case," that is, a girl lost for thirteen years, whom no one could hardly hope to identify from a word description or even from a photograph.



The Above Photographs Show Some of the Remarkable High Power Radio Arc Telephone Transmitter Equipment, Developed by an American Concern During the War. Passing Beyond the Wireless Dreams of Even Valdemar Poulsen Himself, This Concern Has Developed Powerful Arc Transmitters for Both Wireless Telephony and Telegraphy in Various Sizes Up to 1,000 K.W. Rating. The Triple Panel Switch-board Here Shown, Was Built for Controlling a High Power Arc Transmitter and Served to Control the Circuits of the Motor-Generator, the Arc Converter and Auxiliary Apparatus. The Photo Showing the Man Standing by the Large Arc Transmitter Illustrates the Huge Size of a 30 K W. Arc. The Third Photo Shows an Oscillation Transformer Developed for Tuning the Antenna Circuit of Arc Transmitters. The Signaling Relays Are Also Shown In This Photograph.

High-Power Radio Arcs

WHEN Valdemar Poulsen invented his famous Oscillating Arc, which today bears his name, and which is capable of quickly and very efficiently developing radio frequency currents of undreamt of magnitudes, he probably never thought that arcs rated at several hundred kilowatts, and even up to a thousand kilowatts, would be built some day.

However, as the accompanying photographs show, some very remarkable radio frequency arc generators have been built by the concern exploiting the Poulsen patents in this country. This concern has developt the Poulsen arc into a reliable and highly efficient generator or rather converter of direct or alternating current into a radio frequency current suitable for exciting an antenna such as used in all radio stations for the application of either wireless telephone or undampt wireless telegraphic transmission.

At the present time, there are in use in this country and abroad arc transmitters of the following sizes, which are manufactured by the American concern: 5, 20, 60, 100, 200, 350, 500, and 1,000 kilowatts. These arc radio transmitters are rated according to the normal amount of direct current power supplied to the converter.

The photograph herewith of an arc converter with a man shown standing opposite it, is a 30 kilowatt radio transmitter of this type. It is used to change direct current into radio frequency current as aforementioned, and shore stations of moderate power and the larger naval stations are frequently equipt with arc converters of this size.

Another view of modern arc transmitting apparatus for radio stations, which shows a double deck control switchboard for arc radio transmitting. A motor-generator set is required for converting the alternating or low voltage direct current into direct current of a more suitable and high voltage, averaging 450 to 600 volts, which is best suited for the efficient operation of the arc converters. The three panel switchboard here shown, serves to control the circuits of the motor-generator, the arc converter and auxiliary apparatus.

The third photo shows an oscillation transformer of recent type developt for tuning the antenna circuits of arc transmitters. This switchboard and helix are known as a wave changer and antenna loading inductor, as well as signaling relay system for a 30 kilowatt arc radio transmitter. The modern high-power radio arc transmitter is a very efficient and noiseless piece of machinery. The efficiency of these arc transmitters is surprisingly high, about ⅓ to ½ of the direct current power supplied to the arc being converted into radio frequency energy, in the antenna circuit. The arc flame is rated with a theoretical efficiency of 50%. These arcs much resemble the ordinary street arc lamp with which we are all familiar, but burn in a heavily enclosed chamber, filled with a gas containing hydrogen, and illuminating gas has been used very successfully in the arc chambers.

The two electrodes between which the arc proper is situated, is placed between the poles of two powerful electro-magnets, which produce a strong transverse magnetic field tending to blow the arc out. The negative electrode is usually composed of carbon or graphite, while the positive electrode is constructed of copper and arranged so as to be water cooled. Usually a small motor rotates the carbon electrode in these arcs, so as to cause the arc proper to burn evenly. This appartus has been so carefully and thoroly improved, that the only adjustment of the arc, is that occasionally required to adjust the length of the arc flame, until maximum antenna current is obtained.

With these large arcs and big electrodes the carbon poles are decomposed very slowly, thus making it possible to operate the arc converter for several hours at a time, with but few slight adjustments of the carbon feed mechanism now in use.

There are two forms of magnetic circuit used in the modern radio arc transmitter, the open and the closed type. Where a very strong magnetic field is necessary as in the large size arcs, the closed magnetic circuit is employed. For arc generators rated at 100 kilowatts or less, the open magnetic circuit is commonly utilized in practise, and this is the type used on the 30 kilowatt arc generator here illustrated.

The magnetic field is set up in the open magnetic circuit arc of this type, by two large field coils, situated one below and the other above, the arc chamber. In these latest type arcs, the usual choke coils used in arc circuits, are built as an integral part of this series winding, and help to energize the magnetic circuit.

In the small arcs rated at from 15 to 20 kilowatts, the field coils are wound with cotton covered magnet wire, in layers, with a series of vertical air ducts to properly ventilate the windings and properly carry off the heat from them.

The arcs rated from 30 to 100 kilowatts have magnetizing field windings, formed of a number of pancake coils wound with copper strip, with micanite insulation, placed between turns. The pancake coils are then separated from one another by means of Bakelite spacers, and the coils are provided with both vertical and horizontal air ducts.

The radio experimenter will find the subject of oscillating arcs of extreme interest for the purpose of producing high frequency oscillations for wireless telegraph and telephony transmission. There are also many other wonderful phenomena which are produced by the tuned oscillating arc of Poulsen. One of the most interesting phases of this subject is the "speaking" arc, and in fact, this was one of the first fundamental experiments and facts on which the use of the arc for wireless telephony and telegraphy was developed. The "speaking arc" comprises the usual arc, preferably of the hand-fed type for experimental work, shunted by a large capacity and inductance. Suitable choke coils are placed in the D. C. supply circuit, one choke in each line and the voice currents are superimposed on the arc by means of a microphone and a telephone induction coil or small spark coil. The microphone is connected with several batteries, in series with the primary of this coil, and the secondary is sometimes shunted across the arc with a condenser in series.

As aforementioned, illuminating gas is used in the arc chamber when available, and alcohol is the hydro-carbon used frequently in the small size arc transmitters. Kerosene or coil oil are often used for high-powered, short-wave arcs.—*Photos courtesy Federal Telegraph Company.*

A Long Wave Vertical Coupler

Herewith I present a diagram of a long wave vertical type loose coupler, designed primarily for the comfort of the operator. As it will be noted, all the control elements are as near the table as possible. The great objection in having a long wave coupler is that one has to reach some three feet, either sidewise or vertically, to vary the secondary coil's position.

The primary and secondary are wound with No. 28 and No. 30 wire respectively. However, this does not have to be adhered to by the constructor as a mineral detector might want to be employed. The number of taps to be used lies with the builder.

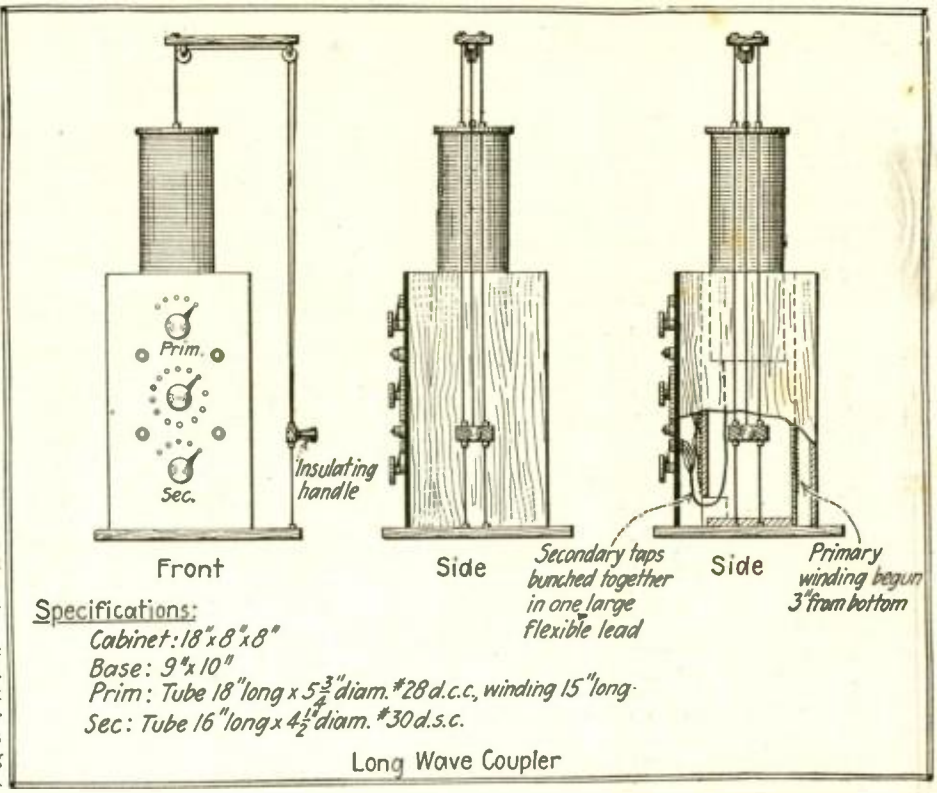
An Ingenious Radio Stunt—Why Not Build a Vertical Type Loose Coupler? The Movement of the Secondary Is Accomplisht by the Change of Position of the Handle, Which Is So Arranged as to Balance Almost Exactly the Weight of the Secondary. The Slight Friction of the Taut Copper Wires Is Sufficient to Hold It in Place.

With a coupler of this sort, all the good merits of the usual affair are preserved but all its disadvantages eliminated.

I hope E. E. readers will benefit by building this design of coupler.

This vertical radio cabinet may be made out of wood, stained and polished, with a bakelite front and may be mounted so that even the sliding secondary may be concealed within. Very large loose couplers may be made in this manner and long wavelength reception easily obtained. A large loose coupler always is far more effective than a small one no matter how many loading coils are added to it. The coil measurements are clearly indicated in the diagram at the right.

Contributed by JOSEPH PIGNONE.

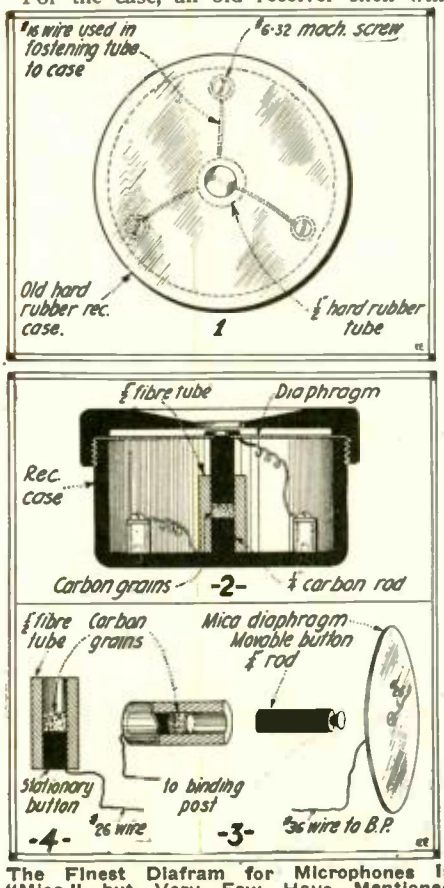


Long Wave Coupler

Building a Mica Diafram Microphone

Many readers have probably heard of mica diaframs being used on wireless receivers. Why not on transmitters?

For the case, an old receiver shell will do, but it should be either hard rubber or composition. First remove the magnets, leaving the binding posts to use for the transmitter. Next a piece of fiber or hard rubber rod will be needed. It should be one-half inch in diameter and one-half inch to three-quarters of an inch long. Drill a one-quarter inch hole thru the middle of this, to hold the carbon grains and the carbon buttons. Two carbon buttons will be required and these can be made from one-quarter inch carbon rod with faces polished.



The Finest Diafram for Microphones Is "Mica," but Very Few Have Mentioned Using This for Such a Purpose. Here Is One which Promises to Have Great Favor With the Amateurs.

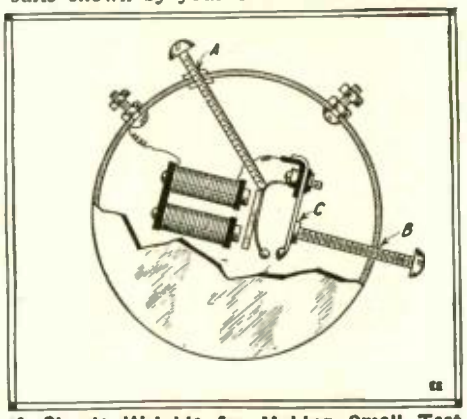
The movable button is attached to the mica diafram and should be ground down slightly on an emery wheel or with emery paper, so that it will move freely in and out of the fiber tube which holds the carbon grains. The mica diafram should be the same size as the tin diafram formerly used on the receiver, and a hole large enough to receive the movable button should be drilled in the center. Diagram 3 shows the shape of the button and method of fastening it securely to the diafram. Insert a piece of No. 26 bare copper wire into the hole in mica diafram and then insert the carbon button into the same hole. Wind the wire tightly around the button and apply a small amount of solder on the wire to keep the carbon from slipping out. The stationary button is fastened tightly in the fiber tube by wedging it in with a piece of No. 26 copper wire, which thus forms the lower connection and should be soldered to one of the binding posts. Fasten the fiber tube to the bottom of the case with cement or glue, being careful that it is in the exact center. After this dries and the carbon grains (best to purchase them; they must be polished) have been placed in the tube, make connections to the movable button and the binding post by a piece of No. 36 insulated wire and place the diafram in its usual place, making sure that the movable button does not stick. Place the cap on the shell and it is ready for use.

Contributed by HOWARD WILLSON.

Making Test Buzzers Adjustable

Many amateurs are now studying the code with their buzzer practise sets. These buzzers in most cases are non-adjustable. I found that the note of these buzzers could be increased one hundred per cent by the following method: Drill and tap holes at A and B in Fig. 1, for 6-32 screws. Insert two such screws at these holes. The one at A should be 1¼ inches long, and the one at B, one inch long. Insert a piece of fiber ½ inch square, at C, between the screw and the brass.

To get the best note, adjust the two screws. You will be surprised at the results shown by your old buzzer.



A Simple Wrinkle for Making Small Test Buzzers Adjustable.

Small test buzzers, particularly, are usually hard to adjust with any degree of precision. This stunt makes it easy to accomplish the desired adjustment in a few seconds. Where the buzzer is noisy and troublesome, as in making wave-meter measurements, it is best placed inside a box filled with cotton or felt. This absorbs the sound of the buzzer and enables sharp measurements to be made easily.

Contributed by ISRAEL WOOLF.

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 $5.00 each month for the best photo or photos and $2.00 to each "Honorable Mention." Address the Editor, "With the Amateurs" Dept.

"Amateur Electrical Laboratory" Contest

THIS MONTH'S $5.00 PRIZE WINNER— FRED C. DAVIS

IN my laboratory, the smallest on record (with the most junk in it), there are two hundred different chemicals, for chemical experiments and analysis, followed thru the chemical lessons printed monthly in the ELECTRICAL EXPERIMENTER. I have a four-inch telescope to view the stars, which I use in carrying out the instructions given thru lessons in the "E.E."

The electrical equipment is extensive and practicable. The "Lab." is lighted by five nitro globes. Also, one part is devoted to a photographic outlay where I print and develop all my own photos. An electric printer is another one of the many useful apparatus to be found in my establishment. I also have a red electric light. Four spark coils repose gracefully upon the book case, containing files of the "E.E." and copies of the "Experimental Electricity Course" and "Wireless Course". A loud-talker is connected to the parlor, a step-down transformer at its right. I also have in my possession mechanical spring motors, electric motors and almost everything necessary to complete the "Bug's" gamut of happiness.

It was thru the ELECTRICAL EXPERIMENTER that I obtained help in fitting out my laboratory to the best advantage.—Fred C. Davis, 1018 Vine St., St. Joseph, Mo.

HONORABLE MENTION—WILLIAM LILLY $2.00 PRIZE

THIS is a photograph of my electrical apparatus. I have in my work-shop one induction motor 1/30 H.P.; one Tungar rectifier, with which I charge my friends' storage batteries; a toy transformer fastened underneath the table which operates small lamps of low voltage; small electro-magnets of different kinds; some test lamps and call bells; and numerous other appliances, too numerous to mention here.

I have a small wireless set which I constructed myself, and an Erector set with which I can build many useful things and run them with the electric motor supplied with the set. I also have a very fine set of books, the "Proceedings of the American Institute of Electrical Engineers", the "Hawkins Electrical Guide," and "Standard Wiring for Electric Light and Power".

In my "Lab." can be found a full set of electrician's tools. As you will see in the photograph, there are two wet cells and several kinds of acid and various other materials for performing interesting experiments.—William Lilly, 512 East St., Madison, Ind.

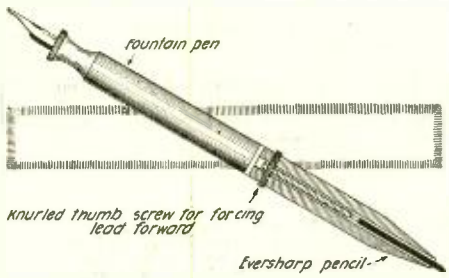
What To Invent

By JAY G. HOBSON

ONE THOUSAND DOLLARS AWARD,

WILL be given in cash for an improved shoe polish box opener if adopted by a large Buffalo, New York, polish manufacturer.*

They want a practical box opener for their shoe polish box. The opener must not perforate the top or bottom of the box, either before or after opening it. This is very important and will not permit of rivets or other holes.



Why Doesn't Someone Invent a Simple and Cheap—We said It, CHEAP—Combination Lead Pencil and Fountain Pen, as Mr. Hobson Points Out, so That When We Want Either a Pencil or Fountain Pen We Have It in Our Pocket and Not Ten Miles Away.

The box must be absolutely airtight. The opener must be easily attached and such as will nest or pack well with the box in the regular one dozen sized cartons.

It should be low in cost and attractive as well. For any such acceptable improvement they will pay $1,000, cash, the inventor to show good title to the improvement and to convey the rights of same to the manufacturer.

Here is a splendid chance for our readers to exercise their inventive talents and possibly win the thousand dollar prize for a simple tin box opener.

Perhaps the accompanying idea will do the trick. One in the shape of a small lever secured to the top portion of the box, and when lifted upward raises the lid easily.

Something similar to this arrangement should prove acceptable and land the bag of yellow gold.

COMBINATION FOUNTAIN PEN AND PENCIL.

Will someone kindly invent a practical non-leak pen and ever-sharp pencil combined as one, about the same size as the popular fountain pen in wide use to-day,

If so, I, for one, will gladly shout his praise from the housetops because (and many will agree), the writing tools are forever becoming separated.

When a "Feller" wants his pen nothing but his pencil is in evidence, and vice versa. Hitch them together in a compact combination like the illustration, and I'll be your first customer, and a walking advertisement for a necessity that will sell like hot cakes. The retail cost of a combination of this kind should run less than separate cost of present designs.

MOTORCYCLE IMITATOR.

Recently I had the pleasure of visiting some friends living in a small Southern town. One little boy, by the name of "Billy," blessed this particular household.

Billy owned a nice red bicycle, with coaster-brake and everything for trimmings, but the ambitious little chap was not satisfied. He would leave his pretty wheel setting on their front porch where the envious eyes of the less fortunate youngsters devoured it as they passed on their way to and from school. He simply was tired of riding it.

But this particular day was a holiday, so Billy, for some personal reason, rode his flyer considerably all forenoon. I was sitting on the porch talking with his father when he came flying up the sidewalk like a red streak. Reaching the front steps he exclaimed: "Daddy! I'm tired riding that old wheel, I wish I had a big, noisy motorcycle."

His father replied that, some day when he was older, perhaps, they could afford to get one.

An idea struck me between the eyes about that time, and I joined in: "Say, Billy, how would you like for me to make a motorcycle out of your bicycle right now?" I suggested as I pulled out my knife, getting up to hunt for a stick. "Oh, gee!! Can you do that, Mr. Hobson?" Billy inquired, somewhat puzzled.

"You bet your boots" said I assuringly. So Billy, his Dad and I went out to the wood house where I soon fashioned an apparatus for imitating the sound of a real motorcycle, something on the order of the illustration herewith.

Billy and I fastened it to the frame of his bicycle about half-way between the seat and the hub, so the point of the imitator touched the spokes of the rear wheel.

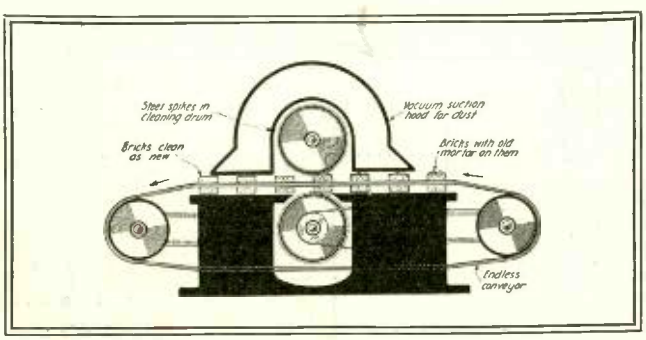
When the wheel turned each spoke hit the prong of the imitator, and this noise sounded very much like the "put-put-put" of a motorcycle engine at high speed.

Billy was delighted with his imaginary motorcycle, and the last I saw of him, before leaving, was a proud boy humming down the main street.

This little device may seem too simple for worth commercially, but I am positive they would sell at 25c to 50c each, to every boy owning a bicycle, if they were attractive in appearance and made to imitate a motorcycle properly.

BRICK CLEANING MACHINE.

A bad fire had gutted the entrails of a large brick store building some months past, but left the tall walls standing in defiance of the hot destructive hands.



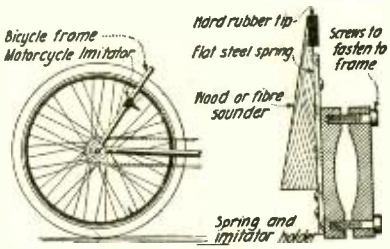
Instead of Hiring a Large Number of Men at a Considerable Wage to Clean the Old Mortar Covered Bricks when a Building is Razed, Why Not Invent a Machine Similar to the One Here Shown Which Would Clean the Bricks Rapidly and Thoroly? A Simple Machine of This Type Could Be Sold for a Hundred or Even a Few Hundred Dollars, to Contractors All Over the Country, at a Good Profit. One Man Could Work It.

The owners having collected the insurance were feverishly razing the remains to make room for a new fire-proof building.

Colored laborers were sitting on pyramid-like piles of old brick pounding the mortar from them, as it was desired to use the best of the old brick on the foundation of the new building. Knocking the hard mortar from each brick with a hammer was surely slow and expensive work.

I was both amused and interested at this procedure, for the dusty workmen sang funny songs, keeping the proper tempo with every blow of their hammers.

While enjoying this bit of comic scenery, an idea flashed aboard, picturing an efficient *brick cleaning machine* similar to the drawings.



While Spending His Vacation With Some Friends, Mr. Hobson Noticed That the Young Son of the Family Had Become Very Melancholy Because His New Bicycle Was Not a "Motorcycle." Questioning Developed the Fact That He Liked to Hear the "Put-Put" of the Latter. With a Little Ingenuity, the Device Shown Was Quickly Made, and Which Produced the Much Desired Noise.

A powerful machine embracing a metal or wooden frame with two large round drums carrying spikes about half inch long on their circumference. A conveyor chain between these drums. This conveyor is pocketed with oblong holes the shape of the brick. Old bricks placed in the conveyor are carried between the two large revolving drums, which cut the mortar from their surface, making them as clean and useful as new.

A practical machine of this description is badly needed by wrecking companies, contractors and brick concerns.

Success for an invention of this nature is assured, and the inventor who gets there first will make an independent stipence or I miss my guess.

A brick cleaning machine, which would probably require half a horse-power to operate it in good fashion, could be driven very nicely from a small gasoline engine, such as those used on large construction jobs by contractors. There are several fractional horse-power gasoline engines available on the market at a low price. In some cases, it might be more expeditious and just as economical to drive the brick cleaning machine with an electric motor, as it frequently happens that current is available on construction jobs, or from a building nearby.

There is plenty of room for several more inventions along this line, having to do with brick and stone work. Several years ago, there was a demand made on a firm of engineering designers, for a brick-crushing machine which resembled the one just described, so far as its size and cost were concerned.

A street repair company wanted to have this machine crush old bricks, etc., and refine them down to a small degree, in fact almost to a powder so that the resulting substance could be mixed with cement and become very efficient mixture for covering holes in street pavements and the like.

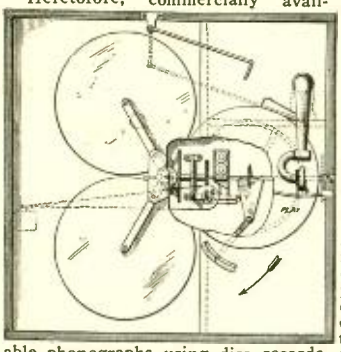
*Name sent upon request and stamped envelope.

LATEST PATENTS

Multi-Record Phonograph.

(No. 1,334,076, issued to Robert G. Brown.)

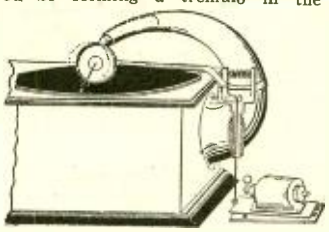
Heretofore, commercially available phonographs using disc records have had no provision for automatically playing a succession of records. The inventor of this device has constructed a machine which automatically plays in succession, any predetermined group of records performing all the functions, such as lifting the stylus, substituting another record and placing the stylus in the proper starting position, so that it may play thru the next record. A magnetic trip turns the tables around, a clutch having released one table then grips another table upon which the second record is placed. Its engagement with this table causes the phonograph to operate without interruption.



Phonograph Vibration Device.

(No. 1,333,726, issued to Mervyn O'Gorman.)

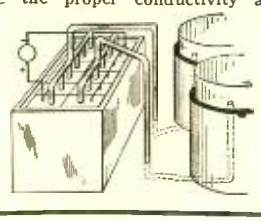
Various means have been tried for producing a definite feeling of expression from phonographic machines so as to modulate the sounds and music. In this recent patent the inventor has originated a method of forming a tremulo in the voice, whether this has or has not been produced in the record, and making the tremulo under control of an operator. For producing this, the sound box of the tone-arm is rapidly vibrated back and forth ⅛ of an inch by means of a motor, which motor has an off-balance weight attached to its shaft so as to cause a vibratory action similar to the vibrators on the market at the present day. This is accomplisht thru a system of levers.



Oxygen and Hydrogen Generator.

(No. 1,334,668, issued to Gustave Miller.)

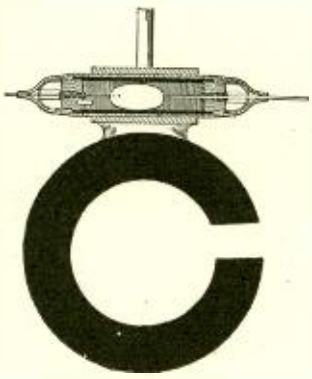
There are a number of cells having suspended electrodes so that one row will have anodes and the other cathodes. This means that one cell will generate oxygen only, and another hydrogen only, due to the electric decomposition of the water, sodium hydrate being added to produce the proper conductivity and an E. M. F. of about three volts employed. The anodes and cathodes themselves are open-ended pipes, hence providing a maximum area of the electrode surface for the generation of the gases.



Electrically Driven Clock.

(No. 1,334,422, issued to Henry E. Warren.)

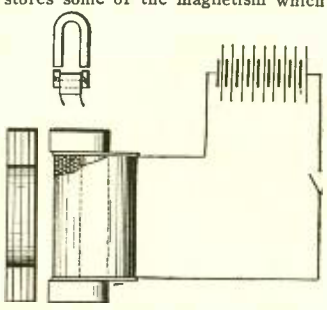
This is an improvement upon Mr. Warren's electrically driven clock described quite some time ago in our magazine. It consists of small hermetically sealed glass tube with two contact-making devices, one in each end. A globule of mercury sliding between the two pins will make contact with them for a greater or shorter length of time, depentent entirely on the extent of oscillation. Another contact has a quenching action so that the oscillations of the pendulum are under constant control, regardless of what conditions of charge or discharge the clock battery may be in.



Controlling Field of Magnets.

(No. 1,334,531, issued to H. S. Folker, & D. M. Birdstrup.)

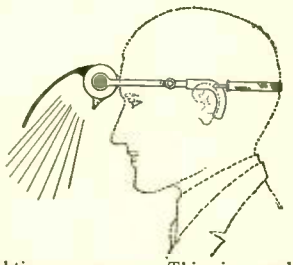
This is a method for dispensing with the movable keeper now universally in use in connection with permanent magnets used in railway signal work, by placing a solenoid a short distance from the poles of a permanent magnet, so that the poles of the latter will conflict and will be opposite to the polarity of the solenoid. A solenoid with greater magnetic force than that in the permanent magnet is provided. When the solenoid is energized, it deflects the field of the permanent magnet and during such deflection also restores some of the magnetism which may have leaked out from the permanent magnet, due to the fact that its poles are not joined by a keeper.



Reading Light.

(No. 1,333,830, issued to Charles S. Burton.)

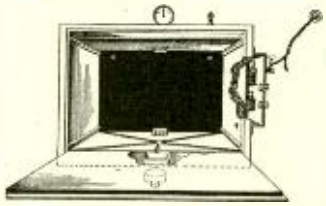
This invention embodies a reading light and eye-shade in one, adapted so that this light can be operated from either the regular current or from a pocket battery. Two pads prevent the device from affecting the forehead of the user and collapsible arms on either side make it resemble a pair of spectacles. An elastic band stretches across the back to hold it in position. A small tubular lamp is used for the lighting purposes. This is nearly surrounded by a shade which prevents the glare from affecting the eyes and illuminates the material.



Electric Oven.

(No. 1,336,105, issued to Frank M. Sutton.)

Aside from the fact that it is a "fireless cooker," there are many other clever novelties. In the first place, it has an electric thermostat which can be regulated so that a temperature between any practical limits can be maintained. In addition, to this an automatic clock device maintains the current on for a definite period whence it can either be put off and the fireless cooking action of the stove utilized, or the current can be interrupted intermittently by the clock acting as pilot thru a relay. Resistance wire comprises the heater element. A pilot lamp is located on top and a furrow in the base permits any gravy, etc., to run forward into a special receiving chamber.

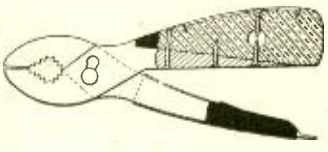


Spark Plug Tester.

(No. 1,333,698, issued to Ernest I. Bass.)

A combined tool which will act as a pair of pliers, also fitted with the usual double pivot hole, whereby the distance between the jaws of the pliers may be changed in order to grip nuts or pipes of larger or smaller diameter, acting as a wrench. Non-conductive material such as fiber is used on one handle, two screws extending to a hole in the center of it so that the spark plug test can there be made. The other end of the pliers constitutes a screw driver. It is not necessary, therefore, to remove the spark plug of an engine to find out if the same is in good condition. The space between the screws in the handle of the tester will have a hot flaming spark fly across it if the plug is not at fault. This test can be made in a few seconds.

Combination tools of this nature always seem to have taking ways when it comes to the motorist's side of the story, as he can make his spark plug test, remove the wire or remove the plug without the necessity of a handful of tools. The design is rugged and the quadruple tool unique, promising a good sale.

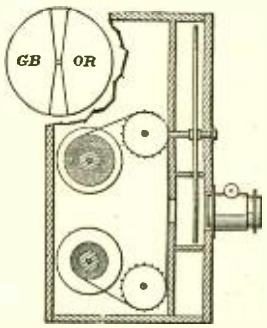


Colored Moving Pictures.

(No. 1,333,730, issued to C. Raleigh & W. V. D. Kelley.)

In various patents for the production of motion pictures in colors, methods are described which utilize a "color filter" made up of the three primary colors, so that the filter is used both in taking and projecting its films. This necessitates about 48 pictures per second, otherwise the pictures become very jerky. In this new invention, however, a screen is divided so that each factor is made up of two colors, such as red and blue, and the next blue and green, etc. This allows for a blending between the two successive images and relieves eye strain, because two of the three nerve color centers will at all times be excited. Simultaneously, it reduces the number of pictures per second to 24.

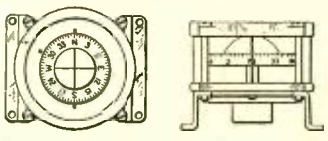
Of course, when the pictures are projected, a means for synchronizing the color filter with the motion picture films is used, thus one picture will be projected thru the green-blue side of the filter and another thru the orange-red side of the filter. This proceeds rapidly so that the light which is emitted thru the film is simultaneously colored, prior to its exit thru the forward lenses in the projecting camera. Retention of vision, in this case, also making itself noticed, otherwise instead of a perfect blending of colors obtaining by this method, a series of rapidly interrupted flashes would result. The idea of having two nerve centers in the brain continuously affected seems to be quite novel and different from other similar methods of color motion picture projection using filters.



Magnetic Compass.

(No. 1,334,273, issued to Charles H. Colvin.)

A new improvement in magnetic compasses has come to light with this recent invention, particularly to be used in airplane work. Like all modern compasses, it is suspended in a transparent container, and floated in a liquid to decrease erratic action. Its novel feature being the employment of two separate cards, one to be read from the top and another from any side. In this manner, the horizontal and vertical cards can be observed by several individuals stationed at different points, the latter differing from the former by 180 degrees. The compass therefore can be read from either side, front, back, and from the top. In this way, the pilot and navigator can both see the compass and obtain their own reading for the particular result they are looking for. An expansion chamber is also provided which compensates for liquid expansions, due to temperature changes.

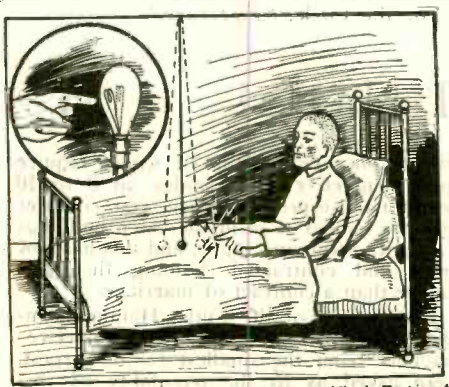


Poisoned Convicts Become "Electrified"!

One of the First of the Phenomena Noted In the Case of "Botulinus Poisoning," Caused By Eating Decayed Canned Salmon, Was That the Body of the Patient Had Become Highly Electrified. He Was Unable, for Example, to Throw a Piece of Paper In the Waste Basket, the High Electric Charge In His Body Attracting the Paper to His Hand.

AS per schedule, the case of the thirty-four convicts at Clinton Prison, Dannemora, N. Y., who became poisoned by eating canned salmon, and thereafter developt remarkable electrified propensities, was fed to us for several days by the ever-busy newspapers, under the captions of "human magnets" and what not. The facts in the glaring case are here persented for the first time.

The following details relative to *botulinus poisoning*, which took place at this institution, February 20th, 1920, are cited in a letter which we have received from the chief physician at Clinton Prison, Dr. Julius B. Ransom. Dr. Ransom says:

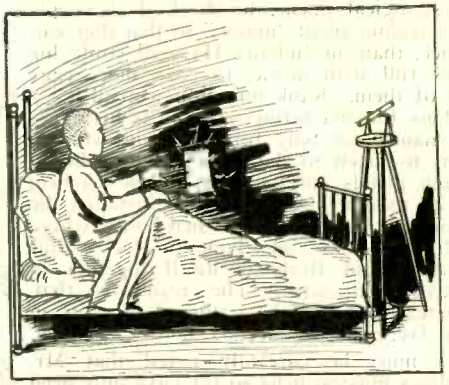


Among Other Things the Electrified Patient Was Able to Move a Suspended Steel Tape Measure and Also to Attract the Filament Of An Incandescent Lamp Towards the Side Of the Globe.

"Dr. Rosneau, of Harvard University, did not make any investigations of the *electric phenomena* and only came into the case with reference to the *botulinus poison*, as it was a rather large group of cases and opportunities for study were unusually good. Of course the newspaper reports were garbled and exaggerated as they usually are when they attempt to report scientific matters. The newspaper accounts were taken from a report made by myself to the Superintendent of Prisons, setting forth the history and development of 34 cases of *botulinus poisoning, due to the eating of canned salmon.*

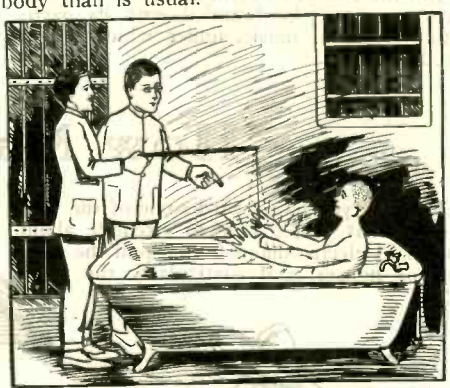
"During the course of these cases it was discovered by accident that peculiar static electric power had developed in the patients. It was discovered in this manner. One of the patients who was convalescing crumpled up a piece of paper, I imagine in both hands, and attempted to throw it in a waste basket; it absolutely refused to leave his hand. From this time on experiments were made, and the matter was reported to me, and I found that *every* case of *botulinus poisoning* developed this strange power, and that neither the attendants nor nurses associated with them had any such power. All sorts of experiments have been tried and it was found to be a constant condition; that is, that this peculiar power of creating a magnetized (electrified) field by rubbing the hands together, which puts them in circuit, will electrify different objects, so that they will retain that electrification for many hours. For instance forms of paper, such as newspapers, and ordinary correspondence paper when electrified by these patients and thrown against the wall adhered and clung to any object for many hours. By again rubbing the hands together and rubbing the electric light bulb the filament will begin to vibrate very rapidly and follow the motions of the hands, and attach themselves to the side of the bulb with a good deal of sparking at the base of the filament. The compass needle of a surveyor's instrument can be rotated with any piece of paper electrified by these patients. A steel tape suspended, will feel the magnetic field in a remarkable manner and sway from side to side.

"What relation there can be between the botulinus toxin and this phenomena of course is difficult to identify; it has been suggested that it is the *dryness of the skin* which prevents the ordinary passing out or dissipation of the electric currents from the body; *but the patient submerged in bath tub performs the same phenomena as when clothed!* The ability to electrify is proportioned to the severity of the disease; as the patient convalesces he gradually loses this power and when quite well loses it altogether.



Another Phase of the Electrified Paper Phenomenon, Due to the Patient's High Potential Electric Charge Occasioned by Botulinus Poisoning. A Sheet of Paper Electrified by the Patient Would Remain Against the Wall for Hours. He Was Also Able to Move the Compass Needle of a Surveyor's Instrument.

"I might mention further that all these cases were ataxic and developed peculiar reflexes. Many of them were almost entirely blind and had paralysis of the upper lid "Ptosis." Of course, in *botulinus poisoning* the nervous system is about the first to suffer; one thing is quite clear, therefore, static manifestation is closely linked with the disturbance of the central nervous system and represents, no doubt, simply a much higher degree of static storage in the body than is usual."



Electricians Argued That If the Patient Was Placed in a Tub Full of Water, That the Charge Would Disappear, But Strangest of All It Did No Such Thing—and the Patient Was Still Able to Attract a Steel Tape Measure or Other Object By Electro-static Attraction.

Study Astronomy

By Arnold H. Kamiat

Of what value is a knowledge of astronomy? There are those that think it of little or no value to the average man. Their objection is based on the seeming remoteness of astronomic phenomena from the affairs of life. It is not a practical study, they say. "What," they ask, "is there in the subject that any one can put to use in the guidance of his course thru life?"

To these critics, as well as to all who have never studied astronomy, the author wishes to address himself. A study of the subject is of practical value. It furnishes the student with an opportunity for the culture of more than one instrument capable of being used in the pursuit of life's aims. As evidence of this the author submits the following propositions:

First, there issues from the task the benefit of a broadened mental horizon. One is provided with an insight into the nature of the universe of stars and planets. Of what value is a broad mental horizon? Among other things, it bestows upon its possessor a more exact comprehension of the relative importance of things and events.

Thus is made possible the issue of a second benefit, namely, a sharpening or refining of one's sense of proportion. This is a valuable mental acquisition, particularly for the person desirous of co-ordinating into a practical philosophy the numerous and varied elements of his stock of knowledge.

Third, persons of romantic impulse will find a means of satisfaction in the study of astronomy. Absorbingly interesting is the picture of bodies and systems of unthinkable size, poised in the inconceivably vast celestial area. Impressively grand is the spectacle formed by the play of forces most gigantic, traversing vast distances and bridging aeons of time in their interplay. And mysteries—no Sherlock Holmes has faced more mysteries, or more profound mysteries, than those the astronomer is called upon to solve.

Fourth, the person in quest of a proper understanding of scientific concepts will find here a valuable aid. Celestial phenomena present clear and distinct demonstrations of physical law. The flaming stars are scenes of fiery interplay of elements known to terrestial chemists. The student of geology will find light on the question of the earth's origin and growth. Evolution may be studied in the birth, development and death of planets and solar systems. The universality of natural law may be seen clearly manifesting itself in the farthermost regions in space and the most infinite lengths of time.

Begin, therefore, this most pleasant and instructive task.

STUDY ASTRONOMY.

It Is To Laugh

Misfortunes never come singly. No sooner does Mr. Gernsback announce his physiological music, to shock deaf people into feeling silent "music," so that they can dance, than an Indiana Hayseed stuffs his hens full with music, to coax more eggs out of them. Rank imitation we call it.

This Indiana farmer—Habig is his eggs-act name—not only forces his unfortunate hens to listen to the music as the phonograph grinds out its notes in the kitchen, as he used to do, but he has installed the phonograph right into the hen house, where 122 Orpingtons and Plymouth Rocks, Buff Cochins and Brahmas dwell together in peaceful industry. The result is that, whereas formerly he gathered 65 eggs in one day, he now collects 115.

It must be carefully noted that Mr. Habig's musical hens so far have only been reared on Jazz music; yes nothing but pure Jazz. They like it best, to the exclusion of all other "highbrow" or classic music.

Do musically produced eggs—with Jazz—give us omelets that shimmy?

Imagine eggs influenced by the strains of the Marseillaise? Gosh, but won't this make *fiery* ham and eggs! No need to even fry them—no doubt they are fiery enough!

On the other hand, ponder about the effect syncopated and futurist music must have on the poor hen. Surely you couldn't blame her if she were to lay scrambled eggs!

But this is far from the worst. Suppose we *hatch out* such musically produced eggs! Will the new chicks shimmy, dance, waltz or fox-trot, all depending upon the records their mothers were listening to?

But the end of atrocities is not yet. Soon every egg will be branded with its particular brand of music, under which it was produced.

An Indiana Farmer, Habig by Name, Has Found That by Playing "Jazz" Tunes on His Victrola, Placed in the Chicken Coop, That His Chickens Become so Full of Pep That They Lay Eggs Faster Than He Can Gather Them Up,—Almost!! For Guinea Hens, Echoes from Verdi Are Appropriate.

Thus you step up to the egg counter and select your eggs suited to the particular tastes of your family.

For father's breakfast: *"Vamp the lady."*

For Jimmy's breakfast (aged 19): *"Spring Song."*

For Betty's breakfast (age 16): *"Kiss Me Again."*

For Mother-in-law, breakfast, lunch or supper: *"Good-bye Forever,"* or *"Funeral March,"* by Chopin.

For Alice's breakfast (she's a switchboard operator): *"I hear you calling me"* and for supper: *"Ring out, Wild Bells,"* by Gounod.

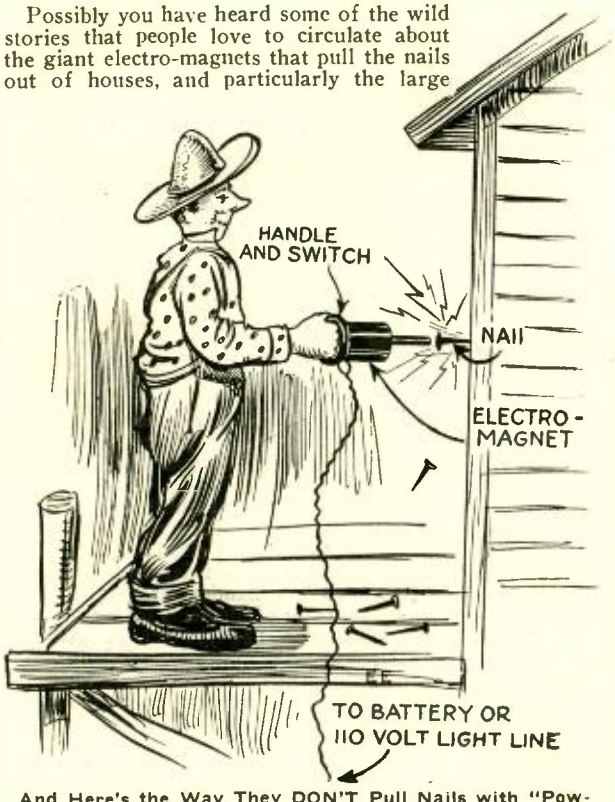
For mother's supper: *"Waiting."*

For grandfather's breakfast: *"I may be old, but I've got young ideas."*

For the Cook: *"Tipperary."*

How Magnets Don't Pull Nails!

Possibly you have heard some of the wild stories that people love to circulate about the giant electro-magnets that pull the nails out of houses, and particularly the large



And Here's the Way They DON'T Pull Nails with "Powerful" Electro-Magnets at the Government Military Camps Where They Are Demolishing Buildings by the Dozens at Present. If You Think Any Ordinary Magnet Will Pull a Ten-Penny Nail Out of Wood, Just Try It!

buildings which were erected by the Government at the huge army camps during the war, and many of which buildings are now being demolished. This story has become so persistent, and we have heard it so often, that we had our artist draw the accompanying illustration just to show how cute one of these "nail-pulling" experts would look, with a nifty little electro-magnet in his hand, so as not to split the boards, as some of the people who profess to know about these matters, have told us. Well, here's how he looks, according to what they have told us; but, were we to show you how he would look if he had an electro-magnet sufficiently powerful to pull these nails by their "heads" out of the building structure, the magnet would be bigger than the man almost, and it would take a young steam derrick to cart the magnet around and manipulate it. And then it could only pull out carpet tacks.

If you have ever tried to pull a nail that has been firmly driven in the wood, by means of a nail puller (and they do make good nail pullers nowadays), you will at once realize that it would require some magnet, even to budge an 8 to 10 penny nail, especially when you consider that the lumber used in the camp buildings was quite green and sappy, and this has now dried and contracted, holding the nails tighter than a contract of marriage.

The experts of the Cutler-Hammer concern, specialists and builders of electro-magnets from the smallest to the largest, were asked as to the possibility of this "nail-pulling" magnet fable and, lucky for us, we had a suit of armor on that day or we would have been badly bruised by the tornado of glass ink stands, paper weights, et cetera, which greeted this query. A word to the wise is, and was, sufficient!—and we are satisfied to go home and smoke our pipes in peace and laugh up our sleeves, long and gleefully, at the wonderful magnet nail pullers which are "helping" (?) our Uncle Sam to tear down buildings!

Anyone who has had much to do with electro-magnets, even those as large as five feet in diameter and capable of lifting twenty tons or more of pig-iron, will at once realize that the head of a nail presents but a very small area on which to set up magnetic attraction. It is a scientific fact, as pointed out by the engineers of the aforementioned concern in an article publisht by us some time ago, that if such a five-foot, twenty-ton lifting magnet were placed near a cube of iron, say two inches square, that this cube will not be attracted over a distance exceeding one to two feet, but here we have a relatively large area in which to set up magnetic flux and attraction—four square inches, and also the iron cube is not held in any way, but is perfectly free.

Scientific Humor

FIRST PRIZE $3.00

And a Mastodon Is Done!—TEACHER—"What is a polygon?"

STUDENT—"Oh, a dead parrot of course."—*Henry F. Robbins.*

Not in U. S. A.!—The astronomy pupil was asked—when is the moon full?

When it is all lit up, came the reply.—*E. M. Bacigalupi.*

Indeed Y'ass!—"Could you telephone (tell-a-phone) from a trolley car?"

"I don't think I could."

"Your vision must be terribly defective."—*J. B. Dowden.*

A Ringer.—"Why didn't you send up a man to mend our electric bell?"

"He did go, Madam, but as he rang the door bell twice and got no answer, he concluded that there was no one one at home."—*Richard Schlendt.*

Hur-Ray!—Alice and John were returning from the "movies" where they had seen the well-known player, Chas. Ray, upon the screen. Alice was pensive for a while till finally she lisped:

"John, dear," slipping her arm around him, "is Charlie Ray related to this—er—*Violet* Ray?"—*Geo. T. Conner.*

Requiescat in Pace!—TEACHER (in chemistry)—"Suppose you were called upon to attend a person who had swallowed a heavy dose of oxalic acid, what would you administer?"

PUPIL.—"The sacrament!"—*George W. Gish.*

We'll Be Switched!—"I guess Ma has been hunting bargains again."

"Why?"

"Caws Pa just asked her what kind of a switch she bought and she said she got a snap."—*Bunnie Wells.*

Ought to Keep Company With the Cat!—Tuesday morning while sprinkling the clothes of the week's washing, my little girl, who is three years old, came running all excited and dragging my electric iron.

"Oh, Mamma," she said, "let's turn on the juice and see her spit."—*Mrs. Bert Trullinger.*

In the Dark, of Course!—Not long ago a farmer in the swamps of Mississippi had an electric lighting plant installed on his farm. Eventually something went wrong with the outfit and an electrician was called in. He found the dynamo all shot to pieces, but set to work and remained busy till darkness stopped him. Then the farmer came out from supper to see how things were going.

"Mr. Blank," said the mechanic, "I notice a considerable amount of sparking in the fields here."

"Heck yes!" agreed the farmer. "The city chaps allus does their sparkin' round these parts of a evenin'."—*George T. Conner.*

Mr. Burbank, Take Notice!—1ST. AGRICULTURE STUDENT—"My fortune is made."

2D AG.—"How's that?"

1ST AG.—"I'm going to graft a bean plant on a corn stalk and raise ready-made succotash."—*A. H. Flury.*

Illuminating.—At their hotel, Pat and Mike were frequently wakened during the night by bed-bugs. Next day they applied for different rooms. After turning off the light Pat noticed several fire-flies in his room. He quickly arose and called to his partner: "Mike, get up. The bloomin' critters are after us wid flash-lights."—*G. Fisher.*

THIS month, we are pleased to say, our new department shows considerable improvement over the last. Contributions still come in with unabated fury from all parts of the world. "Current jokes" are still as thick as in currant pies and as indigestible—if you eat too much of them. We hope soon to see the last one of them.

Good old pre-historic jokes of antediluvian times are still fluttering in with every mail, some of them having no doubt been copied from hieroglyphs. You see a joke is somewhat like an invention—it is re-discovered periodically by independent inventors. But we have hopes—so on with the dance.

All jokes publisht here are paid for at the rate of $1.00 each, besides a first prize of $3.00. And every time we pay a dollar for an old one—and it happens often—the joke is of course on us! P. S.—We have a good notion to pay ourselves $1.00 for the above witty one!

Help! Will Someone Else Cop 'Er!

My girl is sure some alchemist,
That's why I'll have to drop her;
For every time I'm out with her
My silver turns to *copper.*
—*J. H. Schalek.*

Watt—Again?—LOGICAL—"I want some good current literature."

"Here are some books on electric lighting."

"Ohm! ah ha! I ampereing at them. Watt I want is light reading for Eddie's sons until they armature."—*Wm. F. Mahony.*

And the Digestion Tablets, Please!—IRATE DINER—"Send the cook in here."

WAITER—"Certainly, sir. Shall I send in the automatic roaster, the mechanical fryer, or the electrical toaster?"—*C. A. Henderson.*

Extermination?—BOTANY TEACHER—"Johnny, what can you say about germination?"

JOHNNY—"That's easy, we just got done licking the German nation."—*Roy Andersen.*

So That's Why We Get Burnt!—1ST BOY—"Did you know that the human being contains sulphur?"

2ND BOY—"No, really?"

1ST BOY—"Yes, that's why some girls make better matches than others."—*Henry F. Robbins.*

She Must Be a "Magnavox"!—SPARK—"What do you think of this new invention, — the loud-talker?"

COIL — "New invention, nothing. I've had a mother - in - law around the house for the past fifteen years."—*A. H. Flury.*

HE 8 4 2.—He looked as though he needed something to drive dull carraway. "Got any consecrated lye"? "You mean concentrated lye", suggested the druggist. "Maybe I do. It does nutmeg any difference. It's what I camphor, anyhow," said the customer; "what does it sulphur?" "Ten scents a can," said the druggist, furiously sucking at a sour lemon to keep from laughing. "Gimme a can," said the customer rather gingerly, "I never cinnamon as witty as you." "Well," said the druggist, eyeing the customer with a syruptitious glance, "I ammonia novice but I've soda good many puns but I don't care a copperas far as I'm concerned. You don't hear me myrrh-myrrh, do you?"—*J. H. Schalek.*

Maybe a Scientific Blunder!—NEW LABORATORY ASS'T.—"What is a Bachelor of Science after he gets married?"

THE LAB. "WISE CRACKER"—"A student of Domestic Science."—*Adolf E. Dietrich.*

Can a Ford Afford It?—BROWN—"Jones is getting too technical!"

SMITH — "Yeh?"

BROWN — "He told me his Ford had *epilectric* fits!" — *R. F. Twinam.*

Some Machine—"I watched a wonderful machine at our shop work this morning."

"And how does it work?" we asked.

"Well," was the reply, "by means of a pedal attachment, a fulcrumed lever converts a vertical reciprocating motion into a circular movement. The principal part of the machine is a huge disk that revolves in a vertical plane. Power is applied thru the axis of the disk, and work is done on the periphery, and the hardest substance, by mere impact may be reduced to any shape."

"What is this wonderful machine?" we asked.

"A grindstone," was the reply.—*John Glenn.*

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 pencilled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions address to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

THE LIFE OF LIBERTY MOTORS.

(1046) E. O. Bearden, D.F.M., A.F.M., ex-sergeant mechanic, writes the Oracle:

Q. The ELECTRICAL EXPERIMENTER publishes a statement made by Col. H. H. Arnold, U.S.A., that the life of a Liberty Motor 400 H.P. was 100 hours. I beg to differ with that statement, having had charge of a flight of 31 D.H.-IX's in Russia. All of my engines had flown in that nine months over 150 hours and some still more up to the time I left the squadron. And being I have done some of the longest raids of the war behind a Liberty, I say that it is the finest internal combustion engine made, and I have had 12 years' experience in aeronautical engineering work in Germany, France and England. In my nine months' experience with the Liberty I did not have even a broken valve spring out of 31 machines.

A. We are glad to give the following explanation by Col. Arnold, of his statement on the 100 hours' life of a Liberty motor:

"To the Editor, Electrical Experimenter.
"Dear Sir:

"Apparently the statement that I made that the life of the Liberty Motor was 100 hours is not understood by the public at large.

"The TRANSCONTINENTAL RACE, *in which there were about forty-five Liberty Engines used, demonstrated that the life of the Liberty 400 H.P. Engine was about 100 hours WHEN USED WITH THE THROTTLE WIDE OPEN. The enclosed letter states that Mr. Bearden had engines which had been flown in nine months over 150 hours, and some still more. For this information it is to be noted that during aerial forest patrol in the year 1919 the Air Service had some Liberty Engines which were used more than 400 hours and still in use; but those same engines which had an average of 75 to 100 hours when used in the Transcontinental Race with the throttle wide open went to pieces after 25 or 30 hours' running. It is hoped that this explanation will clear up the statement quoted by me.*

"H. H. ARNOLD,
"Colonel, Air Service,
"Department Air Service Officer."

ELECTROLYTIC RECTIFIER.

(1047) Ernest L. Allen, Slater Park, Pawtucket, R. I., writes this department:

Q. 1. As to the proper solution for electrolytic rectifiers.

A. 1. We would state that the solution for an electrolytic rectifier should be preferably of aluminum phosfate; sodium phosfate comes next on the list for obtaining the best practical results. Then, in order, any of the solutions named herewith can be used:

Bicarbonate of soda,
Sodium chlorid,
Acidulated water.

In each case, the salt added to the water causes what we call a saturate solution.

The distance between the plates should preferably be one inch, and the plates will have to be sufficiently large to allow the amperage required by the apparatus to flow thru. Likewise, you will find that some form of resistance will have to be connected into the circuit, and preferably four jars are used with the single phase current.

TESLA TURBINE.

(1048) Eustis H. Thompson, 17 Midship Road, St. Helena, Md., inquires:

Q. 1. How does the Tesla steam turbine operate?

A. 1. We have no exact data on the Tesla turbine. However, we understand that it consists of a number of very smooth polished steel plates, closely joined together and perfectly aligned. These plates are mounted on a shaft connected in such a way that there is an opening running thru the center to the space between the plates. Steam is forced into the center canal, and escaping along the sides of these closely aligned plates, causes a rapid whirling motion. This same device is used as a pump by simply reversing the connections.

For utilizing the excess natural power you mention, we would advise the production of nitric acid or nitrates for fertilizer, the purification of metals, or any electrolytic means of forming elements. You might build huge arc furnaces and use the excess power for smelting, etc.

DOLLARS FOR JOKES

A SCIENTIFIC magazine is supposedly notorious for its dry reading. Still we flatter ourselves that the ELECTRICAL EXPERIMENTER can hold your attention without your yawning too frequently.

Of course you like to laugh—we all do. Sometimes we make you smile while you peruse the EXPERIMENTER. Perhaps sometimes you laugh out loud—at some of our "preposterous ideas" which we print here. And then of course the joke's on us, because we were real serious!

Now it occurred to us that we would like to print a column of real, original jokes every month, but here's the hook: The joke must be a SCIENTIFIC JOKE. No, this is no joke, we mean it!

Anyone can print or re-print jokes, but we want them with a dose of science. So, till further notice we will pay $3.00 as a monthly 1st prize for the best joke, and $1.00 for each other one we print.

So you will know what we mean with a "Scientific Joke," we print one here, which we purloined from the "Baltimore American":

LOGICAL.—"I want some good current literature."
"Here are some books on electric lighting."

Now of course, our readers can do much better than this. So let's wait and see. One reader can submit as many jokes as he pleases. Even if it is old the joke is not necessarily barred or condemned. There is one rule however: The joke must not be too technical; in other words, it must be readily understood by anyone. Not more than 100 words can be used. Use only one side of the paper.

Address
SCIENTIFIC JOKE EDITOR,
Care of this publication.

DEVICE TO CHECK FALLING AIRPLANES.

(1049) M. H. Garland, 5539 Page Ave., St. Louis, Mo., writes us:

Q. 1. Describing a rocket device for checking falling airplanes.

A. 1. Regarding your scheme for attaching several cylinders filled with powder to operate on the order of a sky rocket, so as to permit an airplane to be checked in its downward flight in case the engine should fail, etc., it is very difficult to figure out beforehand, even approximately, just what would happen with such a device as this, as there are so many different factors which may arise in attempting to apply the scheme in practise.

We believe the quickest way in which to ascertain what this device can and would do would be to experiment with a small model airplane rigged up with a series of small fire crackers or special tubes filled with powder, arranged to be ignited in the desired manner.

RADIUM FOR CANCER TREATMENT.

(1050) Charles Rinde, 406 W. Oak Street, Lodi, California, states:

Q. 1. Can radium cure cancer of all sorts:

A. 1. In regard to whether or not Radium treatment can cure cancer of all sorts, we would have to know more definitely as to the exact location and the diagnosis the attending physician has made of the disease before we can advise definitely as to whether or not it could be cured by radium.

Cancer consists of various tumors, both benign and malignant. A Rodent Ulcer sometimes takes as long as two years or more before the "Radium treatment" has any effect upon it whatsoever. Cancer of the tongue and Carcinoma of the tongue of a Melanotic nature does not generally give very favorable reactions toward Radium treatment. Then again the effects of the treatment may not be as permanent as one would like it to be. For instance, in Lymphosarcoma the growth disappears extremely rapidly when irradiated, but usually fresh tumors continue to arise in Lymphatic glands in various parts of the body, and hence a more thoro treatment will be necessary. In Glioma of the Orbit, on the other hand, the tumor disappears within a fortnight of the treatment, but sometimes recurs.

THE CONDENSED CHEMICAL DICTIONARY. 525 pages, cloth covers, size 6¼x9¼ inches. Publisht by the Chemical Catalog Co., New York, 1919.

Undoubtedly, this book is one of the finest and most complete of the chemical catalogs yet publisht, being absolutely reliable and explicit in its details. It is a catalog intended for the chemically educated reader, or the layman in contact with various industries whether he be exporter, importer, broker, jobber, purchasing agent, and in fact wherever the individual having frequent need for detailed information in regard to chemicals and the chemical profession.

We do not believe that there is any other publication having incorporated in one single volume all the matters which this book contains. A novel feature and a great convenience is the fact that a generous space is left between all items giving room for a line or so for text data and a wide margin at the bottom of each page, leaving more room for additional more extended notes.

The book is not crowded and the type is very clear, the arrangement itself being in definite logical order. It is profusely cross-indexed and modern spelling, that is, A. C. S. spelling is used, except where departures from the former spelling are very great, in which case both old and new terms are given. The derivation, properties, a method of purification, grades, containers to be used, the uses, fire hazards, shipping regulations, proprietary uses, and whether made in America or not, are found in logical order, readily understood.

An individual asset is the table appendix in the back of the book, giving atomic weights, tables of weights and measures, metric equivalents, conversion of Fahrenheit and Centigrade scales, specific gravities, definition of units and regulations regarding the transportation of chemicals, which renders this book an extremely desirable reference for every chemist whether amateur, professional or expert.

THE FORD STANDARD EQUIPMENT. Profusely illustrated. 139 pages, size 5¼x 8 inches. Flexible cover. Publisht by the American Bureau of Engineering, Chicago, Illinois.

This is a book originally designed for repair men in any branch of Ford repair work whether it is generator, starter, ignition or motor repair. The manner in which to locate trouble, how to install lighting, or starting systems, of Ford type and many other types, are all included. Obviously, it is not a book for any kind of Ford installation, but it is the book required to thoroly understand the Ford starting and lighting system now being placed in cars made by the Ford Company.

A greater part of the book is devoted to the starting and lighting system, but the ignition system is also completely dealt with, as are troubles other than electric. It is a book for every Ford owner, garage man and repair man.

INVENTIONS: THEIR PURCHASE AND SALE. By Wm. E. Baff. Cloth bound stiff covers, 230 pages, including index. Size 5x8 inches. Publisht by D. Van Nostrand Company, New York.

An ideal book for the inventor, patent attorney, manufacturer, or buyer of patents; describing explicitly the salability of the invention, what do and do not constitute well-founded claims; how to make claims; marketing; together with the cost and retail prices of articles.

It is so profuse in its knowledge, which it imparts to every conscientious reader, that no inventor whether he is a new man in the field or an old timer, should fail to read it.

The book is written by a patent attorney of good standing and explains with remarkable precision how everything regarding patents is done, from the time the inventor gets a "bug idea" until the very end, viz., the final exploitation of the patent.

We would advise every inventor presently engaged in patent work of any nature, or who intends or has had patentable ideas, to secure this most excellent treatise.

ABOVE THE FRENCH LINES. Letters of Stuart Walcott, American Aviator. Cloth covers, 94 pages, illustrated. Size of book 5½x8 inches. Published by Princeton University Press, Princeton, N. J.

A very interesting and out of the ordinary volume which everyone will enjoy reading, picturing as it does the great charm of a strong personality which shows itself thru the various letters here reproduced. The author was one of those sterling aviators who introduced the courage and intrepidity of the American soldier to the French army, and many a pleasant half hour can be spent with this little volume which will appeal to everyone interested in the history of the fliers on the Western battle front. It is in line with that unbeatable little gem of spontaneous mirth, "Dere Mabel." These letters combine the tales of the strenuous days of the aviator and his flying machine in the thick of war, and also little glimpses and side-lights on the *vin rouge* days behind the French lines.

EXAMPLES IN MAGNETISM. By Professor F. E. Austin, B.S., E.E. Flexible covers, 90 pages, 27 illustrations. Size 5x 7½ inches. Publisht by the Author, Hanover, New Hampshire.

This manual of examples in magnetism will prove useful to students of electrical and radio subjects and particularly those interested in the arithmetical and higher mathematical aspects of the subject. The work covers the elementary and further advanced mathematical relations dealing with magnetism and magnetic fields, and some very interesting and well illustrated problems are worked out, so that the student can fully grasp the explanations given. There are sections dealing with the calculation of magnetic moments; pole strengths; the earth's magnetic field and its components; turning moments of magnets; results and forces due to magnetic poles; comparison of intensity of magnetic fields; mapping of magnetic fields, etc. In the appendix at the end of the book are a number of extremely useful tables. One of these gives the three variable magnetic elements, that is, magnetic declination, inclination, and horizontal intensity in gausses for various states and cities thruout the United States, etc. Another table gives sines, cosines, tangents, etc. The index is quite profuse and there is also provided an index of the various examples, problems, illustrations and lessons.

EXAMPLES IN ALTERNATING CURRENTS. Vol. 1, 3d edition (with additions). By Professor F. E. Austin, B.S., E.E. Flexible covers, 224 pages, illustrations. Size 5x7½ inches. Publisht by the Author, Hanover, New Hampshire.

Every student of alternating currents, especially those interested in radio work, will find this volume by Prof. Austin very practical and useful. This book covers problems in alternating currents and the general theory of alternating current circuits in a clear manner, which anyone can understand if they are familiar with the simplest rules of algebra. The calculation and relation of electro-motive force, current and resist-

(*Continued on page* 192)

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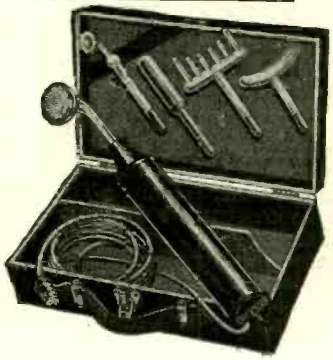

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Book Review

(*Continued from page* 190)

ance are dwelled upon at length in various forms of complex circuits, including those with resistance, inductance and capacity, conected both in series and in parallel. The fore part of the work covers alternating current wave formations; the production of electro-motive forces; A. C. pressures; value of sine curve; rate of change of sine curve alternating quantities; how to plot "curve of squares" for a circle; method of finding the areas of curves; equivalent sine curve; effective or R. M. S. values of non-sine pressures; calculation of the inductance of a coil, and numerous problems on this and allied subjects.

All of the mathematical subjects are clearly explained, making the work a very valuable one indeed to the student. An appendix of useful tables is provided giving the values all worked out for 2π and $\frac{1}{2\pi f}$ and $\frac{1}{(2\pi f)^2}$ for various frequencies f, in cycles per second, from one up to 150, and also 1000, 2,000 and 150,000 cycles per second. Valuable tables are also given of the numeric values of the capacity necessary to neutralize the inductance L in henrys, to produce resonance in an alternating current circuit.

How to Keep up a Car

By HAROLD HOLLINGSHEAD

(*Continued from page* 156)

applied to valve of inner tube before air is applied will prevent any air from escaping from tire.

THE CARE OF BODY.

Now how to keep the isinglass and Pantasote tops in good condition is quite a question to most people. If the top is in a very bad condition, first clear thoroly with kerosene and let dry. Then apply a heavy coat of 3-in-1 oil with cheese-cloth. This is the finest oil of its kind for such purposes, and your neighbors will think you have bought a brand new top. Next, the isinglass is not cleaned with gasolene, kerosene or benzine, but by using a clean soft chamois dampened in clear water, using a little elbow grease, on both sides of the isinglass, together with cleaning and dampening the chamois as you go along. You will find the rust and grit coming off on your chamois, and your glass becoming clear. Be sure and keep cleaning chamois well in clear water, and use no soap.

A rag partially dampened in kerosene and 3-in-1 oil is an excellent remedy to remove all sand and grit from body. To keep from scratching paint on body, great care should be taken to thoroly shake out cloth as you go along, as this cloth will accumulate much grit, which is very injurious to paint. After this is done, a clean piece of silk cloth, from an old shirt-waist, will wonderfully brighten up the paint. If these rules are carried out by automobile owners and drivers they will find their gasolene and repair bills much lower.

A FEW POINTS IN DRIVING.

In driving a car, do not advance spark on starting, or on a hill or heavy pull. You have no doubt remembered your motor knocking on a hill, thru your spark throttle being fully advanced. Restart your spark and you may not get the speed, but you will eliminate the knock, and make your motor last twice as long and save your repair bill. In running your motor idle, slow down motor to slowest possible speed. This will keep motor from heating up and eliminate the collection of carbon, and will also save gas bill. In starting and stopping at all times shift to low or intermediate gears, which will save the strain which would come on motor by pulling in high gear.

AIR FLEET FOR SOUTH POLE.

A fleet of twelve to fourteen airplanes will be taken along on the Terra Nova, the ship which John L. Cope will fit out at London, for his expedition to the South Pole.

"It is not without realization of the limitations of the use of airplanes that we have included them in the equipment," said Captain Wilkins, who commands the air wing. "There will be two pilots to each machine, except on the single-seater scouts. The fuselages will be so constructed that they can be used as sledges.

"There is a general impression abroad that a spectacular dash to the South Pole will be made by air, but this is not so. The principal use of airplanes will be for photographic flights."

I want to ask the readers of ELECTRICAL EXPERIMENTER a very frank question. "Why is it that none of you seem to be interested in becoming Travelling Salesmen or in learning to be an expert Automobile Repairman."

The circulation of the EXPERIMENTER is over 150,000 each month. According to the figures which you all gave me a little while ago there are over four readers to every copy. This means over 600,000 readers of our magazine.

It seems as though among such a vast number of progressive men as this (just think of it, over half a million) there must be a great many who would want to become either Star Salesmen or to learn auto mechanics—the heart of the great automobile industry. This latter industry has already become one of the greatest in the United States—no other country comes anywhere near equaling us in our production of automobiles, trucks, tractors or accessories. And the industry is growing every day. It bids fair to become our second greatest industry, next only to the steel business.

High grade travelling salesmen as well as expert auto mechanics are making big money these days. Many young men all over the country are studying for one or the other position. Why not the readers of ELECTRICAL EXPERIMENTER?

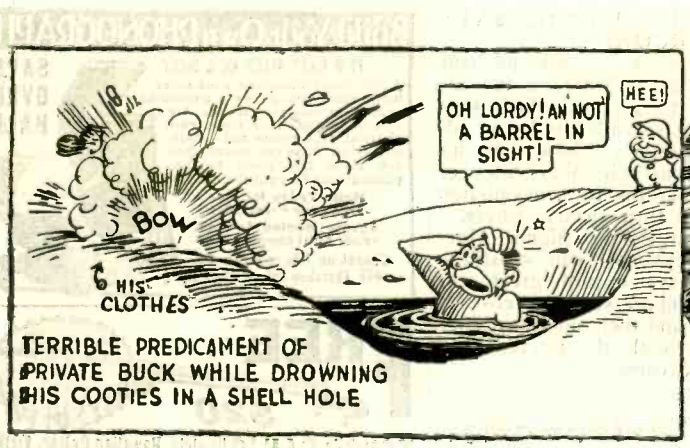
During the past year a number of advertisers have run attractive ads. in our magazine announcing what looked to me like mighty good offers covering instruction in salesmanship and automobile mechanics. When the ads. appeared I thought "Surely, these are going to strike a very responsive chord among our readers." I looked for the ads. to pull heavily. But they did not. For some reason or other very few readers paid any attention to them and in each case the advertiser reported failure.

If our readers are really not interested in such subjects, I don't want to urge these advertisers to try again. But if you are I do. Won't some of you write me personally and tell me whether or not you are interested and if not, just why you aren't—or if there was anything in the ads. that didn't appeal to you, tell me just what it was. I'll certainly appreciate every letter you send me, and you will be helping your magazine and indirectly yourself.

The E. E. is your magazine. The more you patronize your advertisers the more space they will use in ELECTRICAL EXPERIMENTER. The more advertising we carry, the more pages of solid text in that issue. For each additional two pages of advertising we get we add three solid pages of reading matter. So by helping the advertising you help yourself.

Please let me hear from you—just as many as can write me to-day.

R. W. McMott
Advertising Manager.



The Laughter and Tears of America's Greatest Army

The One Priceless Souvenir of the Great War That You Will Enjoy and Treasure Above All Others—A Complete File of 71 Overseas Issues of the Famous Stars and Stripes Bound Into One De-Luxe Volume.

HERE is the most remarkable human document that has come out of the great world war. Here is a living, breathing record of the lives of two million men in war—written by the men themselves as they fought on the bleeding soil of France. It is our soldiers' own wonderful story of those days over there—a story that will live forever as the most unique historical document ever written.

Here is their own true story—the sort that grips the heart and stirs the emotions for it rings with the sincerity of men who suffered the Hell of war and came back smiling. From cover to cover this wonderful volume breathes of the romance, the pathos and humor of the struggles and adventures of America's greatest army.

Nothing can give you so vivid, realistic and gripping a picture of what our soldiers experienced in France as their own remarkable newspaper, the Stars and Stripes, written by the soldiers, for the soldiers, over there on the battlefields in the thick of the fight. It is an amazing story this famous newspaper tells—a day-by-day, intimate, heart-stirring story of war and of the irrepressible spirit of fun that made the American doughboy the wonder of the world.

Behind The Scenes With The American Doughboys

To read the Overseas issues of the Stars and Stripes is to live over, in startling reality, those days with our soldiers in France. It will bring you face to face with actual conditions as they knew them—their novel life in the French villages, their droll experiences with foreign customs, their marches over the long white dusty roads, their nerve-torturing baptism of fire, their glorious gallantry at Chateau Thierry, Saint Mihiel, and their magnificent drive through the Argonne.

The Stars and Stripes is the only publication of its kind in the History of the United States. It was originally intended only for distribution among the men of the A. E. F. in France but its fame grew and spread and many copies found their way back to the States. These are highly treasured and jealously held by their fortunate owners. Fabulous prices have been paid for single issues. Articles from the columns of this remarkable newspaper were reprinted everywhere and finally there sprang up an insistent demand from parents of soldiers, Universities, Statesmen and patriots throughout the country for complete files of this unique, historical publication.

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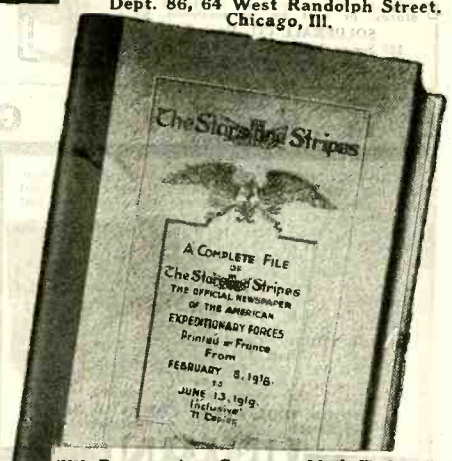

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U. S. LEADS IN RADIO, SAYS MARCONI.

The Italian newspapers recently publisht an article by Guglielmo Marconi, the inventor of wireless telegraphy, which says that the United States heads the list of all countries in wireless inventions, her inventors having surpast all others in producing practical apparatus for transmission of the human voice thru electric waves.

"Within this year," said Signor Marconi, "wireless telephones will substitute the present clumsy system with great economic advantage, suppressing the cost of the telephone lines and their upkeep. They will also do away with the interruptions due to atmospheric causes."

Popular Astronomy
The Earth as a Magnet

By ISABEL M. LEWIS, M.A.

(*Continued from page* 161)

118 days—a record time. She has traversed all oceans from 80° North to the parallel of 60° South and has crost and recrost her own path and the path of her predecessor the *Galilee* many times, thus making it possible to determine for the points of intersection the secular changes in the magnetic elements.

After a thoro overhauling in 1919 and the installation of a four-cylinder gasoline engine, *made of bronze thruout,* to take the place of the producer-gas engine used on earlier cruises, the *Carnegie* started on her sixth cruise with a crew of twenty-three officers and men on October 9, 1919. A cruise of 61,500 miles has been planned in the South Atlantic, Indian and Pacific Oceans to last approximately two years. Unsurveyed regions in the South Atlantic and Indian Ocean will be covered and the route is planned so as to obtain a large number of observations of the progressive changes that have taken place in the magnetic elements. This is accomplisht as stated above by intersecting former routes and obtaining new values of the elements at the points of intersection.

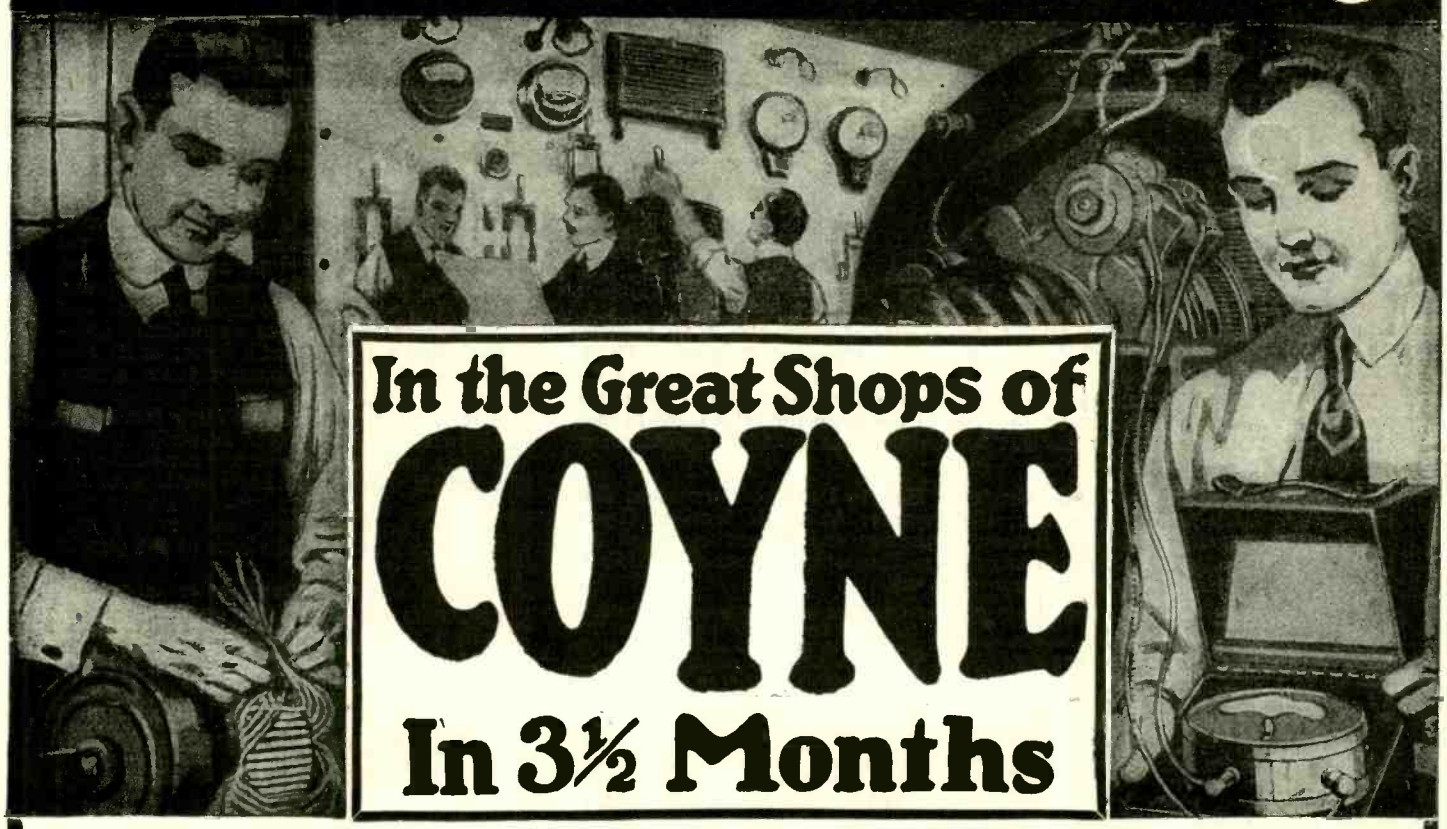
In addition to its ocean magnetic surveys the *Bureau of Terrestrial Magnetism* also carries on extensive land surveys in all parts of the globe. In 1919 special expeditions were sent out by the Department to observe the total solar eclipse of May 29th at stations distributed over the entire zone of visibility of the eclipse and immediately outside. At Dr. Bauer's station in Liberia the total phase was visible in a cloudless sky for more than six minutes, which is very close to the maximum length of phase that can possibly be observed. Unmistakable evidence was gathered at all stations of an appreciable variation in the earth's magnetic field during a solar eclipse, which variation is the reverse of that causing the daylight portion of the solar diurnal variation of the needle.

In addition to the magnetic survey work on land and sea which is the chief work of the *Bureau of Terrestrial Magnetism,* atmospheric-electric observations are carried on continually on land and sea and experiments have been carried on at Langley Field, Va., lately in the development of methods and instruments for determining the geographic position of airplanes by astronomical observations. There has also been recently formed under this department a *Section of Terrestrial Electricity.*

The cause of the earth's magnetic field is still one of the greatest unsolved problems of astro-physics. The theory that has been advanced by Schuster that all large rotating masses are magnets *as a result of their rotation* has received considerable attention from astrophysicists, and attempts have been made to prove this experimentally. It has been found that iron globes spun

(*Continued on page* 196)

Learn Electricity



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Popular Astronomy
The Earth as a Magnet

(*Continued from page 194*)

at high velocities in the laboratory do *not* exhibit magnetic properties. This may mean simply that the magnetic field is too weak to be detected in the case of a comparatively small iron sphere spun for a limited period under laboratory conditions. It must be remembered that the earth has been rotating rapidly on its axis for millions of years and is, compared to terrestrial objects, an extremely large mass. Yet it has been shown that as a whole our earth is an extremely weak magnet, and that if it were made entirely of steel and magnetized as highly as an ordinary steel-bar magnet, the magnetic forces at its surface would be a thousand times greater than they actually are.

If it is true that all rotating bodies are magnets, then all the heavenly bodies, planets, suns and nebulæ are surrounded by magnetic fields. We know nothing to the contrary. In fact, we know this to be true for the earth and sun, and strongly suspect that it is so in the case of the planets *Jupiter* and *Saturn*.

When we understand more about the properties of matter, the nature of magnetism, as well as of gravity may be revealed to us.

Popular Astronomy
Questions and Answers

[By ISABEL M. LEWIS

The following questions have been asked by A. K. L.:

1. Maps of the solar system show all of the planetary orbits on a plane. Are they actually so?

Answer 1. It is customary to represent the orbits of the planets as complete circles, all lying in the same plane, that of the earth's orbit, or ecliptic. As a matter of fact, the planetary orbits are ellipses of very small eccentricity, not circles, and they do not lie in the same plane, but since the inclination of the planetary orbits to the plane of the ecliptic is so small (amounting to only 7° in the case of Mercury, the most inclined, and averaging about 2° for the others), it is more convenient, tho not strictly accurate, to represent them all lying in one plane. In form the orbits of the planets are so nearly circular that, again with the exception of Mercury, their ellipticity could not be detected on a drawing eight or ten inches in diameter.

2. Was there ever any attention given in astronomical circles to Vail's theory of the annular world, in which he tried to prove that the earth once had Saturn-like rings which produced queer effects upon the religion and mind of primitive man?

Answer 2. I have never heard this theory discussed astronomically.

If the earth had been originally surrounded by Saturn-like rings it is very doubtful whether they could have existed up to the age of primitive man, as the theory you mention states, and yet have disappeared so completely in the comparatively short interval of time, astronomically speaking, that has elapsed since the age of primitive man.

There are astronomers who are inclined to the belief that other planets besides Saturn were originally surrounded by rings of meteoric particles, and, according to a cer-

tain lunar theory, the moon was formed by the breaking up of such a ring, many millions of years ago, and its lunar craters were formed by a bombardment from meteoric masses within the ring. It must be remembered in this connection, however, that many lunar craters are fully fifty or more miles in diameter, while recent observations of Saturn's rings set three miles as an upper limit for the size of the individual moonlets.

3. How powerful would a telescope have to be to ascertain whether the "canals" on Mars are natural or artificial, and what would this power be in ratio with the most powerful existing telescope?

Answer 3. The visibility of the "canals" of Mars is not dependent alone upon the size of the telescope used. We have here a problem in which the atmosphere plays a very important part. Observers of the Martian canals insist that their visibility depends quite as much upon having excellent "seeing" conditions as upon the telescope itself.

It must be remembered that when high magnifying powers are used the imperfections of the atmosphere are also magnified. It is well known that the moon under high magnifying powers appears more as it would viewed thru water instead of thru air.

If it were possible to establish an observatory at an elevation of three and one-half miles, thus leaving behind one-half of the earth's atmosphere, we would come closer to solving the mysteries of the "canals" of Mars than by increasing the size of our telescopes.

I do not know what results have been obtained with the 100-inch Mt. Wilson reflector in observing Mars, or whether this great instrument has yet been turned on Mars, tho it has been stated that it shows a wonderful amount of intricate detail on the moon; but it is well known that the 60-inch reflector of the Mt. Wilson Observatory has not yet revealed the canals of Mars, and neither has the 36-inch Lick reflector. Yet there are now too many independent observers of the canals of Mars who have all seen the same canals with comparatively small telescopes to make their actual existence any longer a matter for doubt.

It is generally considered that high magnifying powers are not suitable for the observation of planetary detail, owing to the imperfections of our own atmosphere. High magnifications only magnify the "boiling" and unsteadiness of the air that are so fatal to the observation of all finer detail on the planets and moon.

If the canals of Mars are actually artificial waterways made by intelligent beings it is, of course, not the actual waterway itself that is visible, but the strip of vegetation lining its banks. No telescope that man has built or could build would show lines on Mars only a few hundred feet wide, and no artificial waterway would be made so wide.

Practical Chemical Experiments

By PROF. F. L. DARROW

(*Continued from page 167*)

appears in the tube. For purposes of comparison test at the same time an equal quantity of distilled water and compare the number of drops of soap necessary to

give permanent suds in the two cases. This will give an idea of the degree of hardness.

To determine whether the hardness is temporary or permanent boil a 50 cc. sample of the water and test as before. If less soap is required than before but still more than perfectly soft water, the hardness is partly temporary and partly permanent. If there seems to be no difference in the amount of soap required, the hardness is all permanent. If the water seems entirely softened, the hardness is all temporary.

DETERMINING THE IMPORTANT MINERAL CONSTITUENTS.

First evaporate a half liter of the water to one quarter its original volume. Filter and save both precipitate and filtrate.

Dissolve the precipitate by pouring thru the filter the least possible amount of dilute hydrochloric acid, and collect the solution in a clean test tube. In doing this note whether there is any effervescence. If there is, *carbonates* are present.

Iron: To a little of the above solution add a few drops of potassium sulfocyanat solution. If a red coloration results, iron is present.

Calcium and Magnesium: To another small portion of the solution from the precipitate add a little ammonia water and ammonium oxalat solution. If a white precipitate forms calcium is present. Warm and filter. To the filtrate add ammonium chlorid solution and a little of a solution of di-sodium hydrogen phosfate. If upon shaking and rubbing the inside of the test tube with a glass rod, a white crystalline precipitate forms magnesium is present.

Sulfates: For sulfates, test both the solution from the precipitate and the filtrate obtained from evaporating the half liter of water. To a small quantity of each add a little barium chlorid solution and dilute hydrochloric acid. If a white precipitate insoluble in the acid results, sulfates are present.

Phosfates: Evaporate to dryness the remainder of the solution from the precipitate, moisten with nitric acid and add an equal volume of ammonium molybdate solution, prepared as described in the previous article on the sanitary examination of water. Let it stand over night. If a yellow precipitate forms, phosfates are present.

Chlorides: To 10 cc. of the above filtrate add a little silver nitrat solution and dilute nitric acid. A white precipitate shows the presence of chlorides.

Calcium and *magnesium* may also be present in the filtrate and therefore the same tests as before should be made with the filtrate too.

Lead: Evaporate 50 cc. of the filtrate to 10 cc. and add a little of a solution of potassium bichromat. If a yellow precipitate forms lead is present.

A confirmatory test may be made by passing hydrogen sulfid gas thru some of the concentrated filtrate for a few minutes. If lead is present a black precipitate will appear.

Sodium and Potassium: To test for these metals evaporate some of the filtrate, obtained from the evaporation of the half liter of water, to small volume. Into this dip a clean platinum wire and hold it in the oxidizing portion of a Bunsen flame. If the flame is colored yellow, sodium is present. See Fig. 5. Repeat the operation, but this time look at the flame thru three thicknesses of cobalt blue glass. A violet color seen thru the glass proves the presence of potassium.

The course of procedure outlined in this article covers all the important tests made in the ordinary chemical examination of water for industrial purposes. It comprises work of great interest and of high commercial importance.

Radium—the Bad Boy of Science

By HAROLD F. RICHARDS, M.A.

(*Continued from page 171*)

a *skyscraper*, or it could be included in the circuit of the electric chimes in a church steeple, so that the successive alpha particles could *play chimes* for the amusement of the town. In order to emphasize the enormous magnification represented by these actions, I may be permitted to repeat what I said in a previous article—"that the electrical charge carried by an alpha particle is so small, that as many of them would be required to light an ordinary incandescent lamp, as there are drops of water in the modern swimming tank."

2. A "SPEEDOMETER" FOR GASEOUS IONS.

The nature of the *ions* produced in gases by the action of radium rays, ultra-violet light and X-rays is best investigated by determining *the velocity with which the ions move*. The variation of this velocity with the nature, pressure and temperature of the gas sheds much light upon the characteristics of the ion. Before describing the experiment I may as well state that the results of many experiments have shown that, in all probability, *the process of ionization consists in the expulsion of an electron from a molecule of gas*. The electrical charge on the electron then attracts other molecules to it, *so that the ion is really a cluster of molecules, bearing a single electronic charge*. This molecular aggregate moves under the action of an electric field, but suffers many collisions with other molecules. The experiment to be described permits us to measure the *velocity* with which the positive and negative ions move. The apparatus *automatically* starts and stops the action in the space of *seven-thousandths* of a second, and registers how fast the ions traveled *in the meantime*.

Figure 2 illustrates the apparatus used. It involves what is called a *gravity* or *drop chronometer*, which is really nothing more than a clock capable of measuring intervals of time down to *one thousandth of a second*. As is well known, the action of gravity upon a body is always *uniform*, and we can determine at once, by a simple calculation, how long it will take a falling body to cover the distance between two given points, if we know how far it has already fallen. In the apparatus as illustrated, the *projectile* is a steel cylinder held in place by an electro-magnet. If the circuit in the magnet is broken, the projectile falls, and in so doing releases *in succession* two light mechanical *trips* of iron, which have been held in place by very weak magnets. When the trips are thrown by the falling weight, *electrical connections* are broken, and the time elapsing between the breaking of these two connections is readily found, when we know how far the two trips are apart and how far the weight has fallen before striking the first one. When the first trip is thrown, the primary circuit of a large *induction coil* is broken, and this causes a *single instantaneous* flash of X-rays to pass thru a narrow slit into the ionization chamber. In order to avoid a spark when the connection is broken, so that the break will be instantaneous, a capacity of a few tenths of a microfarad is connected around the break. This is not shown in the diagram. The X-rays are so directed that they produce a thin layer of ions at the surface of the first plate in the ionization vessel, which is simply a brass box. This plate is originally connected to the negative pole of a battery of storage cells, and the *electric*

field causes the *negative* ions to be driven across to the other plate, while the *positive* ions are immediately absorbed in the first plate. The charge communicated to the second plate is measured later with an electrometer. Now comes the most important feature of the experiment. When the falling weight strikes the first trip and thus causes ions to be produced at the surface of the first plate, that plate is at a *negative* voltage; but when the weight strikes the second trip the plate is brought into connection with the *positive* end of the battery, the electric field in the ionization chamber is *reversed*, and the ions which were moving towards the second plate are turned back to the first plate. The time elapsing between the production of the ions and the reversal of the field can be easily regulated to such a value that the negative ions just fail to reach the second plate, before they are forced to turn around and return to the first plate. The *drop chronometer* tells us this time, and since we know the distance between the plates, we can at once tell how fast the ions traveled.

In order to ascertain when the ions have just reached the second plate, the time allowed for the ions to travel towards it is gradually increased until the electrometer shows the first indication of a charge. The electrometer consists of a flat circular brass disc cut into four segments. Two of these segments are connected to earth, and two to the plate whose potential is to be measured. A very thin needle of paper, covered with aluminium foil, is suspended by a fine quartz fiber above the crack between the segments. The needle is charged to 80 or 100 volts. When any electrical charge reaches the brass disc, the needle is deflected, and the amount of twist is measured by the motion of a spot of light reflected from a very small mirror attached to the fiber that carries the needle. The method by which the reversal of the electric field is effected is very simple. A battery of storage cells is earthed in the middle, so that its two poles are at potentials of 50 volts *negative* and 50 volts *positive*, respectively. These two poles are *short-circuited* thru a *high* resistance of 50,000 ohms, furnished by a test tube filled with water. Before the lower trip is struck, the plate of the ionization chamber is connected to the *negative* end of this circuit, but when the trip is thrown, the circuit is broken, and the plate is left connected to the *positive* pole to the battery. This reversal of potential occurs virtually instantaneously, because the water resistance is practically *non-inductive*.

In an actual experiment, the weight was allowed to fall one foot before striking the trip that starts the experiment. The distance between the two trips necessary to allow the ions just to reach the second plate was found to be 0.75 inch. Therefore the time elapsing between the starting and stopping of the experiment was 0.007 second. In this time the ions moved 0.25 inch, which was the distance between the plates. Dividing 0.25 by 0.007, we find that the velocity of the ions was 36 inches per second, or about 2 miles per hour. This was in air at atmospheric pressure.

In the course of many experiments, performed under different conditions, it was found that the velocity of the negative ion in air varied from 20 *to* 140 *inches per second*, for a field of 50 volts per inch. The apparatus is sufficiently sensitive to reveal the difference between the velocities of the positive and negative ions. The latter always move somewhat faster than the positive ions, which shows that the positive ions are *heavier* than the negative ones. From these figures it is evident that the ions are very slow compared to the *alpha* or *beta* rays of radium, for these rays travel at speeds varying from 15,000 to 150,000 *miles per second!*

"A" FOR ADAM, AND "E" FOR EVE.

A telephone clerk in the San Francisco, Cal., office of the Postal Telegraph-Cable Company, had finished copying a telegram from a patron, and then began repeating the contents of the message according to instructions, relates *Telegraph and Telephone Age*. The first word of the message was "Ship," and the clerk quite properly started in: "S, for Samuel, H, for Henry, I, for Isaac, P, for Philip," and about this stage she realized that the patron was making signs, or yelling for help. When he succeeded in "breaking," the clerk was advised that the sender of the message did not care a Chinaman's back-tooth about her friends, Sam, Henry and Ike. What he wanted was to have the message read back to him. What could the poor girl do?

How "Cartoon Movies" are Made

By JOSEPH H. KRAUS

(*Continued from page* 132)

Thus it might take 20 to 30 pictures to show a person talking, his mouth opening and closing. In photographing for this result, very peculiar skill is needed. Thus there may be two exposures, of one picture; one of another, perhaps three of the third, et cetra to give the desired effect. In the "breath space" mentioned, after the Kaiser and Prince have knocked at the door of the inter-allied peace council, the words slowly formulate "Looks like ve're not vanted."

415 SEPARATE DRAWINGS IN 1 "MOVIE" CARTOON.

In animations of chasers, (where people race down the street one after the other, et cetra, in one cartoon made by Mr. Bert Green, who has drawn the cartoons here shown, was shown a street at night and as you look down the block you would see a man coming around the corner, rush to a saloon on which was the sign "closed". He then stumbled across the street, only to find another hope shattered—"Closed" on the next saloon. He did this all the way down the street, pausing, leaping, running, jumping, before one-half dozen saloons, until he got to the foot of the street (or the foot of the screen, rather). In this latter act, lasting a few seconds only, Mr. Green figured 160 drawings would be necessary, but by the time he had his created friend "down front," 415 drawings had been made.

Drawings of this nature are held until ready for the camera man, whence they are taken to the photographic room, where they are placed in the frame, one after another in their proper relation and photographed by the pressing of the button, which in turn releases the shutter. The camera itself is electrically driven with a cam-like device which allows for the snapping of one picture at a time. Sometimes the button is prest three or four times in succession in order to obtain that many stills of that particular position. The film, is then in order, to be run off and corrections, changes, and cuttings, are made in the trial room. Two lamps, one on each side, of the mercury vapor type are used to illuminate the board.

EDUCATIONAL VALUE.

So far we have spoken of "cartoon movies" in respect to comedy and animated functions, but they have a purpose which serves far better ends than these. Take, for instance, the drawings showing in animated form, the cross-section of a gasoline engine in action, the gas coming down, bubbling over, vaporizing, filling the chamber, the revolutions of the shaft taking place, the piston being pulled down, the valves closing, the piston rising upward, and at the height of compression, a spark occurs, the explosion forcing the piston around again,

—all shown in animated form so beautifully, that one can never forget the internal operation of a gasoline engine, when once it has been seen.

Again in this gasoline engine movie, the stationary parts are placed on celluloid and moving parts on paper, both the celluloid and paper being photographed together, like mat work in regular photography,—sixty-four drawings, each separate and distinct, were necessary for the moving piston alone, in order to eliminate the jerk, so common in most cartoons of this type.

Even cut or sectional models cannot explain or instruct in detail to the same extent that these animated pictures do, and for this reason we see a great future for animated cartoons of this nature. Not alone in the field, of the cartoon itself but in the educational field, namely showing people how to do things and demonstrating to laborers who may not know the language, exactly what they must do in order to carry on to successful completion, some necessary operations.

Mr. Bert Green and Miss Kelly, his assistant, have often sat up nights for weeks at a time photographing and drawing pictures for animated cartoons of this type.

"In order to have a smooth running cartoon", says Mr. Green, "it is necessary that a good deal of patience and time be expended. It is actual labor and by no means happens as quickly as you'd think."

The Amateur Magician

By JOSEPH H. KRAUS

(*Continued from page* 163)

Our puzzled faces grew even more perplext when the Professor burst out in an uproarious laugh, "Simple; why, it's so simple," he ejaculated. Taking the wheel itself from its suspended pin, he stated: "Now this wheel is 12 inches in diameter, perfectly balanced, having a jewel bearing or a cup shape bearing in one end which rests upon this pointed steel rod. There are no wires leading to the wheel itself, but under the arrow at this end is a curved flat piece of soft iron. This is balanced by a piece of copper at the opposite end similarly placed. The entire bottom is then covered over with a thin piece of black paper and varnished so that the iron and copper embodied in the wood base will not be seen in the event that the wheel be removed.

"The disc upon which it rotates is numbered as you see from 1 to 10, and in the false bottom of the table is the mechanism which controls the wheel. This mechanism chiefly consists of ten electric bell magnets taken from ordinary electric bells, and so mounted that they will act directly upon the iron base inserted into the wheel. Thus when an electric circuit is made thru any of the magnets, the wheel naturally stops at that point, being first slowly retarded and then held in place (due to the relatively long iron armature). In order, however, that the action be invisible to the spectators, the wheel is allowed to slow down considerably so that it barely moves along.

"In the false bottom of the table likewise, is the required battery. Here, three ordinary dry cells are employed, altho more compact units could be used. As to the wiring, I shall show you this presently."

Releasing the catch on the side of the table, he lifted the cover off, much the same as one opens a phonograph box. The wiring there was clearly apparent. "You have noted by this time," he added, "that the table is made up of small brass squares, fastened to the wood seemingly for an artistic effect, but mainly for concealing the method of making contact to the magnets,

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A Wartime Radio Detective—Part II

By PIERRE H. BOUCHERON

(*Continued from page* 177)

I swept the Hudson River with my glasses and I was sure I saw a rather uncertain answering "blinker" on one of the ships lying at anchor!

Following previous instructions our next step, now that we were sure of the existence of the flashes, was to immediately dash to the top of the Singer tower in order to catch the signalers "with the goods." After considerable argument, necessitating much explaining and proof of authority, a night watchman took us to the tower, where for the space of half-an-hour we searched diligently for the concealed signaling system, but without results. The watchman finally decided to leave us and went back to the elevator with which we had come up, after having promised to return in a short time. As for my companion and I, we decided to remain in the now completely darkened tower and endeavor to hear or see anything connected with the mysterious flashes as we were both certain they had originated in this very spot.

The elevator had no sooner started on its downward trip when the corner where we had crawled at the top of the tower was suddenly illuminated by several vivid flashes of a most weird bluish kind. At the same time we heard the sharp metallic click of an electric circuit-closing device. We were both transfixt with astonishment and fright. My detective friend made for his hip pocket while I, if I remember rightly, literally sweated blood—as I frantically tried to regain my wits and decide on the next move. The flashes stopt for a short period when they suddenly reappeared again. This time we both looked in the direction from which they came, which we noticed to be at the top of the elevator shaft. Thru the blinding light of the flashes I saw the exact spot from which they were emanating. Finally the awful truth dawned upon me—the "mysterious" light signals were being caused by the *elevator starting and stopping switching device!* That is, the circuit-breaking system which controlled the electrically operated elevators, and which in this particular case were installed at the very top of the shaft, were directly responsible, for every time the elevator started and stopt the resulting make-and-break of the circuit breaker would cause a rather large arcing at the points of contact and this vivid arcing could plainly be seen to distant observers thru the tower windows. It will thus be evident that if the elevator stopt at several floors on its way up or down, a considerable number of flashes would result and these had naturally enough aroused suspicion. Needless to say our written report on this case was a short and snappy one. No, thoughtful reader, in our hurried exit from the building we did not stop to explain things to the night watchman. Thus ended an otherwise perfect tho at first mysterious night.

THE PARADOXICAL PHANTOPLEX CIRCUIT.

For many moons there had been literally heaped upon our heads all manner of complaints and reports from telephone subscribers all the way from Yonkers to Albany, N. Y. These reports were to the effect that signals closely resembling the dots and dashes of Radio-telegraphy were being heard on telephone lines, and in some cases these signals were so strong as to seriously interfere with speech. At first this was assumed to be *induction* of some sort which could easily be traced by telephone engi-

neers. However, the number of cases assumed such large proportions, and some of them seemed to be so logical in their wording, that it was finally decided to investigate them. In fact, the deciding factor was brought about by a report prepared by an expert radio man who was willing to back his professional reputation that the signals were man-made, and furthermore sounded very much like radio.

Ordinarily, such a condition might have been explained by ascribing it to the bona fide transmission of nearby naval stations, where oscillations were induced in a telephone wire acting as an antenna, and where the telephone transmitter rectified the signals so as to be heard in the receiver. However, in this case the signals were said to be *unreadable;* that is to say the characters themselves were foreign to either the Morse or Continental Codes, and even an expert operator was unable to make sense of any individual character; moreover, had they been regular radio signals, code or cipher words could have been copied. Accordingly, several expert radio men were instructed to investigate the origin of these strange signals, starting from the outskirts of New York City, and slowly working up as far as Albany, N. Y. With the assistance of telephone exchange officials, a series of tests were conducted and the strange signals heard at various times on many telephone circuits leading to the Capitol.

We had with us an expert telegraph and radio operator whose boast was that he could copy two messages being sent at the same time, one in Continental and the other in Morse Code, writing with both hands. Not only this, but he claimed he could read messages *backwards* as well; so that with such talent in our party we were prepared to copy anything in the dot and dash category, including static and Martian! After a great deal of head shaking and cursing, our expert friend admitted having met his Waterloo, as altho the signals were composed of dots, dashes and spaces, *no combination of them could be interpreted to assume the outline of even one letter!* Had we been able to make sense of the signals their source of origin could have been traced without much trouble, but under such circumstances there was only one conclusion to be formed, which was that here was secret information of some sort being transmitted between certain points without the cognizance of government, telegraph or telephone engineers and officials. So the case began to take on a more serious aspect, particularly when it was brought to the attention of officers charged with the welfare of the nation.

Our expert operator, however, had not given up hope, and each time the signals were heard saw him making wild pencil and paper movements in an endeavor to catch some of the elusive dots and dashes.

Finally the denouement came with the unexpectedness of an exploding bomb, when one day our expert telegrapher dasht into our midst, shouting "I've got it, I've got it." In his hand he held a piece of paper which he proceeded to explain to us. The accompanying illustration, Fig. 1, is a copy of his sketch as nearly as I can remember it.

It seems that he had managed to copy on paper a series of dots and dashes exactly as he had heard them, even tho they had been sent at a considerable rate of speed; after which he had carefully studied the characteristic of each dot, dash and space. As will be seen in the illustration the upper line of dots and dashes are those which he had heard, while in the lower line is to be seen the *exact opposite* of the above. That is to say, where a *space* had occurred in the series of "heard signals," a *dash* had been marked below; where a dot had occurred a slight space had been marked below, and

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The Amateur Magician

(*Continued from page 202*)

which are between two adjacent brass squares. These are all placed on the diagonal, as shown in this little sketch. It is very simple now for me to place my hand over the required square and when the wheel slows down sufficiently to allow the ring on my finger to make contact between the two squares, which excites the respective magnet. This accounts for the wheel stopping at the place I desire. Incidently, if I should energize the magnet following the one where the wheel has stopt by placing my finger across those contacts, the wheel will move forward due to the action of the magnets making a sort of an electric motor from the device."

Closing the cabinet he showed how, by placing his ring between two adjacent points, and running his hand across the table in a careless sort of manner, he could cause the roulette wheel to rotate with increasing speed every time he repeated this procedure. "It can readily be stopt incidently by just going backward, like this," and demonstrated that by passing his hand along adjacent squares in an opposite direction, bringing the wheel to practically an immediate stop. "Neither of these systems are generally used because of their very perceptible fraudulent trait. For that reason, the wheel is always allowed to slow down sufficiently before the current is permitted to flow thru it."

The visitors eventually left, and before I went I said: "Can you give me a diagram of the hook-up of that outfit, Professor?" "With the utmost of pleasure," he answered, and scribbled down the diagrams which we are able to reproduce here.

"By the way, Old Timer, I've received quite a number of letters from individuals who think that I am revealing the secrets of the magic profession, but I would like to state here that all my experiments have been *original with me*, and in all my years in the Magic field I have never come across any similar ones. It may be that since I have retired some devices apparently similar to mine have come out, but I wish to state here that I will attempt to keep my devices strictly within new and unknown fields, and in no way will I attempt to present to the public sleight of hands or 'Black Art' tricks, which are so old that they have whiskers sprouting out all over them. Some of them would do good to get shaved at least once every hundred years." I've noticed that also, I added, but every knock is a boost, you know. Then thanking him for the pleasant evening I had enjoyed, I departed. More anon.

A Sea-Going Ferris Wheel

By H. GERNSBACK

(*Continued from page 143*)

this were not so, the waves could overturn or spin the car around on its axis, with destructive effects on the passengers.

As will also be noted, the track should be so designed that the wheel only dips into the water up to its hubs. In other words, three cars will always be submerged, while three will be out of water and vice versa.

As to danger, there is much less danger to such a device as this than will be found in our roller coasters, which kill scores of people yearly. The experience we have gained from submarines during the war enables us to build the cars water-tight and practically free from all danger. Even if

tube, the same as on a business type *Dictaphone*. Each day or at each change of the news period, the same as when new editions of the newspaper come out, the message records are removed from the reproducing machine and new ones inserted. The old ones are then shaved at any convenient time which makes them ready for the next *news recording*. The phonographs, are of course, all driven by electric motors and started and stopt by the press of a button controlling electro-magnets actuating on the necessary clutches and brakes. The various sections of the switch-board panels assigned to the respective news topics, would be labelled.—Social news, Sports, Stock Markets, Marriages, etc., and the incoming calls from subscribers for these different classes of news could thus be instantly switched to the respective switch-board section, and the operator having jurisdiction over this particular news.

For smaller localities, the inventor has several other ideas which could be worked out for a lower priced equipment, with a small switch-board. For these small districts it would not be necessary to have a complete phonograph record for *each* news item, and one record could then take care of several items such as Financial, Social and Sport news. The machine would of course be calibrated so that the operator would know on what part of the record each news item was recorded in the same manner as the regular business Dictaphone is calibrated, so that you can tell on what part a certain letter is recorded by knowing between what scale numbers along the record, the letter was recorded.

LATEST NEWS VIA POCKET RADIOPHONE.

Thus far we have seen that the Newsophone presents itself in a very practical manner and one that can be adapted to the requirements of practical inter-communication at a reasonable cost, when used in connection with the regular telephone service. However, there is another aspect of the Newsophone, and that is to use it in conjunction with *wireless telephony*.

As Mr. Yeager has pointed out, and has been suggested many times in the past few years by some of our leading radio experts, including Signor Marconi himself, it will probably be only a very short time before it will be possible for anyone to intercept wireless telephone messages from a considerable distance, thanks to a pocket wireless receiving set which can be carried in the ordinary coat pocket. In fact some of these sets have been built so small that they will easily go in the vest pocket, exclusive of the watch-case receiver which is held to the ear. A great dream of the future, which we would like to mention here so that it goes on record, and which most probably the readers of this article will live to see before a great while, is the radio distribution of news by central news agencies in the larger cities, to thousands of radio stations in all parts of the world. Then any one can simply "listen in" on their pocket wireless set, connected to the nearest metal body such as a radiator, iron bed or umbrella, and receive the "Latest News."

X-RAYING OLD MASTERS.

The examination of old masters is the latest use to which the X-rays have been put. The results, as Major G. W. C. Kaye demonstrated at the Royal Institution, are important. He showed two pictures by Dutch masters, one representing the Madonna and another the Crucifixion. In the former the Madonna appeared to be looking at something which was non-existent on the canvas, but a radiograph examination proved that the missing something was a child.

In the second picture a woman in an attitude of prayer was discovered to have been painted over what was in the original the figure of a man in monkish garb.

Interplanetary Communication

By ALBERT V. T. DAY

(*Continued from page* 135)

might be discovered in the rays from the sun and many stars, and if the photo-electric detector could be made sufficiently rapid in function, it might disclose such fluctuations occurring at very high frequencies, for instance on the order of radio waves.

It seems not unlikely that explosions within the solar atmosphere would produce sound waves affecting in some manner the radiated light intensity with a modulation of corresponding periodicity. *The plunging of meteors into the sun might be HEARD in this way.* The rushing meteor streams of Saturn's rings might also be heard by their irregular light reflection as they pass thru the field of the telescope. It is not inconceivable that one might even listen to the scintillating waves and dashing sunlit streams of another planet's waters. These speculative prospects of course depend on the assumption that any fluctuations inherent in the sun's light would be insufficient to drown the effects of fluctuations in its reflected light caused by the planet or other reflecting object under investigation. In any event it seems likely that many clues to celestial phenomena might be discovered through light fluctuations not sensible to the eye.

For many of the foregoing purposes, the optical accuracy of a telescope would be unnecessary, and a relatively enormous light-collecting reflector surface could be employed. The photo-electric detector could be located on a mountain eminence to receive the concentrated superposed light beams from a large number of individual reflectors mounted on lower ground, or on an opposing slope. If it were in any way worth while and expense, it would be practicable to thus cover an acre or even a square mile, with reflectors thus disposed to coact upon a common detector. This system would be efficient in requiring only a single reflection of the received light. A very simple mechanical scheme has already been devised for composing the angular motion components of the reflectors essential to render their reflected beams stationary and convergent upon their common detector. Substitution of a source of signaling light in the place of the detector will project the artificial light for outgoing signals, under control of a modulating circuit affecting a synchronous tilting of all the reflectors.

A slight addition to this reflector—directing mechanism will enable the reflectors to continually project a beam of reflected sunlight from one planet to another, under control of the modulating circuit. In this instance there will be no limit to the reflecting area, within the bounds of permissible expense. This scheme might be employed for exchanging signals between Mars and the Earth, while the Earth is observed from the night side of Mars near the horizon. Each planet could then send its reflected sunlight signal from its daylight side, and detect its reply signal on its night side, if this were necessary in order to avoid interference of local sunlight with the received signal. Obviously the communication could be rendered continuous by establishment of stations encircling the planets at suitable intervals of longitude.

Not only could light fluctuations be detected in the foregoing manner, but the apparatus could also be adapted to detect and measure constant lights of minute intensity, by employing a periodic rotary shutter, for instance in the focal plane, to cause fluctuations in the light received by the detector. In this instance the frequency of the light fluctuations could be chosen for maximum efficiency.

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.

SPECIAL NOTICE!

Of late we have received so many letters from our correspondents regarding patent advice, that it has been quite impossible to publish all of them.

Altho printed in the smallest type possible, we cannot accommodate more than ten or twelve answers a month. At the present time we are about four months behind. Of course, if our correspondents have time, no harm is done! We would however, advise that if a quicker answer is wanted, correspondents should avail themselves of our special service, as per the notice printed at the head of this column.

All letters are answered in turn as they come into this office, and for this reason it will be understood why it takes so long for an answer to be publisht. Will correspondents please bear this in mind?—EDITOR.

Automatic Steam Valve

(385) Mr. John Burbank of Brunswick, Maine, sends in a drawing of a thermoradiator valve which allows for the escape of air until its temperature reaches about 80 degrees, at which time the mercury in a tube is caused to expand, the expansive force closing the valve successfully.

A plunger action in the valve seat itself allows or much higher temperature without damage in any way.

A. This device is probably one of the cleverest which has yet come to our attention, and we believe that it will be extremely practical, because it can be cheaply made, is fool-proof, and seems to possess all those features which are so necessary and are not embodied in the present radiator valves.

We would advise, therefore, that you get in touch with a reliable patent attorney and have a search made.

Transmitter Diafram

(386) Mr. A. G. Buckner of Portland, Oregon, submits a drawing of a telephone transmitter to the diafram of which is attached a coil of wire. This coil is surrounded by another stationary coil, the claims being that a solenoidal action will take place between the two coils, allowing for an inductive effect from one coil to the other. It is claimed that inasmuch as the diafram vibrates, the device should work.

A. You are quite right in assuming that when the diafram of a receiver vibrates, particularly if made in the manner you describe, that a current will be induced in another coil which could be used for transmitting purposes. But in order to receive an audible signal at the other end of this line, the initial energy would have to be amplified about 16,000 times thru audion amplifiers.

You must remember that the diafram of a transmitter vibrates about .005 of an inch maximum. This does not allow for a great cutting of the magnetic lines of force in the primary coil. The additional weight applied to the diafram would also tend to cause a sluggish action on its part and altho the plan you have suggested is feasible, we do not believe that it would be a commercial success, similar ones having already been patented and forgotten; one in particular, where the diafram had a very thin perfectly flat coil of wire attached to it, this being in juxtaposition with the stationary coil, also of the pancake type. In this way, a much greater effect was noticed but not sufficient to produce audible transmission, without amplification. We, therefore, would not advise a patent on this scheme.

Collapsible Automobile Table.

(387) Mr. Wm. Kossen, of Brooklyn, N. Y., submits a design for a table to be attached to the back of the front seat in touring cars, said table being collapsible. Stating that when persons desire to camp out, they would have good use for the same.

A. We do not believe that the application of a table to the rear of the seat of an automobile, as you have designed, would be of any great value, as when persons desire to camp out, they do not generally like to remain in the car in order to eat their lunch; an added inconvenience being that crumbs, etc., will fall into the car.

Secondly, large cars invariably have some mode of access into the rear of the forward seat in which commodities, etc., are kept. This would prevent the application of the table.

Thirdly, the changes necessitated in the car itself and the various size tables would make such method of procedure a great inconvenience, and quite costly. It would, therefore, be much better to use the small collapsible tables now on the market for purposes of this nature, hence, we do not believe that even tho a patent could be obtained on the device, it would prove of commercial value.

Electric Piano.

(388) Mr. B. M. Gritz of Adams, Massachusetts, submits a device which he claims is entirely original in the form of an electric piano. Each key will make contact closing a circuit to magnets which in turn are to attract the hammers.

A. We regret to inform you that your idea is not original. This is contrary to the belief which you have entertained. A quite similar electric piano, yet simpler than yours, was described in the ELECTRICAL EXPERIMENTER fully 2½ years ago.

This latter was even so arranged that it could be played by means of the ordinary "roll" and hence we do not believe you could obtain a patent on the same.

Loading Coil.

(389) Mr. Duane Ingraham, of Herminie, Pa., sends us a drawing of a loading coil made up in three parts, one perpendicular and two horizontally arranged along the same line, saying "Could I obtain a patent on this combination amateur and commercial loading coil which I invented? It consists of two coils of wire and four switch levers for control. The horizontal coils are arranged so that they form one coil, the vertical one extending upward from the center. The latter is for short wave lengths and has taps at every inch, the former for long wave lengths. Dead-end switches are included. The entire device is 26 inches long and 12 inches high."

A. We could not advise a patent on the loading coil which you have shown in your diagram for several reasons; first, it is too cumbersome, occupying too much room. Secondly, the bank-wound or honeycomb coils could be built much cheaper, serving the same purpose.

Thirdly, it would be very simple for anyone to obtain three loading coils and place them in the position they occupy in your diagram, or in fact, in any other position which would answer the purpose just as well, and it would be impossible for you to obtain a patent on the switches and method of placing the switches which you illustrate; hence, we do not advise now or any other time, the patenting of simple radio apparatus of this nature.

Antenna Switch.

(390) Mr. Dominick Siedlecki, of Schenectady, New York, submits a drawing of an antenna switch constructed on the principle of a balance. Pressing on either side opens the circuit at one end, and closes another. Three contacts are used in one circuit, and two on the opposite swing of this "balance" switch. The correspondent writes: "You can easily see by the illustration that by just one short snappy movement pressing on either knob, opens one circuit automatically; closes another. I have constructed a model which works very well."

A. There is nothing new in the device which you propose. It has been used time and again in radio circuits. In addition, it is good for only small power, falling far below devices presently on the market even for these low-power circuits. Hence, we do not believe that patent is advisable, or would even be allowed by the patent office.

Compound Gasolene Engine.

(391) Mr. Joseph Jakubowski, of Webster, Mass., asks our advice, "Would it be possible to obtain a patent on a gasolene engine made to run on the principle of a cross-compound steam engine? If mixture explodes in No. 1 cylinder, it could pass on to another cylinder."

A. It would be impossible to have a gasolene engine work on the principle of a compound steam engine, the reason being that gasolene when once exploded has not the energy which it would have if a new mixture were allowed to enter.

Of course, the mixture after having exploded, could pass into a cylinder forcing another piston out to a slight extent, but the added efficiency from this other cylinder could not be considered, when the added bulk is taken into consideration, as well as the back pressure caused on the No. 1 cylinder.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24. 1912.

Of ELECTRICAL EXPERIMENTER, published monthly, at New York, N. Y., for April 1. 1920.

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

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

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

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.)

Experimenter Publishing Co., 233 Fulton St., New York City.

Hugo Gernsback, 233 Fulton St., New York City.

Sidney Gernsback, 233 Fulton St., New York City.

Mrs. K. Hymes, 233 Fulton St., New York City.

Harry Winfield Secor, 233 Fulton St., New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds. mortgages, or other securities are: (If there are none. so state.)

None.

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

H. GERNSBACK.

Sworn to and subscribed before me this 5th day of April, 1920.

[SEAL] BEATRICE K. OWEN,
Notary Public, New York County, No. 57. New York Register, No. 1129.

(My commission expires March 30, 1921.)

EARTHQUAKE BREAKS TWO CABLES IN THE SOUTH PACIFIC OCEAN.

Two earthquakes occurred in the South Pacific Ocean recently, resulting in the breaking of both South American cables, according to information received in Washington.

An examination of the seismographic records at Georgetown University disclosed that both shocks were recorded there, the first, which was of considerable intensity, at 1:50 P.M. and the second at 6:48 P.M. The first continued until 2:25 P.M.

The centers of the disturbances were estimated at 3,800 miles from Washington.

A report on the breaking of the cables, both of which were south of Callao, has been made to the Navy Department by the cable companies.

The Phantom Arm

By CHARLES S. WOLFE

(*Continued from page* 151)

"Fine!" snarled the Chief. "Fine and sarcastic! But it won't work. My men found the spot where the shot was fired from. They found the gun, evidently thrown away in haste after the shot was fired. And more, within a radius of fifty feet they found a handkerchief with Coates' initials stamped on it in indelible ink for laundry purposes. Everything points to Coates. Everything but the fact that Coates couldn't possibly be in two places at once."

"No, hardly," agreed Fenner. "Well," he looked at me humorously. "Looks as if you've got yourself mixed up in another case, Bill, old top. I know you want to be in on it. Look me up in the morning, will you, and we'll see what we can do."

"In—in the morning!" sputtered Davidson.

"Sure," said Fenner, wearily. "With nobody dead, and the suspect already in the toils, you don't expect me to trot out at midnight, do you? Here, Chief, relax! Where's those extra 'phones? Here—back your ear up to this, and lap up a 'phone full of this stuff. It's great!"

But a slammed door, and a muffled curse, told us that the overwrought Davidson had taken himself and his burden of responsibility off to fresh duties.

The next morning Fenner and I made our way to the City Hall. Davidson, burly and heavy-eyed, glowered at us from behind his desk.

"Any rift in the fog this morning?" queried Fenner, cheerfully. "Have you fastened the crime on Coates' astral entity?"

"Fastened it on nothing!" savagely. "What do you want?"

"Just a slant at the weapon," said Fenner. "We'll begin at the beginning."

Without comment, Davidson produced a modern high-powered rifle. It was a wicked thing. Its sight was calibrated for ranges from point blank to fifteen hundred yards. Fenner took it in his hands and turned it over and over.

"Sure this is the weapon used?" he asked.

"Empty cartridge in it when found," replied Davidson, promptly. "Plain evidence of having been recently discharged."

Watching Fenner closely, I saw a swift gleam of interest light in his eyes, and as suddenly fade. He jerked open the magazine. "You took out the rest of the clip, of course?" he asked, carelessly, as he snapt it shut.

(*Continued on page* 215)

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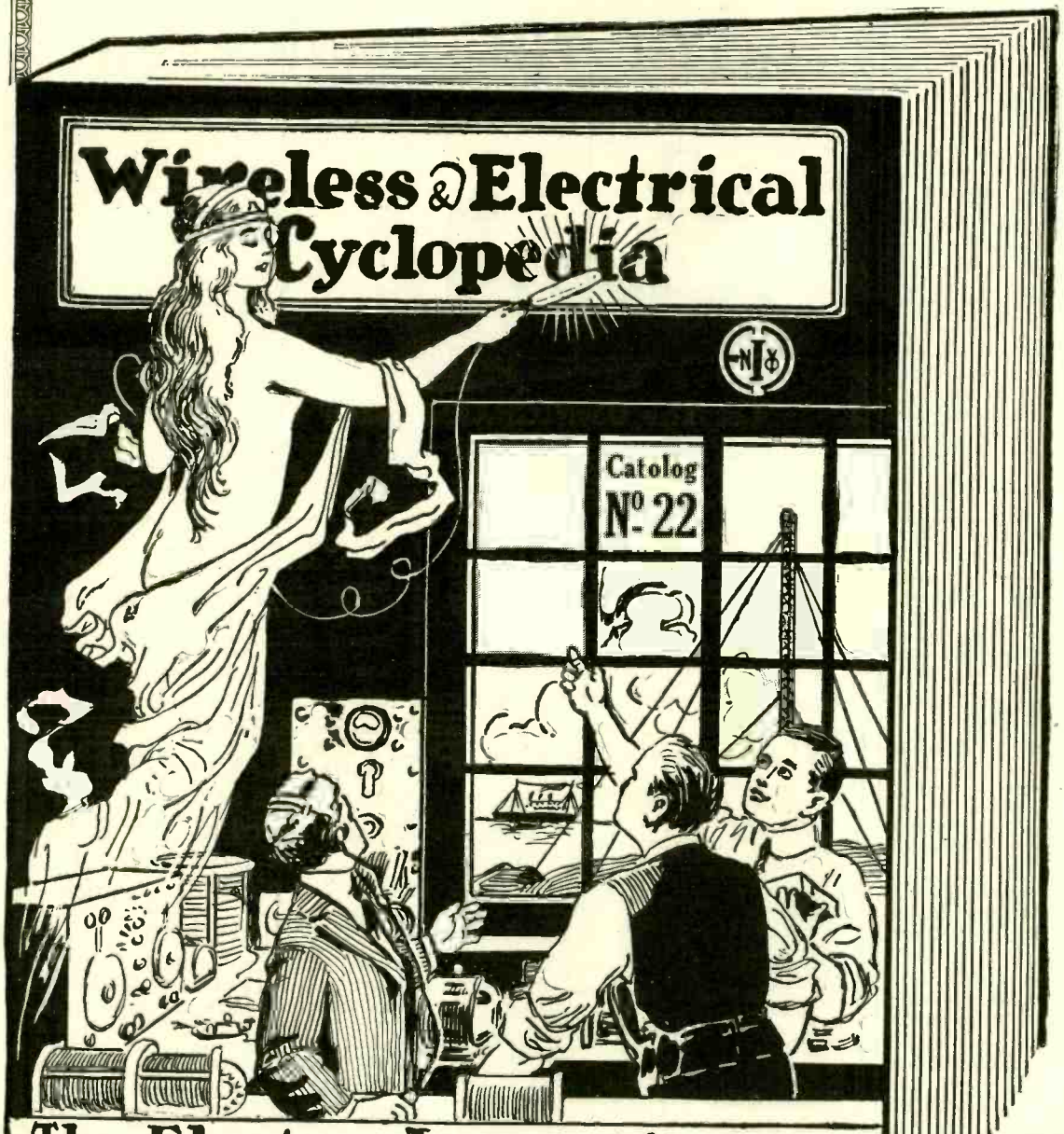

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IN A WORD THE MOST COMPLETE CATALOG IN PRINT

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"Everything for the Experimenter"

The Phantom Arm

(*Continued from page* 213)

"No," demurred Davidson. "There was only the one cartridge in the chamber."

"Search Coates when you pinched him last night?" quizzed Fenner, still turning the gun over speculatively.

"We did that," acquiesced Davidson. "Why?"

"Find any ammunition for this or any other gun in his clothes?"

"No, but that signifies nothing."

"True," granted Fenner. Suddenly he handed back the rifle. "Whose rifle is it?" He fairly shot the question at the Chief.

"Belongs to a man named Smith," grinned the Chief, evidently pleased that the query had found him prepared.

"And where does Smith come in?" Fenner asked, mildly.

Davidson grinned with huge enjoyment. "He is a friend of Coates," he said, sweetly. "Coates borrowed it from him day before yesterday. Anything else?"

"Yes," said Fenner, cheerfully. "Transportation for two to the scene of the shooting, please."

We boarded a trolley bound for Bloomeville. "Can you let us off at the place where the motorman was shot last night?" Fenner asked the conductor as we handed him our complimentary tickets.

"I can," replied that worthy, grimly. "I can let you off at the ex—act spot. I'll not forget that location for quite some time. I was on the back end when Johnson was shot."

Fenner's glance at me spoke volumes. "Is that so?" he said, interestedly. "How did it happen?"

"I was sitting just inside the rear door, making up my report after we'd past the fare limit and I'd been thru the car," said the conductor, evidently willing to talk. "When I heard something bang against the closed front door, I beat it out on the front platform, and there was Johnson in a heap. I shut off the power and give her the air, and stopt her. Johnson was 'out.' I dragged him into the car, and somebody dug up a half pint, and we got him conscious. I ran the car back, and he rode on the front platform with me, holding a handkerchief to his nose. He was weak and shook up, but game. We both thought Coates did it."

"Did you know Coates?" asked Fenner.

"Sure!" came the reply. "He worked for the company until Johnson threw him off when he was drunk. The 'super' fired him, then."

"Motorman?" queried Fenner.

"No, barnman," said the conductor. "He repaired cars and brought in cripples."

"Didn't you get off and look for him?"

"Not me!" retorted the conductor. "I didn't know how bad Johnson was hurt and I wanted to get him into the hospital fast. Here you are."

And we stept off at the place where Johnson was shot.

The road lay along the river. On the left was the river bank, on the right a gentle slope led up, covered with small trees, thick briar bushes, and crawling vines. Fenner turned his attention to this hill.

We plunged into the underbrush and, following a straight line from the point indicated by the conductor, came to a spot, much trampled, which bore mute evidence of the activities of Davidson's men.

"Sit down, Bill, and make yourself at home on this historic spot," chortled Fenner, "while I take a look around."

Nothing loathe, for the climb thru that tangled underbrush had been strenuous, I sat down to recover.

By the time I was rested Fenner was back at my side, whistling "Till We Meet Again" lustily. "Come on, old timer," he said, gleefully. "Us for the roadbed again."

"Find anything?" I demanded, as I scrambled to my feet and followed him down the hill.

"Now, now," he reproved over his shoulder. "No naughty questions. Don't be like Davidson."

He was evidently in high glee, and I was growing excited. I had seen the mood once before—about a half hour before I was formally introduced to the "Educated Harpoon."

When we reached the roadway, he paused.

"Bill," he said, solemnly, "do I look crazy?"

"No," I said, mystified. "What——"

"Then don't yell for help when you see what I do next," he begged. "I am about to look under a trolley track. It is an undignified proceeding."

"What the——" I began, but he was already prone in the road, his finger moving underneath the rails and between ties.

I glanced up the track. A trolley was approaching, bound cityward. "Look out," I warned. "Here's a car."

"I'm not deaf," he retorted, as he scrambled to his feet. "Stop him."

We rode back to the City Hall.

As we entered, Davidson was about to leave. "Hello, you fellows," he greeted. "I was just going to leave. The mystery is cleared up."

Fenner's face fell. "Who——" he began.

Davidson laughed. "It shows what having a fixed notion of a thing will do to your thinker," he said. "Coates didn't do it, after all. I've turned him loose. We rounded up a guy that I think will confess in a couple of hours."

Fenner was grinning again. "Is that so?" he asked, mockingly. "Well, Chief, that's too bad. Now you'll have to hurry and arrest Coates all over again. For he certainly did do it."

Davidson's jaw dropped. "What the Hell are you talking about?" he demanded. "He couldn't. He was in Lowrey's pool room——"

Fenner broke in earnestly. "Go and round him up again as quickly as you can, Chief. I'll show you."

We sat waiting, Davidson, Fenner and I, in the Chief's private office when two detectives brought in Coates. He was very angry.

"Ain't you done with me yet?" he snarled. "What do you want with me now?"

Davidson turned quizzically to Fenner. Fenner gazed a long minute at Coates. Then he reached for a pad of paper, and took a pencil. "Come here, Coates," he said, "and watch me."

Coates stood by his shoulder, and Fenner sketched rapidly.

As he watched, Coates' face blanched, the sweat stood out on his forehead. Then suddenly he broke out hoarsely, "Yes, you've got me. That's how I pulled it off. I confess, Davidson. It was me. And I'm glad, damned glad, I didn't croak him. With this slick guy after me, it would be me for the chair. Lock me up."

When Coates was gone, Davidson turned to Fenner. "Show me," he demanded, briefly.

Fenner laid the diagram he'd been sketching before us. As I glanced at it, I started. Davidson stared perplexedly. "Looks like Greek to me," he said, dubiously.

"It was clear enough to Coates," exulted Fenner. "Those are electrical symbols, Chief. He's an electrician, you know. I got wise when you showed me the gun this morning. The first thing that struck me

(*Continued on page 218*)

A Wartime Radio Detective

(*Continued from page 204*)

where a dash had occurred a space of equal length had correspondingly been marked below. The result of this as will be seen was that the lower dots and dashes were *real Morse signals* corresponding in this particular case to NY NY NY AB, meaning that NY (New York) was calling AB (Albany). Other dots and dashes had been copied in a similar manner, and when deciphered were shown to be regular commercal messages of a very ordinary nature and lacking anything like suspicion.

So far, one thing had been solved, which was that the signals were quite authorized ones and were therefore no longer mysterious. As for the reason for their inverted nature which had previously baffled us, this was also very shortly explained to us in the following manner.

A so-called *Phantoplex circuit* had recently been placed in operation by one of the large telegraph companies between New York and Albany, whereby an alternating current was superimposed upon a telephone or telegraph line in such a manner that it was made to operate a complete telegraph system, supposedly without interfering with the normal activity of the line. In other words duplex telegraphy was accomplisht on a *phantom* circuit, and the *back stroke* of the sending operator's key was the one which induced impulses in various external circuits such as telephone and other lines parallel to it; these impulses, of course, corresponding to the frequency of the alternating current used in the "Fan" system. Fig. 2 shows a schematic diagram of a single line Phantoplex terminal station. Thus, in a nut-shell, you have the explanation of a rather simple electrical condition, which puzzled several of the country's leading electrical and radio engineers for many days, and I sometimes wonder how near to a solution we would have arrived, had it not been for the ingenuity of our expert Morse man.

THE ENIGMATIC SHIPMENT OF "MEDICAL" SUPPLIES TO MEXICO.

One day "a friend of the United States" sent in an anonymous letter telling us to watch for a certain case of goods addrest to an individual near Mexico City, Mexico. The case was supposed to leave on the steamer Monterey, sailing on the following Friday. Ordinarily, anonymous letters are usually bad actors and seldom reliable; the contention being that a real citizen is never ashamed to disclose his identity, when the matter has to do with the interest of his country. On the other hand, some of our correspondence school "deteckatives" may come sleuthing back at me with the information that anonymous reports are usually the work of dissatisfied accomplices who have turned traitor by "squealing," and therefore communications of this kind should be treated at face value. Be that as it may, either conclusion may be right, as it all depends upon extenuating circumstances.

This particular anonymous letter was written in a foreign script in exceedingly poor English and explained that we would find the shipment consisting of an interesting array of "supplies" much in demand by the Army and Navy at that time. The case seemed rather unusual and well worthy of investigation, so I and another investigator, specializing in export cases, began a systematic search for the origin of two large packing cases then reposing on one of the East River piers. After many inquiries had

been made of truckmen, warehousemen and others, we found that the cases had been recently delivered to the truckmen by means of a cart, and the address given on the receipt had been a "blind" one. This in itself began to look suspicious, so that we finally decided to go back to the pier and look the two large cases over a little more carefully.

These consisted of the regular type of packing case surrounded by metal bands to strengthen them. They were addrest to a certain Señor near Mexico City, and in addition bore the legend "Medical Supplies —Handle With Care."

The exigency of this peculiar case, whereby we had been unable to secure any trace of the shippers, coupled with the fact that the ship was due to sail the next day, decided us. One of the cases was carefully opened in such a manner that if found a bona fide shipment, it could easily be repackt and allowed to proceed. Upon prying open one of the covers a great assortment of small medical supplies, such as vaseline, camphor, salts, patent medicines, etc., was found and everything began to point to another false alarm. Inwardly my opinion of anonymous letters dropt about 100%. We had about decided to repack the case when one of our number remarked that since we had gone to all this trouble we might as well empty the contents of the case and make sure. When we reached the center of the case, the cut-rate druggist's "delights" suddenly began to disappear, and in their place there was disclosed to our view a large cardboard box. Upon opening it we found the niftiest set of *radio receiving instruments* that ever graced a trans-Atlantic long distance station. *A loose coupler, evidently designed for long wave reception, loading coils, several sets of head telephones, an array of variable condensers and even tho they were practically unprocurable except to the Army and Navy signal branches, there was included twelve vacuum tubes of a type manufactured at that time by the Western Electric Company, as well as several testing devices.*

This was indeed quite a find, as during this period the shipment of radio instruments was very carefully watched particularly when destined to nearby neutral or unfriendly nations, as it was known that despite close censorship of the regular means of communication, definite information was being exchanged between stations in the United States and Germany. Then to make the disclosure complete, the second case of the shipment in question was found to contain parts necessary for the installation of a 50 kilowatt Telefunken radio transmitter which was not a surprise, considering certain information we had previously received on the activities of numerous high power radio stations lately established in nearby countries.

By the way, it may interest some of our embryo sleuths to know that the particular Herr Professor, who had been engineering these "medical" supplies shipments, was shortly thereafter caught in a downtown warehouse in the very act of "doctoring" a case of "hardware," destined to a point not far from Cartagena, Colombia, where, some of you may recall, was located a "somewhat active" high power radio station, sadly in need of repair parts.

There you are, gentle reader; you know almost as much about the case as I do. In the next installment I will tell you about the clever use made of a lightning rod for sending and receiving; the scientist who had secured permission to erect a long antenna in order to develop a new system of "underground radio," after which we shall take a ramble into the very heart of the Catskills, where a German millionaire had erected a secret windmill tower radio station.

REASONS FOR USING BARE WIRES.

"For military reasons, if for no other, the Signal Corps has recently undertaken certain investigations in the phenomena connected with the transmission of high frequency electromagnetic waves over bare wires in earth and in water.

"In carrying out these investigations and in attacking the problems from various angles, the research staff of the Signal Corps laboratory at Camp Alfred Vail, Little Silver, New Jersey, was directed to carry out experiments on bare wires laid on the surface of moist ground and also buried in earth. The staff at the Signal Corps research laboratory at the Bureau of Standards was directed to investigate fundamentally the transmission of electromagnetic waves over *bare* wires in *fresh* water.

"Telephone and telegraph communication has been established between Fort Washington, Maryland, and Fort Hunt, Virginia, across the Potomac river, below the city of Washington, *over a distance of about three-quarters of a mile* (nearly 4,000 feet), by the use of a bare No. 12 phosphor bronze wire laid in the water to connect the stations. The transmitter consisted of an electron tube oscillator which delivered a current of about 270 milliamperes to the line at a frequency of about 600,000 cycles a second. At the receiving end of the line an electron tube and a 6-stage amplifier were used without any ground connection. With this arrangement good tuning was obtained at both ends of the line, and telegraphic and telephonic transmission secured over bare wires immersed in fresh water.

RESONANCE WAVE COIL DEVELOPED.

"A resonance wave coil has been developed. The coil is in the form of a long helix wound with a large number of turns on which stationary waves are produced by the incoming radio signals. An electron tube is used as the detector, the grid being connected to the point of maximum potential on the coil. The wave coil may be used either as a part of the usual antenna system or a part of a line wire, or it may act itself as the antenna for picking up the energy of the signals. In the latter case the coil may be either free at both ends or grounded at one end. Good results have been obtained in either case. It has been also found that the open coil has directional properties and can be used as a goniometer not only for horizontal measurements but for vertical measurements as well. This form of radio goniometer has the great advantage that it permits not only of determining the plane where the signals are strongest but also the direction from which such signals proceed.

"Telegraph and telephone communication has been also established between two stations at the Signal Corps Research Laboratories at Camp Alfred Vail, Little Silver, New Jersey, using a bare No. 16 copper wire buried in the earth to a depth of about eight inches to connect the stations. The distance between the two stations was three-quarters of a mile. Frequencies as high as one million cycles a second were used. Similar communication has been carried on over a bare wire one and three-quarter miles long laid on the surface of moist earth. The current at the transmitting station in these installations was about 100 milliamperes. It has been shown that a bare wire buried in moist earth *with the distant end open*, can be tuned both at the transmitting end and at the receiving end."

As many radio experimenters today have available vacuum tube oscillators suitable for transmitting by radio telephony or undampt radio telegraphy, this field of experiment should prove interesting. There is also another phase of this work which could be experimentally tried out without Audions, at least for telegraphic signals, and that is by means of a buzzer such as those used by the signal corps in carrying out field telegraphy.

Signal Buoy for Ocean Ships

By EDWIN F. LINDER, M.E.

(*Continued from page* 131)

In most of these unfortunate calamities upon the high sea great loss of life has occurred due to lack of methods for keeping in communication with vessels speeding to help the shipwrecked passengers and crews. Not long after a ship had taken in enough water, usually the engine room and such machinery used for wireless became dead, and no means of further communication remained.

The buoy is intended to make up this deficiency as one of its chief features. Being a separate unit makes it possible to provide a system of this kind long after the vessel has sunk.

The searchlight plays probably the most important part in summoning assistance to those in the lifeboats and not alone flashes the signals upward into the sky where it can be easily seen by the navigators on the bridges of ships perhaps one hundred miles away, acting as a guide to the place where the survivors are waiting to be taken aboard, but it also makes it possible for the lifeboats to keep reasonably close to each other during the time of darkness, thereby lessening the chance of drifting apart and not being seen by the rescue ship. This was one of the difficulties in the *Titanic* disaster.

On having performed the work for which it is constructed, if possible it is hoisted aboard the steamer making the rescue, but should for reasons of impracticability it be found that it must be abandoned, a seacock is opened which gradually permits water to fill the entire buoy, sinking it so that it does not become a menace to navigation.

Eliminating the "Hello Girl"

By H. E. CLAPHAM

(*Continued from page* 146)

line follows the step-by-step method, that is, to pick out a particular line in an exchange, the major group is first selected, then a smaller group and so on, until the 100 line unit containing the desired line is reached, when the connection is extended finally to the line itself.

HOW CIRCUITS ARE SELECTED AUTOMATICALLY

As is generally understood, in the present telephone exchange, there is a pair of copper wires running to each subscriber, and connection between any two parties is effected by joining the individual circuits, and promptly separating or breaking them at the end of the conversation. Of course, the subscriber has nothing to do in this matter, but to give the desired number to "Central," who puts thru the connection.

The automatic system, as might be surmised, must have some arrangement at the subscriber's end of the line, by which he can call the party desired. This is here shown, as a numbered dial, secured to the base of the desk telephone, see Fig. 1. The numbers around the edge of the dial range from 0 to 9, thus enabling any combination of figures to be selected. The neat dial on the front of the telephone is all that the subscriber sees, but quite a wonderful mechanism is attached to that little dial, which is hidden inside the instrument. At the edge of the dial, as seen, there is a little fixt hook or protruding finger stop. In calling a number, the finger is placed in one of the openings in the perforated upper dial, directly above the specific number; then the dial is rotated in the clockwise direction toward the fixt stop aforemen-

tioned, when the finger is removed. Then the dial, propelled by a spring mechanism, flies back to its normal position, but in so doing a toothed segment, rotating with the dial, makes a certain number of electrical contacts, corresponding to the number at which the dial was released. Thus, if the dial was released with the finger in a hole number 7, then when it turned back its segment and contacts would send 7 distinct electrical impulses over the line to the "Central Exchange," where a special electromagnetic selecting device moves contacting fingers over certain contacts, suitably arranged, making the connection to the desired circuit.

The call of any number made up of more than one digit, is accomplisht by inserting the finger in the dial, rotating it to the fixt stop, and releasing it, for each number in succession.

The details of the automatic selector at the exchange will be understood from the following: In the drawing, Fig. 6, is represented, a simple selector or circuit finder, for an exchange of 10 subscribers. The 10 subscribers' lines or circuits terminate in the 10 pairs of metal plates or *bank contacts*, as they are called, arranged in the arc of a circle and numbered from 1 to 10, respectively. A ratchet wheel, R, is arranged with its center at the center of this arc of contacts, and carries a pair of springs, W, technically termed a *wiper*. The line of subscriber No. 1, for instance, by whom it is supposed that this machine is used, is represented as being connected not only to the first pair of *bank contacts*, but also to the wiper W; to the rotary magnets, and to the release and rotary push buttons.

Now suppose that subscriber No. 1 wishes to connect to line No. 2. To do this, he presses twice (theoretically speaking), the rotary push button (Rot. B, in drawing), located at his telephone instrument. This closes a circuit from the battery thru the *rotary* magnet. Each time that this circuit is completed the *rotary* magnet is energized and attracts its armature, A. This armature, in turn, carries at the end of its arm, the pawl or finger, P, which engages the ratchet wheel, R, and moves it, and with it the wiper, W, one step each time that the armature is attracted. Consequently, when A has been attracted and released twice in succession, the wiper, W, will have been moved from its normal position at the left of the first pair of contacts, and will rest upon pair No. 2, of gap between the terminals of line No. 1 and line No. 2. By means not shown in this diagram, subscriber No. 2 will be signaled (bell rung) and called to answer his telephone.

The arrangement of the apparatus is such that when the conversation is finisht, and calling subscriber No. 1 hangs up his receiver, the release magnet (Rel. Mag. in cut) will be momentarily energized, and so attract its armature, thus pulling the retaining dog, D, out of engagement with the ratchet-wheel, which is then instantaneously returned to its normal position by means of a clock-spring. This release is here shown as if actuated by the push button, Rel. B. In a similar manner subscriber No. 2 could readily call line No. 1. This explanation, tho simple, shows the principle upon which the more complicated selectors or electromagnetic switches in the larger exchanges operate. The proper sequence of electrical impulses for the actuating of the rotary control magnet, is automatically sent by the spring propelled drum and dial at the subscriber's instrument. While the dial is off normal the transmitter and receiver are shunted out by a pair of springs, in order to eliminate noise in the receiver and strengthen the impulses. Figure 7 shows the circuit of the calling telephone and its relation to the line relay of a switch.

A TYPICAL 100 LINE SYSTEM

A good understanding of the switching mechanism may be had from a consideration of a 100 line system. A 100 line switchboard consists of 100 lineswitches and a number of connector switches. The number of connector switches needed is based upon the greatest number of conversations carried on at any one time.

Each telephone line has its own individual *lineswitch*. The lineswitches are mounted on uprights in groups of 100, and placed in steel and glass cabinets, as shown in the photograph. When a subscriber lifts his receiver, the lineswitch associated with his line extends the line directly to a trunk leading to the line relay of an idle connector switch, and at the same time prevents any other line from using that particular connector switch. The lineswitch must be regarded as an efficiency device, since it makes possible the use of a small number of connector switches for a large number of lines, while without its use each line would have to be equipt with a connector switch. Since the cost of a connector is many times that of a lineswitch, the saving is very apparent. It must be remembered that the lineswitch operates independent of the calling device. It does its work and goes out of business immediately the receiver is lifted. See complete circuit diagram figure 5.

We now come to a consideration of the *connector switch*. The connector takes the place of the operator of a manual board in reaching and testing the desired line, starting the ringing, giving "busy" signals, releasing the connection and the many other things that an operator does in a manual system.

A connector switch (see photograph figure 3), consists essentially of a shaft carrying three wiper springs, which may be lifted by a step-by-step ratchet action, and which may at any step be similarly rotated. Within the mechanism and not shown are three magnets, one for lifting the shaft, a second for rotating it, and a third for releasing it. The relays shown mounted above the switch are for controlling its action. Mounted below the switch are shown what are known as *contact banks*. The lower or line bank contains 100 pairs of small brass punchings, each pair of which is connected directly to the telephone line at the lineswitch. These contacts are arranged in ten semi-circular levels and the numbering of each pair is based on the number of steps required to lift and rotate the lower pair of wiper springs until they rest on the pair of contacts. Thus the number of the lower left hand pair would be 11, since it requires one vertical step and one rotary step to reach it. See diagram figure 5.

The upper or private bank consists of 100 single contacts similarly arranged, which are for the purpose of protecting busy lines from intrusion. Each connector has its own banks of contacts and the line and private contacts are mutiplied from bank to bank. Now suppose we wish to call number 56 on this system. The first operation of the dial must serve to lift the wiper springs to the fifth level of contacts, while the second operation must rotate the shaft until the wipers rest on the contacts of the desired line.

It might be interesting to see just how the two *motor magnets* are operated by impulses from a common source. In figure 8 is shown a simple circuit of the two magnets and the relays which control their action. Lifting the receiver at the telephone extends the circuit of the line relay (L.R.) thru the line to the calling device mainsprings. When the line relay operates it closes the circuit to the release relay. A peculiar feature of this release relay is that it is somewhat slow to release. The slow release feature is secured by placing a heavy copper collar around one end of the core.

Arend F J, r, 813 5th av.....PLA za 4226
Arends Katharine, MD, 178 W 97.....RIV rside 0570
Arendt E, r, 156 W 86.....SCH uyler 2861
Arendt Edwd & Son, Leaf Tob, 151 Water.JOH n 1635
Arendt Ellis, 151 Water.....JOH n 1635
Arendt Simon, r, 29 E 129.....HAR lem 4202
Arengee Co., 21 W 4.....SPR ing 7224
Arens A, Leaf Tobacco, 182 Water.....JOH n 4747
Arens Miss Adele, r, 29 W 84.....SCH uyler 2493
Arens Burchard, Cafe, 520 8th av.....GRE eley 5141
Arens Edgmont H, Bookseller, 17 W 8.STU yvsnt 0717
Arens F X, r, 119 W 80.....SCH uyler 6347
Arens Max, Lawyer, 271 Bway.....BAR clay 5786
Arensberg A, Drugs, 1002 So blvd.....INT rvale 2925
Arensberg M, r, 961 St Nich Av.....AUD bon 1520
Arensberg Walter C, r, 33 W 67.....COL mbus 4826

DR. ROGERS, RADIO INVENTOR, HONORED.

Dr. J. Harris Rogers, of Hyattsville, Md., discoverer of the principle of underground and underwater radio, was recently extended a vote of thanks in a joint resolution unanimously adopted by the Maryland State Assembly. The resolution was introduced in the Senate by Oliver Metzerott and in the House by Clarence Roberts.

Dr. Rogers has been a student of electrical science for many years, and has achieved international prominence. For more than ten years he has devoted his energy to the development of radio.

At the outbreak of the war he tendered his inventions to the Government without reservations. An intricate system was worked out, with stations in various parts of the country. Communication was established between submerged submarines and airplanes, enabling the "subs" to attack to advantage. The system was used in the trenches, and at times was the only means of communication between dugouts and the rear.

Dr. Rogers' work has won great recognition, and Senators France and Smith of Maryland are now co-operating to have Congress adopt a joint resolution recognizing his services.

EDISON'S TELEGRAPH "SENDING" TO BE PRESERVED.

At the joint reunion of the Old Time Telegraphers and Historical Association and the United States Military Telegraph Corps held in Cleveland, Ohio, September 10-12, 1919, a resolution was presented by E. P. Griffith, superintendent of telegraph of the Erie Railroad Company, which had in view inviting Thomas A. Edison to place on phonographic record a message to telegraphers; Mr. Edison himself to send the message by means of a key and sounder, says *Telegraph and Telephone Age*.

Arrangements have now been made with Mr. Edison to carry the project to a reality, and he has agreed to have made a pure nickel master record which will last permanently and from which duplicates may be made.

Mr. Edison's Morse sending will be preceded on the record by an introductory speech by David Homer Bates, and it is the intention to have this record placed upon a machine for reproduction at future gatherings of the Old Time Telegraphers and Historical Association and United States Military Telegraph Corps.

Chicago Professor gave Foundation for Einstein's Theory

By ROBERT H. MOULTON

(*Continued from page* 144)

sion on weights and measures asked Professor Michelson to devise some method by which the meter length could be accurately reproduced. The meter is theoretically *one forty-millionth of the earth's circumference;* but this definition is not accurate enough for scientific purposes. Professor Michelson announced the length of the meter in terms of cadmium light waves, with a maximum error of one part in two millions! This definition will always enable scientists to reproduce the meter accurately, as long as cadmium light retains its properties—which is as long as the earth exists.

The first achievement to bring Professor Michelson's name to the attention of the scientific world was his accurate determination of the velocity of light, accomplisht also after overcoming tremendous experimental difficulties. Light is the fastest thing in nature; it represents the absolute limit of speed. After four years of work and study, Professor Michelson announced that light travels with a velocity of 186,330 miles per second. The maximum error in this figure does not exceed one-fortieth of one per cent. The accuracy of this may better be judged when it is stated that, altho light travels at a speed equivalent to more than seven times around the earth per second, the maximum error in Professor Michelson's figure does not exceed the distance a man could walk in a single day.

On the subject of *spectrum analysis,* Professor Michelson has devoted many of the best years of his life. Spectrum analyses are obtained by means of the *spectroscope.* Every substance when heated emits a characteristic light. By means of the spectroscope this light is analyzed and the elements giving off the light are thereby revealed. The spectroscope has enabled scientists to determine the elements in far distant stars. It has made possible tremendously important discoveries concerning the nature of atoms, the minute particles of which all matter is composed.

The difficulties of spectrum analysis will be realized when it is learned that a single atom of sodium emits 800,000,000,000 vibrations per second, of two slightly different kinds of light. Professor Michelson was engaged in spectrum analysis very long before he improved the spectroscope, calling the improved type an *echelon spectroscope.* This

The Stereoscopic "Movie" Screen

By JOHN J. FURIA, A.M.

(*Continued from page* 134)

from a hyperboloidal one. This distortion is not produced by a true hyperboloidal mirror.

The results of Dr. Pech's investigations were communicated to the *French Academy of Sciences,* at Paris, where a great deal of interest was aroused. As a demonstration of the correctness of the theory, Dr. Pech built a movie screen hyperboloidal in shape, and of a curvature empirically determined to most nearly give the same distortion as does the retina of the average eye. Flat images from the film were projected on the screen, which distorted them as the eye does images of objects in nature. The result was, picture with nature's depth! Audiences to whom the screen has been exhibited have been agreeably surprised at the lack of eyestrain and fatigue, even after prolonged observation of movies on the *Glifograph screen.* The question is always asked, "Why should pictures distorted not produce more strain rather than eliminate it?" When a person views a picture projected on a flat screen, the brain attempts to interpret depth into the picture which is flat, because experience has taught the brain that the objects represented by the pictures do have *depth.* This results in fatigue. If the picture is not flat, but possesses curvature corresponding to that which images on the retina have, the interpretation is natural and no strain or fatigue results.

A person coming toward us on the flat screen grows larger and larger in an unreal manner. On the Glifograph screen the curvature compensates to a large extent the tendency of the image to grow larger and larger as it approaches, and the approach is a natural one.

The Glifograph screens constructed by a French-American Corporation to which Dr. Pech has assigned all patents and rights by its construction causes the spectator to receive the same impression from the "Movie" as he does from nature. They are manufactured to suit theater conditions in accordance with the formulæ derived with the theory, taking into account projecting distance, lens constants, pitch of throw, etc. Hooks are placed at regular intervals on a wood frame so as to form *arcs of hyperbolæ* and the sheet (gummed canvas) is stretched and laced to the hooks. No two are alike except under identical theater conditions.

An astounding peculiarity of the new screen is that it is immaterial whether the screen is placed vertically or inclined, with concave or convex side front, the pictures still seem natural, give the impression of depth, and relieve eyestrain and relief. This is as might have been expected. The theory requires that a *progressive change in curvature* is interpreted by the brain as depth, and not the curvature *per se.*

If we are artistic our sense is soothed on seeing the new element of reality injected into "Movies." If we own a motion picture theater our income is increased by the availability of the extra front and side seats. If we are plain ordinary movie fans, we are happy to be able to go to see Charlie Chaplin and cast our business and domestic troubles into oblivion with feeling that there is "always a hitch in it" (eyestrain and fatigue) with the inevitable headache the morning after.

An engineer named Tarnovsky, says a Moscow wireless message, has discovered a method of salting fish by means of electricity.

"E.E." IN THE CLASS-ROOM.

Editor Electrical Experimenter:

I have been a silent reader of the EXPERIMENTER for over three years; up to about a year ago from newsstands and since that time as a subscriber, and it certainly has filled all of my needs as a science enthusiast.

I am a student in the pre-engineering course in Illinois College, and you cannot know what an aid the monthly copy of the EXPERIMENTER has been: the electrical "wrinkles" and especially the technical articles in chemistry and physics which appear from time to time. My professors are always very interested in all the articles and it may interest you to know that several, such as Prof. Mace's article on magnetic photographs, the articles on inductance by Secor and Cohen, the Berkeland-Eyde process by Cohen, and several others have been read in the chemistry and physics classes, while the table of solubility given by Wilsdon, helped several of us thru "exams."

JOHN R. MARTIN.

Jacksonville, Ill.

Low Voltage Soldering Irons

By H. H. PARKER

(*Continued from page* 169)

ficulty experienced with this form of appliance is in keeping a good contact at the ends of the carbon; when the point grows cold the resistor loosens up, but by always pressing down on the central rod before turning on the current this trouble is obviated. Figs. 4 and 5 show medium and heavy types of soldering irons of this type.

In closing, it might be well to ascertain, before using a storage battery for this purpose, whether it is able to supply a current of 20 to 30 amperes, tho almost any lighting or starting battery ought to stand up under intermittent use of this kind. If, however, alternating current is at hand, a small step-down transformer attached to a convenient lamp socket is by far the most convenient source of current. Connections for A. C. supply and transformer is shown at Fig. 6.

Master "Movie" Thrills

(*Continued from page* 145)

swim, row, shoot, ride and do perhaps a score or more other things; that is why this picture has made such a "hit," as Pauline Curley can do all this and more.

In the scene shown, the heroine is in the act of sending a wireless message of warning telling the location of a stolen vessel so that detectives and police can immediately be dispatched in an attempt to regain it. During the entire play the heroine is thot to be in company and affiliated with the "Crime Trust" operating in the Far West.

Marino, in the rôle of a detective, is attempting to put the "Crime Trust" out of business, but he meets with many failures. Not alone must he contend with the "Crime Trust," but also with *Annie*, captivatingly played by Miss Pauline Curley.

Numerous indeed are the times when she comes to the detective's rescue. Strange to say, the detective does not seem to realize this nor is he aware of the fact that Annie is also a member of the detective service, who has been delegated to help him round up the gangsters, until, at the end of the serial, they join hands at the altar in the holy bonds of matrimony, and live happily (we "movie fans" like to think "for ever after") until the director calls for the next scene.

(*Continued from page 237*)

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Stamps—20 all different free. Postage, 3c. Mention paper. Quaker Stamp Co., Toledo, Ohio.

300 Different Stamps 50c. Fred Onken, 630 79th Street, Brooklyn, New York.

Stammering.

St-Stu-t-t-tering and Stammering cured at home. Instructive booklet free. Walter McDonnell, 105 Potomac Bank Bldg., Washington, D. C.

Stamping Names.

Make $19 a hundred stamping names on keychecks. Send 25c. for sample and particulars. Ex Keytag Co., Cohoes, N. Y.

Song Writers.

If You Will Write—The words for a song I will write the music and guarantee publisher's acceptance. Poems on any subject acceptable. Ethwell Hanson, Room 131, 3808 Broadway, Chicago, Ill.

Short Stories, Manuscripts, Wanted.

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 566 St. Louis, Mo.

Short Stories, poems, plays, etc., are wanted for publication. Literary Bureau, 165 Hannibal, Missouri.

Scenery For Hire.

Collapsible Scenery for all plays. Decorations. Amelia Grain, Philadelphia.

Tricks, Puzzles and Games.

Big trick and novelty catalog free. United Sales Co., Springfield, Ill.

Send ten cents for large (beautifully illustrated) catalogue which contains all the latest tricks, jokes, puzzles and illusions. Oaks Magical Co., Dept. 549, Oshkosh, Wis.

Boys! Something new. Change a playing card into a rose, 10c postpaid. T. Mac Saughlin, Colmar, Pa.

Phonographs.

Build your own phonographs and manufacture them for profit. Drawing, Instructions, Parts Price List, Blue Print, etc., complete, sent free upon request. Write today. Associated Phonograph Co., Dept. E 1, Cincinnati.

Make Your Own Phonograph. Particulars free. DeSelO-PhonE, P. O. Box 720, Attica, Indiana.

Build Your Phonograph. "Perfection" high-quality spring and electric motors, tone arms, reproducers. Wonderful results. Big saving. New catalog and building instructions mailed for 10 cents. Indiana Phonograph Supply Co., Indianapolis, Ind.

Build Phonographs—Universal Type Tone Arms, Motors, and all Hardware. Catalogue for stamp and name of this publication. Sam R. Kremer, 118 Court Ave., Dayton, Ohio.

Electrical Supplies and Appliances.

Blueprints. Electrical connections. Alternating and Direct Current Motors, Voltage changing, etc. Also Transformers, Rheostats, Controllers, Compensators, Automobile Generator, Armature connections. 10 samples A. C. 25c. Catalog free. Charles Chittenden, A-3024 Matthews, Kansas City, Missouri.

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. Learn to make them for Automobiles; we furnish everything. Sample plates, 40c. Windsor Specialty Co., 5419 Windsor Ave., Chicago, Ill.

Selling Out 5,000 flashlights with battery. Douglas Smith, Beechmont, New Rochelle, N. Y.

Inventors: Models, Dies, Tools, 28 years' experience, work guaranteed, lowest price. Manufacturing of specialties our hobby. Peerless Die & Tool Co., 121 Opera Pl. D. B., Cincinnati, Ohio.

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.

Chemical Wonder for electricians. Polarity test papers. Tell instantly, positive-negative wires. 10 papers 25c. Dollar per 100. Agents wanted. Chemist, Box 77, Homewood, Ill.

Experimenter build your own light plant. Wind turbine driven. Generators Government make 12 volts, 18 to 25 amp., $15; with relay and overload circuit, $25; well made, ball bearings. Only a few left; worth $75. Kannig, 248 Hawker St., Dayton, Ohio.

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 blueprint chart method of electrical wiring. Souvenir information card included. Electrical Wiring Diagram Co., Box C-173, Altoona, Pa.

Welding Instructions for operating Oxy-Acetylene apparatus on all metals; sent postpaid fifty cents. Address E. E. Bertschy, Cedar Rapids, Iowa.

Tucker's Overall Waterproofing Insulator, Patented. Grade A for coils, drycells, connections spark plugs. Grade B for cables lead wires. Not affected by heat, oil, salt water. Pt. $.90, qt. $1.50, gal. $5.00. Tucker Waterproofing and Insulating Co., 664 Pleasant St., Brockton, Mass.

For Sale. No. 26 cotton covered wire. $.75 per lb. Free Samples. Ralph Winters, 404 Pearl Street, Camden, N. J.

Miscellaneous.

"How to Read Thoughts"—Mind Reading at any distance, 20c.; "How to Hypnotize," Cure Diseases, Give Astounding Exhibitions; 126 illustrated pages, $1. Science Institute, E-6435 N. Clark, Chicago.

The New and Beautiful Art of Transferring on to Glass; Engraving, Photographs, Lithographs, Newspaper Cuts, Sketches, Writing, Show Cards —anything. Wonderful results secured by this easy, inexpensive method. Fifty cents (no stamps). Jack Hartman, 913 21st St., Rock Island, Ill.

Wanted—Small Gasoline and Steam Engines, Electric Motors, etc. Will pay high cash prices for good material. Johnston, West End, Pittsburgh, Pa.

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Oil Belt. Big production close by. Two hundred acres good land. Soft spring water. New Buildings. Timber, Sugar Bush, Live Stock, Tools, etc. Fifteen thousand dollars. Terms. C. E. MacDonald, Ceres, N. Y.

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Clean your wall paper. Remove that dust, dirt and grease spots. Complete instructions, only one dollar. James T. Herr, 2919 W. North Ave., Baltimore, Md.

Tattoos Removed. Simple process. Satisfaction guaranteed. Pharmaceuticals and instructions for $1.00. No stamps. Alfred Hogue, 45 Gale Ave., Pittsfield, Mass.

Astrology—Stars tell life's story. Send birth date and dime for trial reading. Eddy, 4307 Jefferson, Kansas City, Missouri. Apartment 85.

Exchange.

Bargain — Four-inch Astronomical Telescope. Object glass alone worth price. H. E. Bussey. Box 1698, Atlanta, Ga.

For Sale—One Cyclopedia of Applied Electricity $18.00. Parker Blake, North Troy, Vermont.

For Sale—I. C. S. Chemical Engineering Course. R. C. Coomber, Dexter, N. Y.

Exchange—New post-card projector for Marconi VT. Sell $6. Also wireless outfit. Write if interested. D. F. Dunsmore, Hinton, West Va.

Sell or Exchange—Radioptican, ⅓ H. P. motor, Oudin Coil, and many other attractive bargains. Send stamp for circular. Harry Hughes, Terrace Park, Ohio.

Roof Leaks stopped quickly, permanently; our guaranteed roof products ready for use; does not settle; thinning unnecessary. Surprisingly low cost. Martinek Co., Dept. AA, 405 Lexington Ave., N. Y. C.

Bargain—1¼ K.W. Westinghouse Generator, 125 volts, 10 amps. With field rheostat. $45.00. Henry Messerly, Box 331, Staunton, Ill.

Boys, Here is Your Chance! Bargains, clearance sale of chemical and electrical apparatus, balances, etc. Send stamped envelope for list. A. L. Pouleur, Norton, Mass.

Silk-Wound Coupler, detector, condensor, $13. Marshall, 520 Hudson Ave., Weehawken, N. J.

One Hundred-Dollar Equity in practical electrical course for sale or trade. Make offer. Frank Mikulka, 1913 So. Cushman, Tacoma, Wash.

Let's Swap! Whatd'ye got? Whatd'ye want? Three months' time. National Exchange Medium, Detroit.

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Hook-Up Record Sheets, loose leaf, 3" x 5" printed skeleton diagrams, 50 apparata, instructive, makes valuable reference book, 5 kinds; assorted set 30, 25c; sample and circular 2c. E. R. Dike, 411 E. Lafayette St., Jackson, Tenn.

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Telefunken Radio equipment taken from German ships by U. S. Navy. Motor Generators, ½ K.W., $1.50. Receivers, Type A 4 E $75. Gaps complete $65. Primary inductance $25. Transformers 500, $50. Frank R. Brick, Jr., 50 Ave. B, Bayonne, N. J.

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