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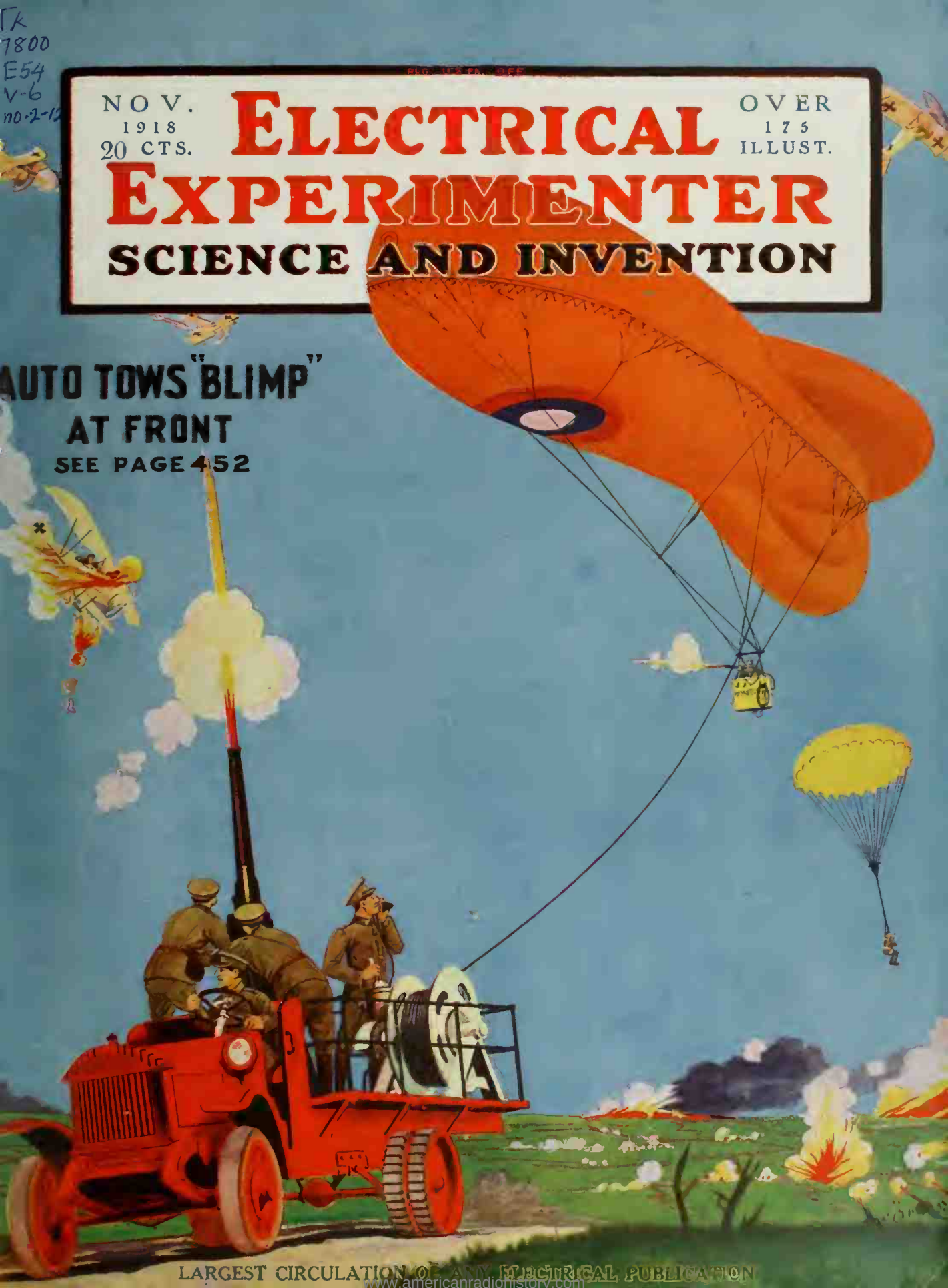
ELECTRICAL EXPERIMENTER

SCIENCE AND INVENTION

OVER 175 ILLUST.



AUTO TOWS "BLIMP" AT FRONT

SEE PAGE 452

Learn Electricity

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

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

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

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

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(Check trade interested in)

Name.....

Address.....

El Paso, Texas, Oct. 1, 1917.

MR. CHARLES F. HAANEL, St. Louis, Mo.
In Re "The Master Key"

My Dear Mr. Haanel: The value of an idea is determined by its application. Pragmatism has long since spread beyond the confines of Missouri. The world insists on being shown.

The lash of circumstances and the logic of events are, more than ever, impelling men to think. Whether an idea be a new process for picking cabbages, or an old process (Kaiserism, for instance) for preserving kings, we are from Missouri.

A philosophy of life having as its base blind optimism; a religion that won't work seven days a week, or a proposition that isn't practical, appeals to the intelligent not at all. It is results that we want and the acid test is: will it work?

The Master Key qualifies. It is the most lucidly scientific statement of "Truth" that I have seen. It reconciles rationalism and religion; illumines economic determinism and the materialistic conception of history, and is an infallible guide to understanding. It contains in condensed form the substance of an entire library on science. Its teaching, if consistently applied, will make a man healthy, wealthy and wise. Its distribution is super-missionary work in excelsis. Those who wish to think intelligently will find it invaluable.

Intelligence rules. Desire, intelligently directed, is a creative force which automatically causes its object to manifest on a material plane. It is the law. Let him that hath an ear to hear, hear.

Yours truly,
CHAS. A. HEARD.

May 15, 1918.

Dear Mr. Haanel: Ever since I have been old enough to read, I have been reading occult and metaphysical literature. I have waded ears deep through the books from all ages, all lands, all schools.

I have rejected tons of lies, oceans of misconceptions, an entire universe of false deductions.

I have found grains of truth in mines of folly, and worlds of truth in a single grain. The pursuit was interesting in itself, and I do not regret the time spent upon it. But it was a genuine surprise to read your Master Key System and find within, the essence of all that I had read, with much more added thereto.

In this extraordinary system you have sifted the true from the false; you have given in concrete form all that is worth while in many schools of philosophy.

You have placed arcane truths into the hands of the uninitiated as weapons they can learn to use without danger to themselves. I congratulate you. You are doing mankind a service.

Yours very sincerely,
CHARLES F. OURSLER.
501 Fifth Avenue, New York City, N. Y.

THE LOWE OBSERVATORY
Edgar Lucien Larkin, Director
Los Angeles, Cal., Dec. 6, 1916.

MR. CHAS. F. HAANEL, St. Louis, Mo.

Dear Sir: Your booklet, Master Key, ought to be expanded into a book. Its teachings that Mind is the all-dominating creative force is precisely in line with the wonders of the most recent psychology. All persons having desks should have this pamphlet thereon. And it would be a fitting pocket companion.

EDGAR LUCIEN LARKIN.

Detroit, Mich, May 28, 1917.

Dear Sir: The words, "Your world will change as if by magic, the moment you realize the marvelous power within your control." page 6, I have underlined. They state a fact, a real live fact; and to me this is the most wonderful, the most important fact of all—that one may put this knowledge to an immediate test, that one may, after learning of this power, proceed to apply it with a definite knowledge as to results.

W. M. HOWE.

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which can throw wide the doors which seem to bar men from the Treasure House of Nature. This may seem "too good to be true," but remember that within a few years science has placed almost infinite resources at the disposal of man, is it not possible that there are other laws containing still greater possibilities? Get the Master Key and find out for yourself how the invisible forces of Faith and Desire are converted into actual, tangible, concrete facts in the objective world.

Chattanooga, Tenn., Feb. 22, 1918.

The Master Key is wonderful, it has brought about a most remarkable change in my environment, attitude toward life, mental and physical condition. I am an entirely new person and improving daily, discouragement, lack of ambition, physical ills, mental distress, and fear are things of the past.

I cannot find words that express my gratitude for all that the Master Key has done for me. With heartfelt thanks to you, I am,

Yours sincerely,
R. J. ARNOLD.

---

160 Claremont Avenue, New York
New York, Nov. 18, 1916.

I have made a thorough examination of the little booklet which you so appreciatively have called the Master Key, and can unhesitatingly endorse it and its teachings.

In this pamphlet of only a few pages you have led a hungry world to the threshold and placed in their hands a "key" with which the understanding ones may unlock the door and enter "The Secret Places of the Most High," and enjoy the abundance of all good to be found therein. With best wishes.

AGNES MAE GLASGOW.

HOME LIFE INSURANCE CO. OF N. Y.
James Lee Bost, General Agent
Washington, D. C., Dec. 29, 1916.

Dear Sir: Your little booklet, entitled "The Master Key," has been received and I had great pleasure in studying it carefully. It is a very clear and concise, yet forceful presentation of the big subject handled, and shows a very wide study of the absolute teachings and deep understandings of the same.

Very truly yours,
JAMES LEE BOST.

"I am able to extract from this system all that can be made known by the finite mind relative to origin, evolution, destiny and the much-mooted riddle of the Universe."

"I can hardly grasp the full significance of the facts. The vastness of this subject is so overwhelming it seems a life-time of effort could never fathom all its possibilities."

"You have given a wonderful analysis of the power that is the creative force by which the master mind controls his destiny."

"The Master Key is too modest a title for such a stupendous revelation."

"I have found the Key and with it each day am opening the store-house of wisdom and success, of which for many years I was utterly ignorant."

FREE! There is no charge for the MASTER KEY. It is FREE!

CHARLES F. HAANEL, [illegible]ite Bldg., St. Louis, Mo.

Send me the Master Key without cost or obligation of any kind.

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WILL HELP YOU The Master Key SOLVE YOUR PROBLEM

☞ NOTE—*Tomorrow; today* will be *yesterday*. Get your Master Key TODAY! NOW! ☜

Electrical Experimenter

233 FULTON STREET, NEW YORK

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Vol. VI Whole No. 67 NOVEMBER, 1918 No. 7

EDITORIAL

COLD LIGHT

WE have pointed out on various occasions in these columns the criminal waste that daily occurs when we convert coal into electric light. We have shown that when coal is burned only one-half of 1 per cent of the actual energy stored up in the coal is converted into radiant light—the other 99½ per cent goes up in heat where no heat is actually wanted or required. The great problem of the century is heatless light, or at least an approach toward it.

All our efforts in developing incandescent lamps or arc lamps are in the wrong direction. While we have made trifling progress from the old carbon filament lamp to the up-to-date Tungsten lamp, the progress as far as wasted energy is concerned is more than trifling; it only amounts to a very small fraction of one per cent. The arc lamp which is very much more efficient, giving infinitely more light in proportion to the Tungsten lamp, can not, of course, be used in a small room, as it gives more light than wanted, and for that reason is impractical. The other electrical devices which are still more economical, such as for instance the Cooper Hewitt mercury lamp, which may be seen in every modern photographic studio, or the Moore lamp, which is a sort of Geissler tube giving a soft, pink light, are excellent for their purpose, but neither of these are flexible enough where only 30 to 50 candle-power are required.

What we need is something similar to our present-day electric light globes, but such a device must not have an incandescent filament. What this future invention, which is surely coming, will be, we do not know and the best we can do is to make a fair guess.

In Nature we find several light sources that may be termed "cold," altho in reality most of them are not. Take, for instance, the Firefly (*Luciola*), whose light at one time was thought to be of an electrical nature. Recent investigations have shown that the light is produced by the burning of the oxygen in a certain peculiar manner inherent in the firefly's photogenic cells. While, of course, not actually cold light, it comes as close to cold illumination as is imaginable.

Then there is a certain specie of deep-sea fish—Lantern Fish—who attract their prey by giving forth a brilliant light shaft from their photophores. In this case the luminosity is known to be of a phosphorescent origin, which, strictly speaking, is not cold either, but for practical purposes comes close to it. The "Will o' the Wisp" as well as the luminous mushroom fall in the same category, their light simply being due to burning of oxygen.

Electricity at high pressures is also known to give out certain light effects, as, for instance, a highly charged Tesla coil; but this light, if anything, is more expensive than that obtained by means of an incandescent lamp. Next following, we have the high tension Tesla vacuum lamp, which gives forth a brilliant and also cold light. Due to the very high potential currents that are necessary to produce this light, it has so far not been exploited commercially, altho it deserves it.

Perhaps some inventor will devise a sort of combination Cooper Hewitt-Moore gas lamp, which, instead of a filament, will have a hundred feet of very fine glass tubing all coiled up inside of our present day lamp bulb. Then by introducing a suitable gas into this fine tubing, which, of course, must be of a fair conductivity, we may produce some sort of an economic lamp bulb, and, while this light will not be absolutely cold, it might serve for practical purposes. But perhaps the final solution will be found in some device which operates by electronic bombardment of some screen or substance, which thru this bombardment will become intensely luminous. In other words, a device working on the principle of the well-known spinthariscope.

Such a device would consume an extraordinarily small amount of current, and would constitute an ideal source of cold light.

H. GERNSBACK.

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Vol. VI. Whole No. 67 OCTOBER, 1918 Number 7

City of Ham Fired With Electric Bombs

HAM—the French city of that name recently recaptured from the Germans, was set on fire by an elaborate system of electric incendiary bombs, all of which were placed thruout the various buildings with proverbial Hun thoroness, which, when the psychological moment had arrived, were ablaze in an apparently natural manner;—just as if the Allied shell fire had done the awful work. But the trick was not pulled off so smoothly—for we have the evidence in this case of some of the populace who managed to hide in cellars and other places of shelter of just what happened to Ham, once peaceful and happy, and birth-place

The City of Ham Was Fired Instantaneously by the Crafty Germans After They Had Evacuated It, by Means of Electric Incendiary Bombs Ignited by an Electric Current Sent Thru a Network of Wires from a Point Several Miles Away. The Insert Diagram at the Left Shows How the Dastardly and Wanton Trick Was Accomplisht by the Throw of a Switch.

all exploded simultaneously by an enemy officer located several miles away. Perhaps the crafty boche engineers thought that by wiring up the town in this way, and by driving out the inhabitants when the troops retreated, they could set the buildings of a well-known French electrician—Athanase Peltier—who discovered the remarkable electrical fact, that if a current is past thru a junction formed between bismuth and antimony, then the junction is either *heated* or *cooled*, depending upon the direction of flow of current thru the junction. This phenomenon is called in his honor, the "Peltier Effect".

Humanity is thankful for this additional information in the already mountainous pile of evidence against the boche, to one—Walter Duranty, a New York war correspondent of the New York *Times*, who was with the French army when they captured the still burning city. Mr. Duranty reports:

"For pure wantoness of destruction, Ham offers an example that even the Germans will find it hard to beat. It was a non-

FRENCH ALPINE TROOPS CARRY BATTERY SEARCHLIGHT.

The electric searchlight has found more extensive use in the present war than in any previous conflict, owing to the fact that it has been improved and developed so that it has become a truly invaluable adjunct to all military and naval maneuvers, both for the purpose of illumination as well as for signaling. Small but powerful electric searchlights have been used successfully by the Allied armies for signaling in broad daylight, as was described some time ago in the ELECTRICAL EXPERIMENTER.

The present photograph shows a group of French soldiers—*Chasseurs d'Alpine*—sending signals with a portable electric searchlight which can be carried by one man. As those who have anything to do with automobiles will at once perceive, such a searchlight does not require a very large or extremely high candle-power lamp bulb, providing the lamp itself is fitted with a high grade parabolic silvered-glass reflector. Thus it is we find, that this member of the renowned "Blue Devils" is seen carrying the battery for operating the searchlight on his back, while he holds the searchlight projector itself on his breast. By means of a simple shutter arrangement fitted on these searchlights, when they are to be used for sending messages, it is very easy for any one familiar with the telegraph code to flash messages in the form of dots and dashes, or, in this case, by long and short flashes of light, over a distance of several miles. The signals are invariably read at the receiving end by an officer provided with a pair of field binoculars.

Photo—Kyrle Photo Service

Here We See Some of the Famous French Troops—Chasseurs d'Alpine or Blue Devils, Using a Portable Battery Searchlight in the Vosges for Daylight Signaling.

An old-style open street car in Boston has been equipt as a double deck ambulance for removing large numbers of patients to a hospital.

AMERICAN SPUN GLASS NOW IN ENDLESS LENGTHS.

In Venice, for many years, the art of glass spinning was fostered, until that city became known for the great beauty of the ornamental objects which it put on the market. There have always been shortcomings in the work, due to the fact that glass thread could be spun only to the length of the circumference of the wheel on which it was worked, and this was never more than eighteen feet.

This difficulty has been overcome by an American Manufacturer, who can make spun glass thread in endless lengths, and put it on spools as is done with ordinary threads. This enables a multitude of objects to be made, that could not be made before. The threads of glass can be made in all colors, giving a world of brilliancy.

Probably the largest field of use will be in the technical and engineering fields, where it already has a foothold. As absolute non-conductors, glass plates for storage batteries will give longer life than present-day plates. For insulation of electric wires, instruments, etc., the glass thread can be used. As an example of its non-conductivity, power house workers have had their shoes bottomed with spun glass plates, to avoid shock. For the filtration of acids, glass plates are excellent.

military act of vandalism. Chauny street, leading to the market place, was piled high with the wreckage of fallen walls, and at the entrance to the square a group of poilus were risking their lives in clearing the outlet of a cellar in a house whose glowing beams still crackled into flame at each gust of wind and whose side walls were bound to fall at any minute.

"Finally I met a French woman who had lived in Ham before the Germans fired it, and who had hidden in a cellar while the conflagration raged.

"'Ham,' said this woman, 'was destroyed methodically by fires simultaneously started in every quarter by electric devices. Nearly a month ago we noticed the boches had begun fixing up wires in all directions, and we commented on the strangeness of such installation at a time when everything else pointed to a German retreat. It did our heart good to see the streams of guns, the material, and the shattered, dispirited troops that had been pouring backward thru Ham for the last few weeks.

"'As time past the boches steadily continued their preparations for departure, removing wagonloads of furniture, and, indeed, everything of any value. But the wiring parties continued their work all the more busily.

"'Last Wednesday we had the key to the enigma. That morning the French guns were very near and a few shells fell close. At noon the boches issued orders to all civilians to evacuate the town. There were only about fifty inhabitants here, and perhaps twice that number of French and Belgian youths in the boche press gangs. Some fifteen of us and six boys managed to hide in the cellars. I believe all save one or two are now safely accounted for.

"'On the night from Wednesday to Thursday we heard a sudden outburst of small explosions all around. At first we thought there was grenade fighting in the street, as the noise was not loud enough for shells or airbombs. Before dawn my father stole cautiously out. The whole town was flaming above our heads, but our house did not catch fire until we were able to leave it.

"'The boche wires had been connected with incendiary bombs which were fired simultaneously from a central electric control. Ham burned furiously all Thursday and Friday. On Saturday morning the fire was dangerously close, and we left the cellar, to meet French soldiers, who had advanced and taken the town, shortly afterward'."

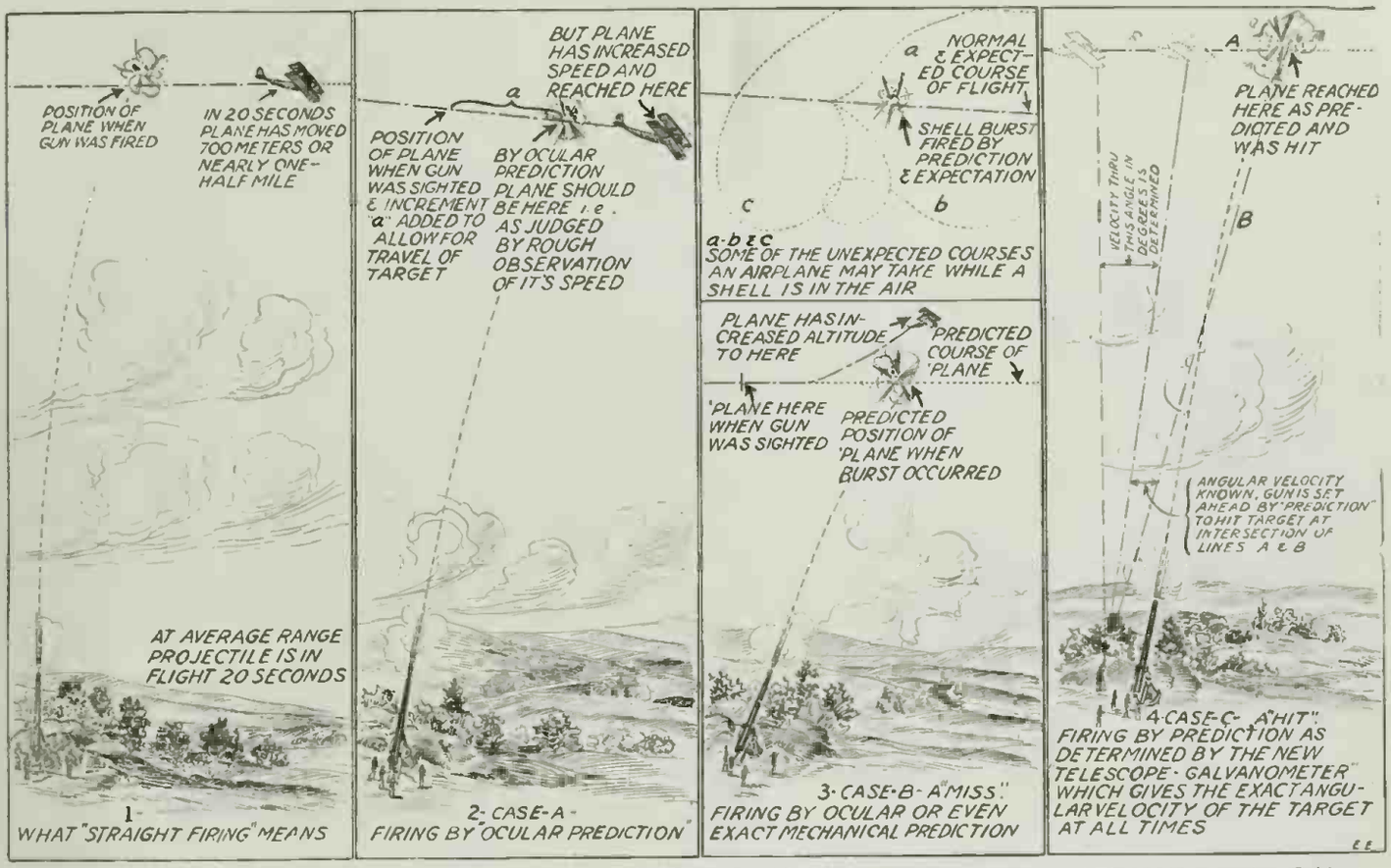
Our illustration herewith shows the scheme of carrying out such a dastardly deed. The incendiary bombs are connected up in series in circuit groups as here outlined, these groups being finally all connected to a single circuit leading to a central switch-board several miles away. At the closing of a switch the boche thus blasted out the only hope the peaceful inhabitants might have entertained of saving at least their homes and furniture.

GERMANS USE NEW AIRPLANE PARACHUTES FOR AVIATORS

American Headquarters in France, Sept. 20, (Reuter.)—Patrols report having encountered an entirely new type of enemy airplane, designed especially to make it easy to maneuver. They also report that the Germans are adopting the parachute as a means of escape from damaged planes.

Did you note the full purport of that last statement? Also, do you remember reading the timely article, "Is the airplane parachute practical?", in the October issue of the ELECTRICAL EXPERIMENTER? Perhaps you do; at least, we hope those who should be interested in such a life-saving device digested the logic there set forth by a man who is a "flier"—and, therefore, knows whereof he speaks. Yes, the report above cited looks good. But, asks the reader, why do we not have such safety attachments provided for America's birdmen? As usual the Germans have taken this idea, which had been tried out several years ago in France and the United States, and developed it to the stage of practicability. The reports from correspondents at the front have mentioned the German aviators' use of the parachute several times of late. Also there is a gentlemen's agreement among the warring birdmen not to shoot a man down when his plane is put out of commission, or when he is parachuting earthward.

Finally, friends, listen to the clarion voice of the official bulletin on "Problems of Aeroplane Improvement," issued by the Naval Consulting Board. On airplane parachutes it says: *"These, considered as a safety device, ARE NOT DESIRED as a factor in the equipment of military airplanes. No entirely satisfactory disengaging device has yet been developed. Such devices may presumably play some part in civil aeronautics and under peace conditions, but under existing military conditions they are not considered a necessary or desirable encumbrance."*



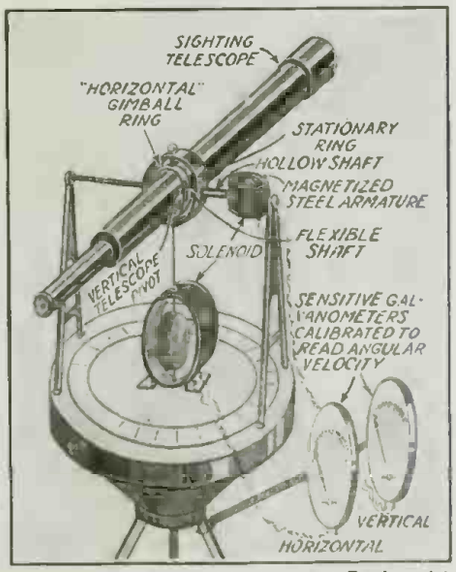
Did You Ever Stop to Ponder the Reason Why Aircraft Do Not Fear Gun-Fire from the Ground? Some of These Reasons Are Evident from the Illustration. An Aviator To-day Considers It a Disgrace to Be Brought Down by a Shot from an Anti-Aircraft Gun.

Why Airplanes Don't Fear Anti-Aircraft Guns

CONTRARY to general opinion the enemy's aircraft when they come to view, are not really to be considered as one of the arms of the enemy artillery, but rather as one of its *eyes*. In fighting the enemy aircraft, our guns fight the artillery of the enemy in its most vital part. When the artilleryman succeeds in landing a hit on an enemy airplane, he performs a most important service for his fellow fighting men, for not only does he bring down the 'plane which may be loaded with bombs, or else fitted with machine guns for attacking 'planes and troops at close range, but further, he is helping to render the artillery of the enemy practically useless by "blinding" it. The artillery airplane, first and last, is to a large extent, an agent of aërial observation. Without this wonderful far-seeing arm of the artillery, neither side can ever hope to accomplish any of the remarkable long range big gun hits that have been accomplished. An American army officer, recently returned from France, stated that on one occasion he saw a very remarkable long range artillery fire in which three eight-inch shells landed squarely on the target *eight miles away*, thanks to the range corrections transmitted *via wireless*, from the observation airplane. The first shot fell a little past the bridge, the second shot fell a little short of the bridge, while the third one fell squarely on the target. Such work as this is being duplicated every day on the Western Front by the remarkable means of communication and observation now mustered together by the able Allied commanders.

This gives at least a slight idea of the great importance of bringing down enemy aircraft whenever possible. One way, of course, is to send aloft other battle 'planes to destroy the enemy aircraft if possible. The problem of anti-aircraft firing has always been with us, and Lieut. Colonel X. Reille of the French army recently gave an interesting discussion on this highly important problem, before the *Washington Academy of Sciences*. What a difficult job it is to hit a 'plane while in flight can best be judged by those who have tried to shoot a bird on the wing, especially when the object of your sight is a considerable distance away. Also the birdmen of today have an unkind habit of looping the loop, taking a nose dive, or executing some other rapidly changing figure in the air, just about the time you get ready to plant your second or third anti-aircraft shell squarely on them. As Colonel Reille points out—"Anti-aircraft firing does not consist merely in firing at an aërial target, but in firing at an aërial target *in motion*. Moreover, this target moves with a speed which cannot be regarded as negligible with reference to the speed of the projectile designed to strike it. An observation airplane with an average wind will attain a speed of 35 meters, or 38.15 *yards per second*." These observation machines invariably fly at an altitude of fifteen thousand to eighteen thousand feet, and it is common for excellent photographs to be taken at this altitude also. At ordinary firing ranges, the time of flight of the projectile shooting skyward amounts to about *twenty seconds*. Hence, under normal conditions, the distance covered by the enemy 'plane between the moment at which the projectile is fired at it, and the moment at which it bursts in the vicinity of the target, is about seven

(*Continued on page 494*)



The Latest Electrical Instrument Designed to Measure Constantly the Angular Velocity of an Airplane Target as It Sails Along. It Is Called a "Galvanometric-Cinemometer." Its Use Means More "Hits" for the Anti-Aircraft Batteries.

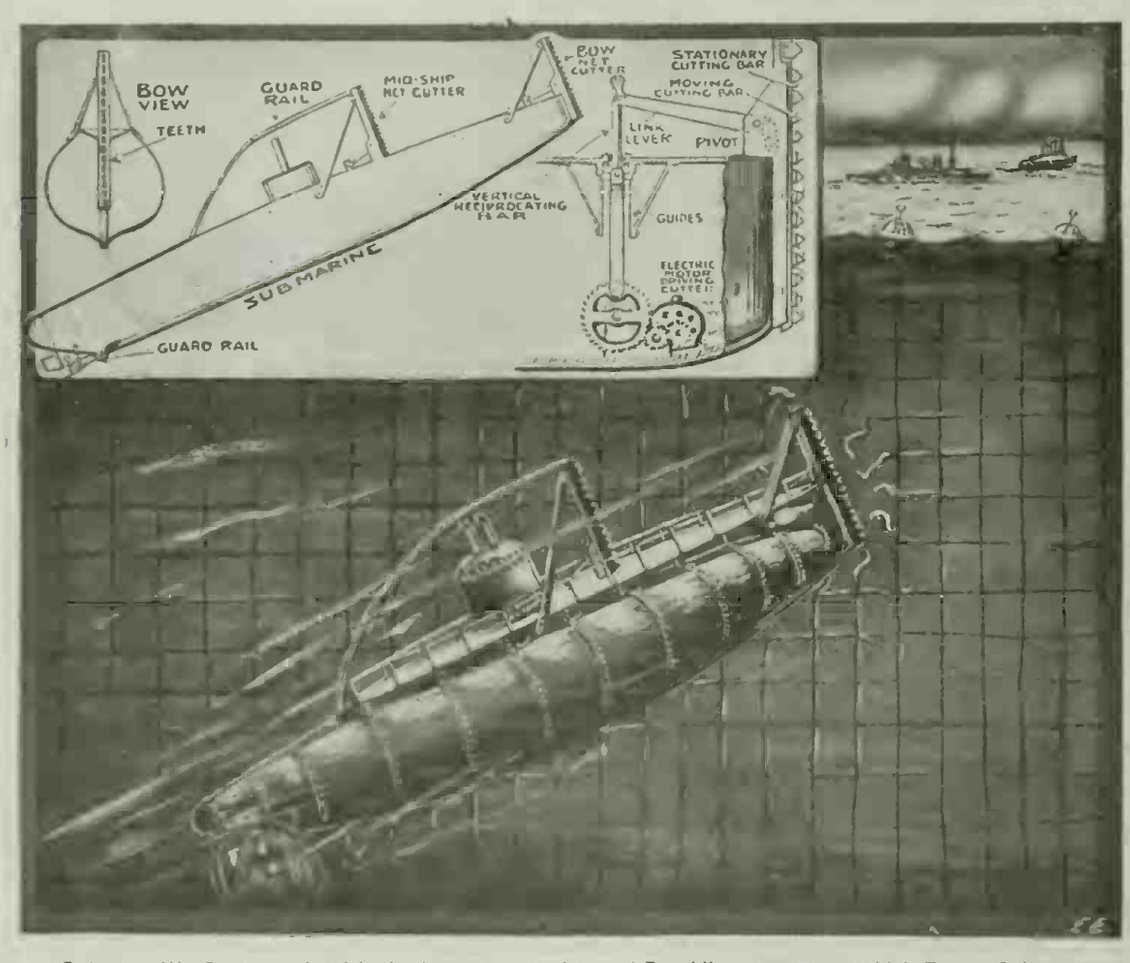
How Submarines Cut Thru Nets

WE often hear heated discussions among the pro-war enthusiasts as to how a submarine war vessel can cut its way thru one or a series of steel nets. We have had ample evidence in the past few years that it is possible for such an under-water craft to burrow its way thru steel nets, no matter how fine the mesh may be, or how heavy the cables of which the nets are constructed. You will hear some people argue about "submarine net-cutters," and when they are asked as to just how the "sub" manages to cut thru the net, especially when running blind, you will invariably hear a reply something like—"I do not know the exact details, but it is very easy." But is it?

Oscar A. Youngren, of New York City, has recently taken out a patent on a *submarine net and cable-cutting attachment* which is illustrated in action herewith. It is simple and rugged in design, and is operated by means of an electric motor placed either inside or outside of the submarine hull.

How can we locate the nets? By observations in the vicinity of such nets before totally submerging; by sinking to the bed of the harbor or channel, if it is not too deep, and liberating a diver from a special chamber provided for the purpose, who can explore the water in the vicinity of the submarine; also the proximity of nets will be made known when the submarine bumps against one, for they are usually strong enough to prevent the submarine from getting any headway once it runs into them. By clever maneuvering of the sub-sea craft and by starting up the net-cutter motors, when this condition arises, the under-sea demon can shortly hack its way thru the net.

The net-cutters themselves are made on the principle of the well-known mowing machine, which carries a long fixt toothed blade over which a second movable toothed blade of similar pitch slides back and forth rapidly. In the design here shown, an electric motor drives a reciprocating cutting rod thru a set of gears, this cutting rod being joined to a vertical reciprocating shaft which slides up and down in a water-tight tube. The upper end of this shaft connects thru a link with a horizontal rod as shown, which in turn connects with a second link fastened to the moving toothed blade. The stationary toothed blade is secured to the hull of the submarine. The horizontal connecting rod is pivoted on the point indicated in the diagram, so that as the motor-driven piston moves up and down, the movable teeth are caused to rapidly oscillate up and down. These teeth are made of tempered steel and of considerable thickness, and not only this, but they are driven with considerable force owing to the manner in which movement is communicated to them thru the pivoted connecting rod and motor gear.



Not Only Are We Confronted With the Important Problem of Providing Nets Thru Which Enmey Submarines May Not Pass, But Also as One of the Prime Warring Powers, We Happen to Be Interested in Devices Which Will Enable Our Submarines to Cut Thru Enemy Nets. The Motor-Driven Net Cutter Here Shown in Actual Operation, Has Recently Been Patented By a New York Inventor and Promises to Be Considerably Efficient. There Are Two Sets of Steel Teeth, One Set of Which Oscillates Back and Forth by the Other Many Times Per Minute.

GROWTHS COVER PORTO RICO WIRES.

Some years ago the telephone and power companies operating down in the southwestern part of the United States and in Mexico found that they had to replace all their wooden poles by steel ones. All for the very good reason that in that part of the country there was a very busy little bird that persisted in picking the wooden poles full of holes, honeycombing them in fact. Now we have a photo of what happens to the aërial telegraph and telephone lines in the tropical land of Porto Rico. Here aërial plant life insists in living on the wires.

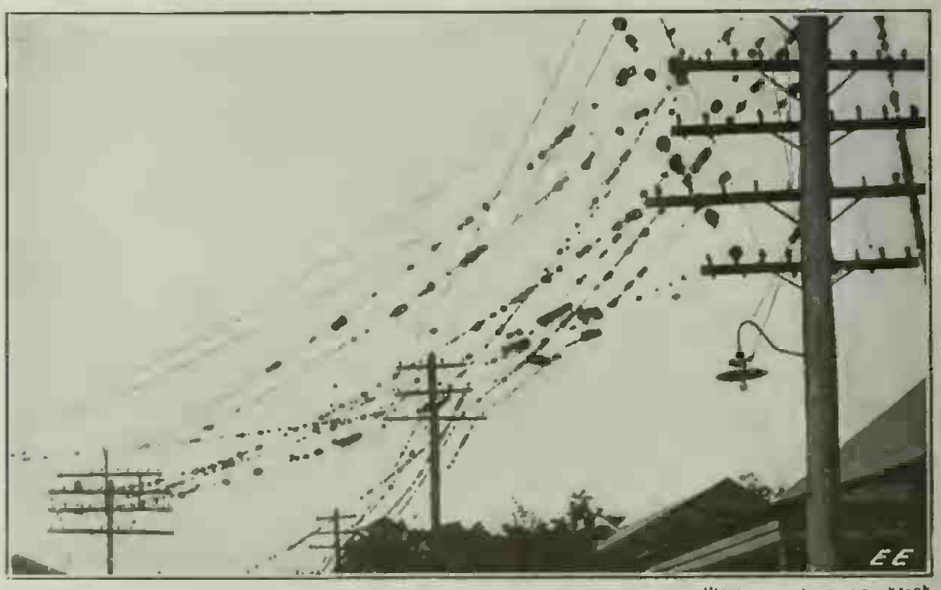


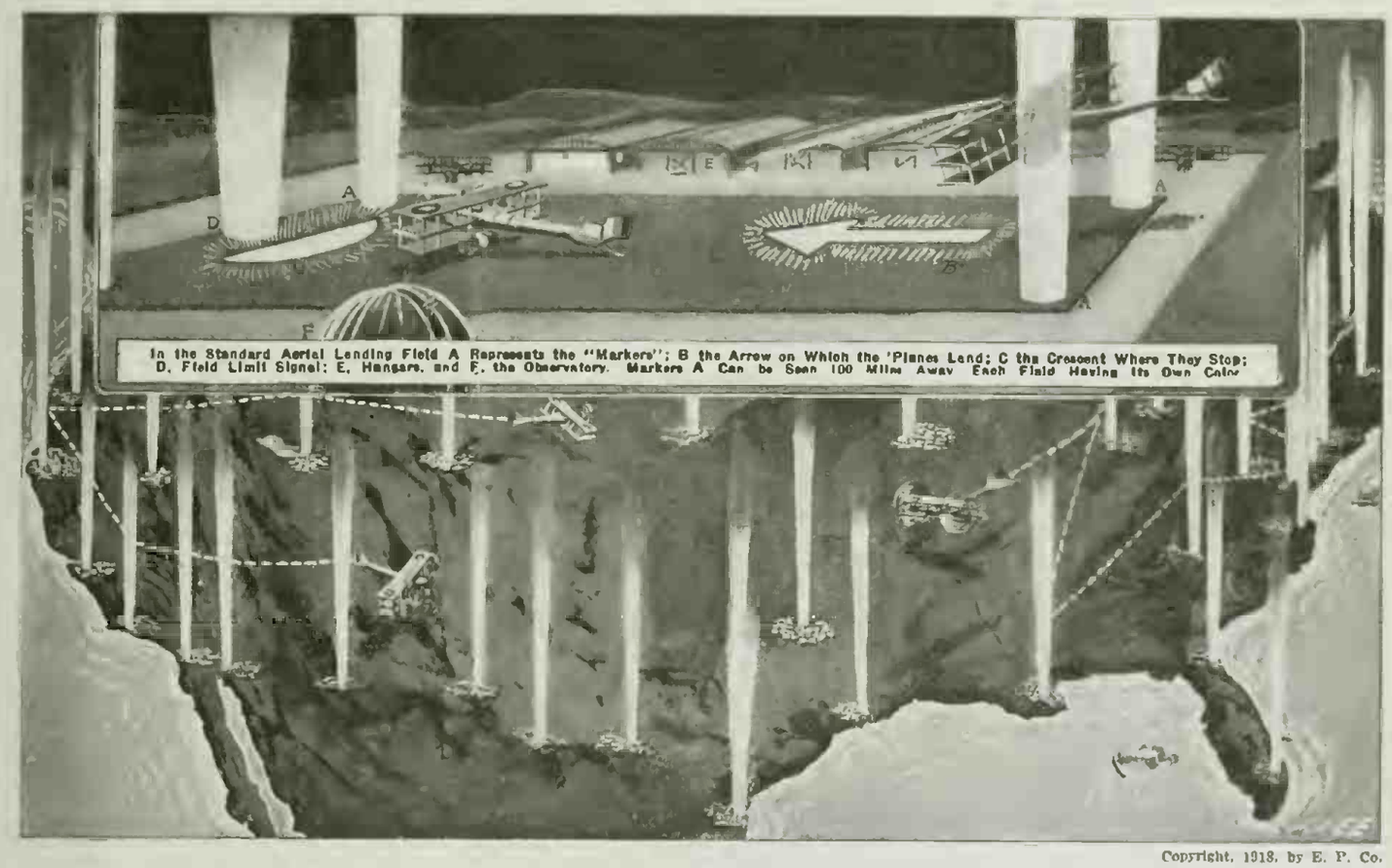
Photo from U. S. War Dept.

This Remarkable Photo Was Taken in Porto Rico, Near Ponce, and Shows the Aerial Plant Life that Insists on Living on These Wires.

Chain of Aërial Landing Fields Across U.S.

AMERICAN birdmen will soon be able to fly across the United States, thanks to the recent announcement authorized by the War Department that a chain of landing fields for air pilots is being built across the continent. In a few states they already await the flyers, being establisht at intervals of 100 miles, one at each corner of the landing field. These mark the position of the field from afar, the vertical shafts of light being visible for a distance of 40 to 50 miles or more. By using different colored marker lights for each field its name and location can at once be ascertained. Only two of the marker beams need be colored, New York City (Mineola) having, say, two red identification beams, Philadelphia, two blue beams, etc. Another scheme would be to use a searchlight signal shutter on all the markers and to periodically blink the shafts of light on and off to give the telegraphic dots and dashes of the landing field's initials—as N. Y. for New York, etc. This could be done by automatic switching means actuated by a time-clock at periods of 5 or 10 minutes. It would also be possible in this way to signal by short and long flashes, corresponding to the dots and dashes of the telegraph code, the condition of the field,—such as dry, muddy, wet, etc. This information is of distinct importance to the aviator intending to land on the field, as the airplane is handled differently for each condition of the field. The landing dive angle varies for wet, muddy and dry fields, as does also the position of the 'plane just before it lands on the field. All army and navy birdmen have to know the telegraph and radio codes so no difficulty is encountered on this score. The electric lantern atop the Metropolitan Tower in New York City has been seen to beat the time at night at a distance of 30 miles easily, with the naked eye, and at much greater distance with binoculars or field glasses.

For night flying airplanes now carry a powerful electric headlight for use in landing, and have out-board marking lights, as well as a tail light, all of which are especially needed in formation flying, where as many as 15 to 20 'planes, or more, often fly in a "V" or other formation. As the airplane heads down toward the field it is supposed, in this layout of signal lights, to light on the illuminated "Potts Arrow", then taxi along until the illuminated crescent is reached. From here the 'plane is run off to the right or left to the hangars. A red "limit" light marks the end of the field. A meteorological observatory will be erected at certain fields. The "Potts Arrow" and other marker lights are illuminated by electric lights sunk in pits in the ground. These are covered with wired glass about two inches thick, over which the 'planes can run. The arrow is red, the crescent blue.



When completed, these well-marked, safe landing places will be to air pilots like water tanks to locomotive engineers or harbors to mariners. Besides oil and gas, the majority of the fields will supply to the pilots shelter and limited machine shop facilities, maps, charts, and barometer and thermometer ratings. New York, Pennsylvania, Ohio, Illinois, the District of Columbia, Georgia, Texas, and California already have establisht lines of such landing fields. Arkansas, Mississippi, Alabama, New Mexico, and Nebraska will soon be equipt.

The value of permanent landing fields, sufficiently close together to establish well-defined air routes across country, was emphasized early in the training of American flyers. Flying by compass has now become an establisht practise, but landing fields, like beacon lights, help the pilot to pick his course, even tho he has a compass. Most of the landings today are on army fields.

Reports to the Division of Military Aeronautics from field officers say that this movement, like that which started good roads, is rapidly gaining momentum. It is predicted that before another year an aviator with a plane of moderate power will be able to make a transcontinental flight without difficulty or inconvenience.

A typical aerial landing field of a type already successfully used in England is illustrated herewith. This layout includes four powerful electric searchlight *markers*,

GERMAN "CARRY-ON MAGNET" IS TEN POUNDS OF BACON.

A "carry-on magnet, efficacy guaranteed," was advertised recently in German newspapers by its "inventor." The magnet was declared to have mystic powers enabling its possessor more easily to endure the food privations of the country.

The price was 300 marks and the buyer was privileged to inspect the magnet before paying. Those who sent in orders received a package bearing the inscription: "Contents: One Carry-On Magnet."

It is not on record that any one refused to pay for it, for the "magnet" proved to be ten pounds of Thuringian bacon. The ingenious "inventor" now is being sought by the police.

Talking Thru Land and Water

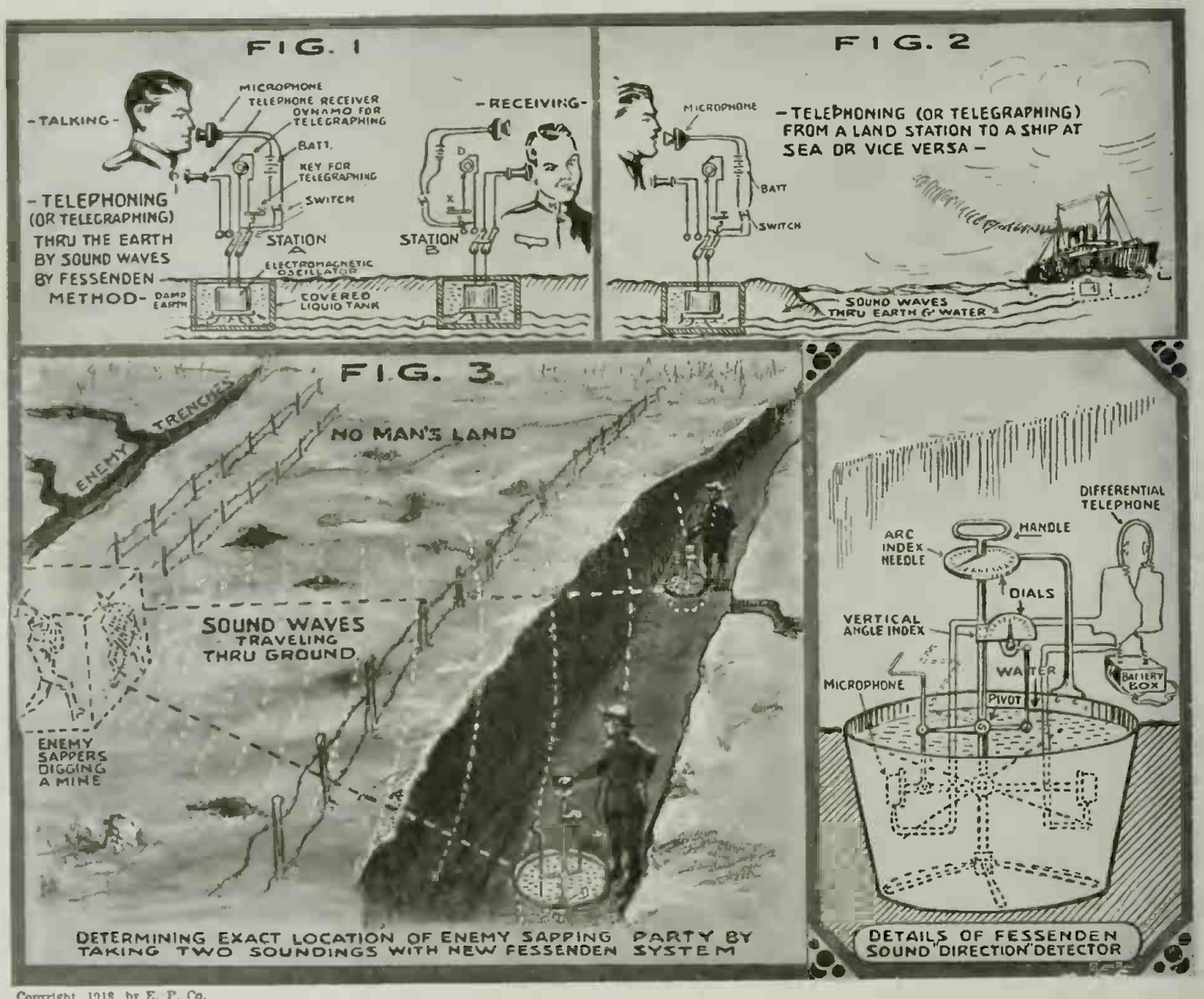
MANY years ago, when our forefathers were fighting hard to settle the country we are now living in, their enemies, the Indians, made use of many clever schemes for communicating intelligence from one tribe to another, even over considerable distances. It is said that the Indians transmitted intelligence over distances of fifteen to twenty miles when necessary, and one of the systems by which they communicated with one another when on the war-path, was to approach of men on horseback by placing the ear to the ground and listening for the sounds of the horses' hoofs, even when many miles away.

Acting on this very idea, it has remained for an American inventor, Professor Reginald A. Fessenden, to invent a system of transmitting and receiving powerful sound waves thru the earth or water. Professor Fessenden, as generally known, is the inventor of a system of submarine telegraphy which employs sound waves for the transmission and reception of intelligence. This system is in use on submarines and steamships as well as war vessels at the present time, and has saved many lives.

The present invention deals with a new and novel method of mounting powerful electro-magnetic vibrators (or "oscillators," as their inventor calls them) in sunken pits which are filled with a liquid, such as water, oil, etc. The electric circuits for either telegraphing or telephoning by sound waves, thru the earth or water, will be readily understood by referring to figures 1 and 2. For telegraphy, use is made of an alternating current dynamo, D, which may be switched on to the powerful vibrator or oscillator immersed in the liquid-filled tank, buried in the ground, or mounted in the hull of a ship. Whenever the telegraph key is deprest, powerful sound waves will be set up and propagated thru the intervening medium. The sound waves are picked up by means of the same oscillator, or else by a sensitive microphone, placed in a tank containing liquid, in the same way as at the transmitting station. The fluctuations of current created by the sound wave impinging on the oscillator or microphone, in turn cause the telephone receiver diafram to vibrate and give forth corresponding sonorous signals. In practise, the telephone receiver is invariably of the watch-case type and mounted on a head-band so as to be easily worn for long periods if necessary.

For carrying on underground or underwater telephony, the apparatus in connected up to a battery and a microphone, as shown

(Continued on page 505)



By Means of the New Fessenden System Here Illustrated It Is Possible to Actually Talk Without Wires Thru the Earth Or Sea for Considerable Distances. Also, the New "Sound Direction Detector" Will Render the Accurate Locating of Enemy Mining or Sapping Operations a Simple and Positive Task.

Magnetic and Other Fool War Dreams

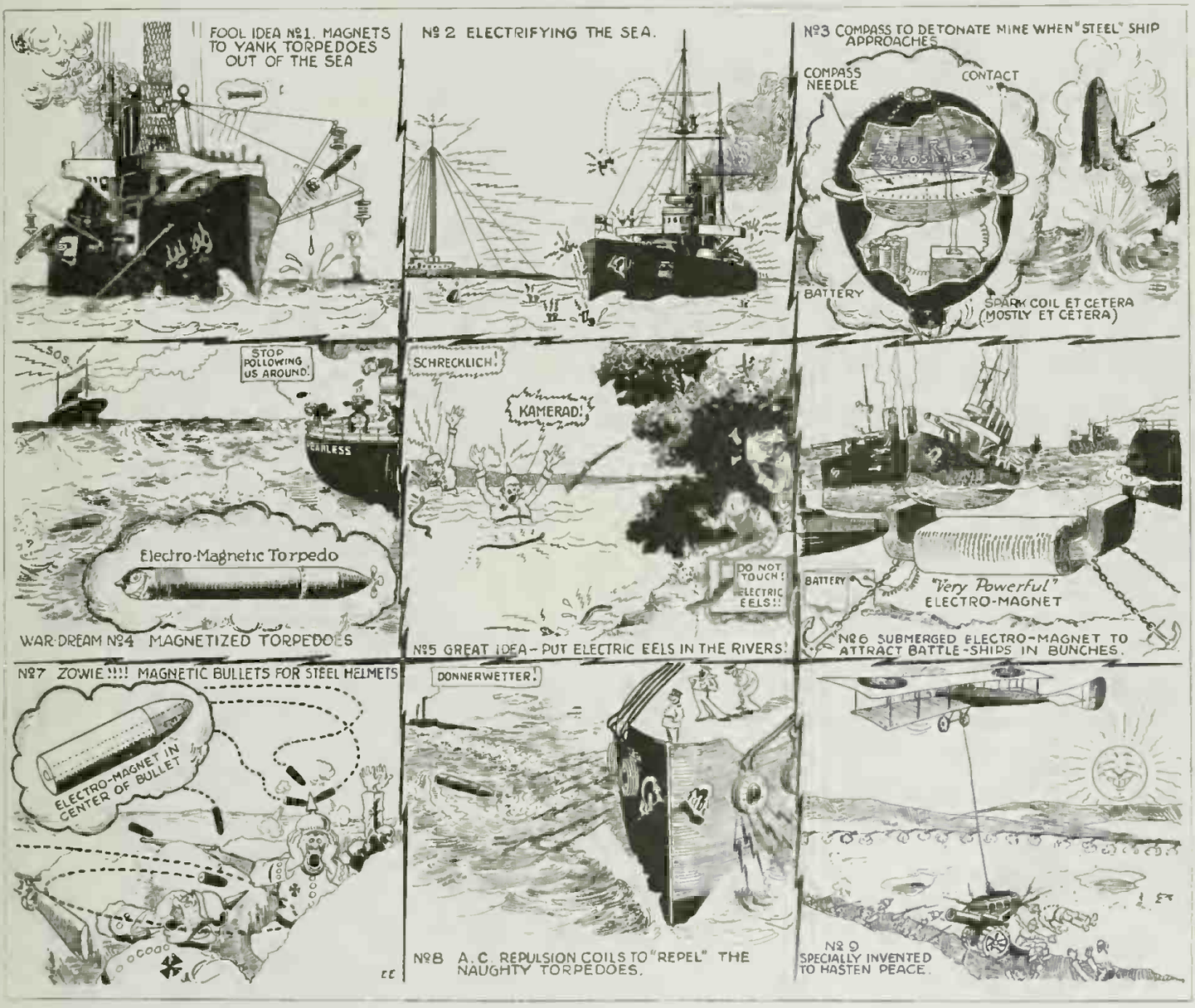
AS TOLD BY THE "ELECTROMAGNET"—HIMSELF

YES, I am the much maligned and all-powerful "Electromagnet," bone of contention among patent liers, insulting engineers, and heaven-inspired inventors of all ages, from twelve to a hundred and twelve. Recently I paid a visit to the Editorial Sanctum of the ELECTRICAL EXPERIMENTER, and some of the inspired contributions and ideas I saw there, reposing gracefully in the waste baskets of the editorial and consulting staff, were from my more or less uninformed Over-Lords, who would have me perform some of the tended rather for the Naval Insulting Board, address Chillimycoat, Greenland, conveniently situated so that these precious ideas could be placed in cold storage and thus prevent their being lost to an ever waiting world.

One of the first would-be patents marked for the attention of the Naval Consulting Board was remarkable idea No. 1. This invention proposes to do nothing less than utilize my all-powerful magnetic attractive force at the ends of long booms, spaced liberally around the "dread-naught," so that of steel plates when they were bank up against me, or at most not over an inch or so away from me and lying perfectly inert, that I could not lift a fraction of a ton or even a few pounds ten feet away!

And so the merry patent war goes on—inventors may come, and inventors may go, but the "magnet fiend" will live on forever.

While browsing around thru other more or less startling inventions, I ran across the masterpiece—No. 2—here illustrated by the editor. The "inventor" was no low-brow or cheap-skate by any means. He proposed



Here Are Just a Few of the Freak Ideas Electrical Inventors Have Proposed Since Uncle Sam Declared War. They Include Everything Imaginable and Some Not Imaginable—Schemes for Combing the Seas for U-Boats with Husky Electro-Magnets Consuming Thousands of Kilowatts, up to the Use of Electric Eels. 'Tis a Wonderful Collection.

most astounding stunts you ever dreamed of in your wildest metaphysical moments—and Brothers, if I may call you such, you ought to see some of those sketches and drawings of hair-raising and other electrical ideas marked, "Please forward to the Naval Consulting Board"! One look at some of the schemes with which their inventors propose to end the war in anywhere from six hours to twelve days would give you the impression that they were in- when the naughty torpedoes come skipping along so joyfully thru the water, the chief electrician can throw in the main switch and feed me 110 volts and God-knows-how-many-amperes, so that I will instanter, according to his idea, proceed to exert an all-pervading magnetic power of presumably *several thousand tons,* thru a radius of *several hundred feet.* Maybe that bird would like to know that if I had a diameter of six feet, and could lift twenty tons taking my co-ally, "High Potential," and injecting several billion kilowatts so as to boost the corona or effluve of my old friend "H. P.", so that he could hurl himself thru space to any convenient distance, say several hundred miles, so as to thoroly electrify all harbors, bays, inlets, and wherever enemy war vessels are wont to congregate, and even the ocean itself. Talk about your "Flying Dutchman." Gosh! but that's a

(*Continued on page* 496)

Why Is a "Blimp"?

By W. EDOUARD HAEUSSLER

KITE or observation balloons as they are termed, are used extensively in all of the theaters of the present war. Together with the innumerable airplanes employed by both sides, they constitute the most important means of observation and artillery fire control. Where there occurs a practical immobility of the lines for long periods of time, a case that is especially true in trench warfare, the observation balloons are particularly useful. It does not necessarily follow that these balloons cannot be used to advantage on marches. They can and are used even then, tho only under most favorable conditions.

Kite balloons are big and awkward to handle, and the manner of letting out and hauling in the balloons is interesting. The army balloon school at Ft. Omaha, which—as also the balloon units abroad—now utilize a portable automobile winch—i. e., a one-half inch steel cable drum and winch is mounted on a powerful auto truck. Greater flexibility is at once attained with this arrangement, for in case of attack or due to sudden high winds, the winch truck can travel along in the proper direction while the balloon is being hauled in. These winches are arranged with a separate engine to wind up the cable, but the drum may be operated from the auto engine when necessary, or both engines can be used for either the auto mechanism or the cable winch. The Germans are said to have used railroad locomotives in one case to haul down their observation balloons when a particularly rapid advance by the Allies threatened to envelop them, balloons and all. "Blimp" crews operate at altitudes of five thousand to six thousand feet usually, altho a twenty-five hundred to three thousand foot level is common, all depending upon the aërial activity of the enemy, and the extent of territory over which they have to observe.

Locomotives are also brought into play by the Allies in this interesting arm of the military activities, a very important branch when it is considered that the observation balloons are the eyes of the army. On a flat car there is mounted a motor-driven winch of the modern reciprocating, automatic adjustment, cable drum type, of extremely positive action. This car is trailed behind the locomotive in conjunction with an additional box car and another flat car. The box car is used to convey the gas stored under enormous pressure in steel "bottles," and the second flat car has the important service of carrying the balloon, bag and basket complete. The locomotive is of the armored type, and we therefore have a formidable "spy" in the shape of this aërial observation train and its equipment.

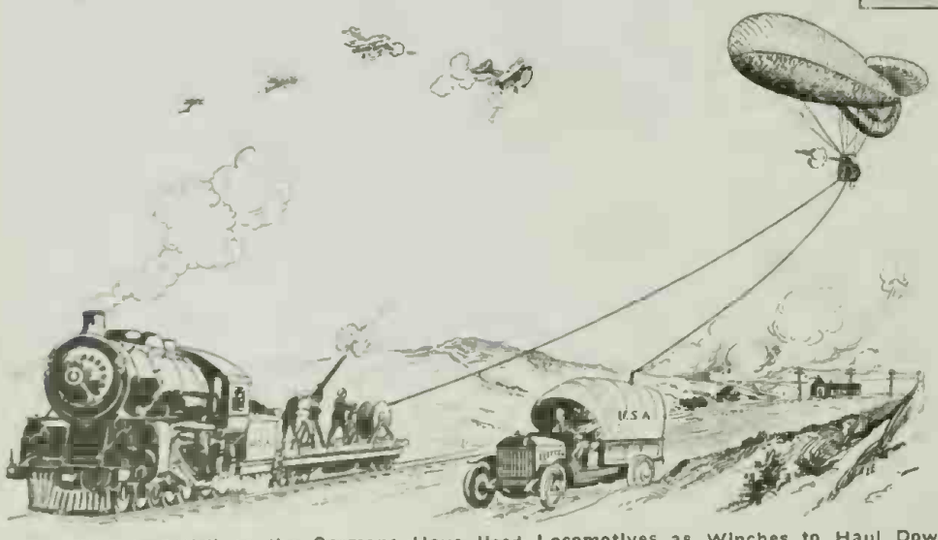
Beside carrying the gas on the flat cars, motor trucks or "camions" as they are now called thruout the Allied army, there are also generating stations situated behind the lines. Here the hydrogen gas is electrolytically produced on an enormous scale. The gas is generated in fairly large cement tanks that have been built into the ground, the tops of these tanks being placed flush with the level of the surrounding earth. These entire apparata have camouflaged covers, hiding the plants from the eyes of the "boche" aviators. The cells are likewise made of cement, and are sixteen in number to a unit. The hydrogen gas is gathered by collector pipes that lead the gas to the gasometers or measuring instruments. It is then allowed to pass into the intake end of a force pump, comprest and forced out of the exhaust side, into the steel containers—"gas bottles"—as they are popularly termed "Over There". The oxygen that is generated simultaneously with the production of the hydrogen gas, is stored

Photo-Telephone Review

This Motor-car, Manned by French Soldiers on the Somme Battle-front, Carries the Winch and Telephone for the Handling of the "Blimp" Balloon. The U. S. Army Also Uses Automobile Winches.

Photo © by Comm. on Public Information

Group of American Balloon Assistants on Duty at the "Gas Bottles"—Each Bottle Contains Hydrogen Gas for Filling the "Blimp."

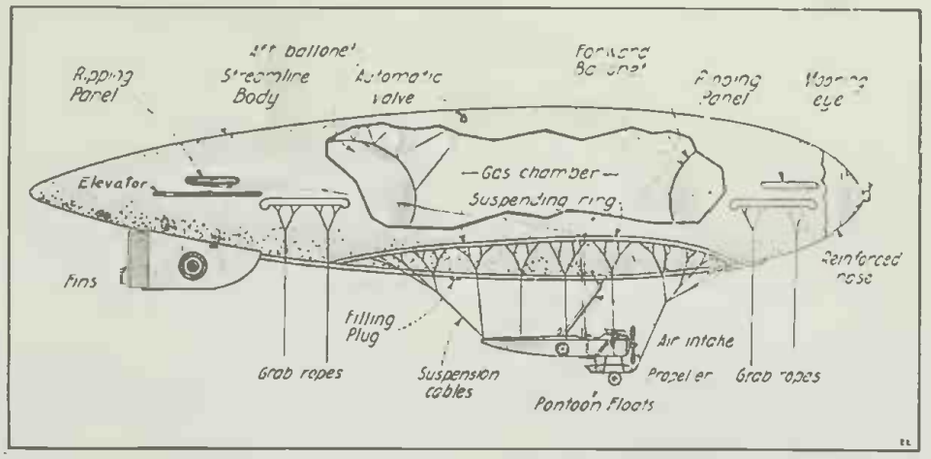


The Allies as Well as the Germans Have Used Locomotives as Winches to Haul Down "Blimps" in Emergency.

and used by the "Gas and Flame" Squads. The oxygen is combined with acetylene, thereby creating an intensely hot flame upon ignition.

In the construction of the balloon bag, almost without exception, the panel system of manufacturing is adopted, i. e., rectangular panels of fabric cemented and sewn together in the same form as bricks are laid. There are at least two plies of fabric in the ordinary balloon; in places there are three. This refers to the gas-holding envelope. The rudder and the interior ballonet is generally only one ply thick. Where two or three-ply material is used, it is cemented on the bias, thus gaining enormously in resistance to *tears*. As a matter of fact, it is almost impossible to tear three-ply balloon fabric with one's hands.

The U. S. Army "blimps" are of the French type, measuring ninety feet long by thirty-five feet in diameter. The greatest beam, to speak nautically, is about one-third of the length from the bow to the stern. From here it tapers off somewhat toward the stern, thereby gaining a streamline effect.



A Longitudinal View of a Power Driven Airship. A "Blimp" It Is Termed by the Allies. It Is Cross-Sectioned in Order to Show the Essential Parts, the Relative Positions and the General Contour of This Type of Airship. The Completeness and Detail with Which the Above Schematic Illustration Has Been Executed, Should Prove Self-Explanatory.

Photo © by Comm. on Public Information.
Raising an American Observation Balloon of the "Blimp" Class.

The "blimps" have air filled rudders which resemble a large "earth worm," extending clear around the center belt at the back of the gas bag, and also down and under the rear section. One side or the other of this air-rudder compartment is *filled* or *emptied* as required, thus presenting more or less head resistance to the wind and causing the "blimp" to swing around to the right or left as desired. The observer's basket is slung well below the gas bag so as to ride easily, and also to enable the pilot to cut loose with his *parachute*, in case the balloon is hit by an incendiary bullet or shell and set on fire.

The appendages attached to the rear of the balloon, are technically known as the *air-rudders*. Tho the principle involved in the operation of this air-rudder is extremely simple it is nevertheless rather difficult to describe in mere words. The action of the ballonet can be better understood by referring to the illustration where the observation balloon is shown in section. looking at it from the bow at the point where the automatic valve cord runs transversely across the balloon. The reader, I trust, can understand from this illustration just how the valve works.

The automatic valves, H, are connected by a cord, X, to a stop immediately opposite to itself. Riding on this cord is an aluminum thimble, C; the thimble is fastened to a series of spider-legged cords, K, which in turn are sewn to the upper surface of the ballonet, A, consisting of a one ply thickness of balloon fabric and placed on the interior of the bag, separating it into two sections; the lower being the ballonet, the size of which amounts to about one-third of the entire capacity of the balloon, and it is *air filled*. The inside portion of the bag above the separating ballonet partition, comprises the other two-thirds of the containing factors of the bag, and is filled with the lifting agent, namely, *hydrogen gas*.

The balloon is not, as popular opinion seems to imagine, entirely filled with this gas. Due to the expansion and contraction of gas in direct ratio to atmospheric conditions, some means necessarily had to be adopted in order that the shape of the balloon would remain the same at all times. In other words, the internal pressure had to be maintained at a certain constant. To accomplish this, the air-filled ballonet was adopted. The ballonet is located in the interior of the balloon proper, and it runs diagonally from end to end; from the *lower* surface at the forward end to the *upper* surface at the rear end, or stern of the observation balloon.

The physical action of the automatic valve comes into play when the gas in the upper portion of the envelope expands. This expansion of the gas forces the upper wall of the ballonet downward, thereby keeping the internal pressure constant. As the ballonet is forced down, it takes with it the spider legs, K, which in turn draw the aluminum thimble with them. The thimble, riding downward on the automatic valve cord, X, pulls it, and the increased tension opens the valve, allowing the gas to escape.

As the gas escapes, the internal pressure tends to become less, and the pressure of the air in the ballonet, which is equal to that of the wind, entering it indirectly from the air-rudder, forces the ballonet, A, upward, and as the tension is removed from the thimble, the valves, H, due to their self-contained spring loading, automatically close. The hand valve produces the same action, and the gas can be made to escape by the pilot pulling this rope at his discretion.

An explanation of the air-rudder will not be amiss here, and it will serve to show how the air in the ballonet is put under pressure by its action. This rudder is situated on the outside of the main bag, toward the stern and underneath. It is a sausage-like arrangement running towards the stern and ending in two small pipes which are communicant with the fins. These fins approximate the shape of the rudder, and are placed toward the stern of the bag and at its "equator". An aperture of about one inch in diameter is located at the forward

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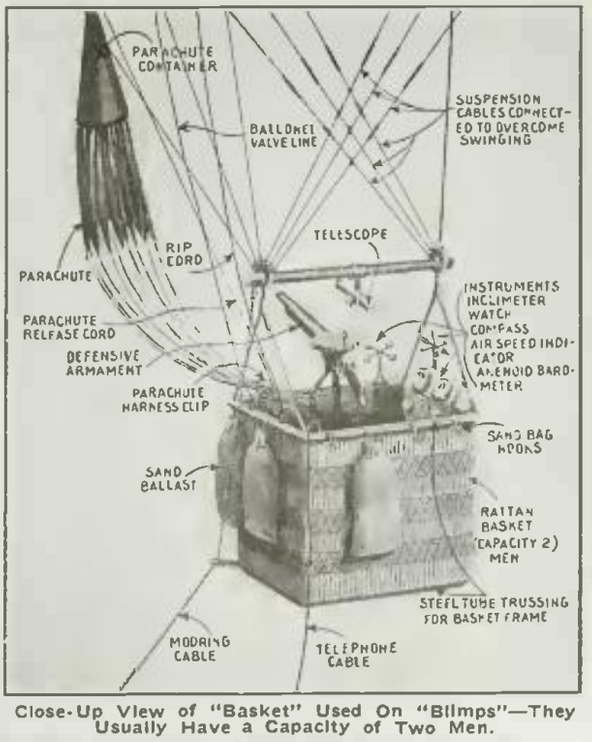


Close-Up View of "Basket" Used On "Blimps"—They Usually Have a Capacity of Two Men.

NOVEL X-RAYS

AN INTERVIEW WITH THE "ED"

By "Fips", Office Boy

AFTER several sleepless nights, I finally made up my mind to interview the Chief, even tho it would cost me my job. A certain matter disturbed me and I simply had to get it off my chest. So I cautiously pussyfooted in to his sanctum, climbed on a chair, and ambushed him by way of an open transom.

Actual X-Ray Photo of Mr. H. Gernsback. This Picture Was Taken in 3 Seconds with a Powerful 5 K. W. X-Ray Machine. Mr. Gernsback Was Lying on a Photographic Plate, FACE DOWN, the X-Rays Penetrating the Entire Skull. Note the Upper Right Hand Gold Tooth. No Sensation Is Felt While the Rays Penetrate the Skull, Except a Slight Contraction of the Two Eye Balls. Photo, Dr. B. Fidler, N. Y. C.

The prospect did not look very promising. Our Editor-in-Chief was very, very busy. With his left hindmost foot he was O.K.ing "E. E." press proofs, by means of a rubber stamp attached to his heel. He glanced at the proofs thru an inverted periscope. To his left ear was strapped a telephone receiver over which the latest electrical and scientific news came trickling in. Of these he made notes using his left hand to write them down in Morse code on a constantly moving paper tape. He was just discussing the next "E. E." cover with the cover artist, and that poor mortal was perspiring freely trying to devise some brand new color scheme that would—in the Chief's language—"knock 'em dead!" The Chief wanted an ultra-violet-sky, tinged with a carbuncle-heliotrope shade. The war machine—which sure was to win the war this trip—and which was to form the hair-raising subject of the cover—was to be a deep Hun-blooded red-vermillion, with garlic colored reflexes, while the wheels were to be of a deep-frozen helium-argon shaded gray, with canary-colored aigrettes on the hubs. Our soldiers were to be camouflaged in chameleon (changeable) colored uniforms, with lilac scented clodhoppers! The dead Huns piled sky high around the machine were to be attired in "Frankfurter"-colored lingerie, while the Hun officers were to appear in Sauerkraut-colored pajamas, with X-Ray green complexions—indicating death by concentrated Sauerkraut-gas.

"War sure is hell", muttered the poor artist as he walked unsteadily from the sanctum as if in a trance, trying to memorize all those colors.

Trembling I entered the sanctum, altho I knew from experience that the Chief, having delivered himself of his monthly "atrocity", would be in a fair humor. Indeed he was. With his right hand he kept throwing rejected manuscripts into the waste-basket, while with his disengaged right foot he shoved hundreds of rejected "Phoney Patents" into a trap door in the floor. Down they went right into the automatic paper baling machine located in the cellar. The Chief, for once smiled. Why shouldn't he. Business was good—in rejected M.S.S. For if there was no money in the magazine business, due to preposterous paper prices—he always sold $50.00 worth of baled manuscript paper a day! And that didn't cost him one cent. Besides most contributors use good paper, too, which commands a higher price!

After discreetly coughing a couple hundred times to attract his attention, I finally caught the Chief's eye.

"Well, what is it?" thundered he, working right ahead with his four extremities.

"Anointed Chief," I said, "there have been millions of requests recently from your worshipping readers, who are begging you on their knees to publish your august countenance."

"Withering inseck," yelled the Chief, "fool, knave, wouldst thou deprive me of mine daily bread? Yon letters mean 50 simoleons in baled paper to mine income a day, at present market prices."

"I thought of all that, Chief. But suppose I know of a way to publish your picture, and still get the letters!"

Instantly the Chief was all attention and I explained my plan to him minutely.

Next morning I walked into his sanctum with the proof of the adjoining X-Ray photo of his head, and after he had snorted his approval of it, I began:

"Illustrious Mumbo-jumbo! Your elcemosynary servant would fain address several questions to his august master——"

"Why August?" exploded he, "this is September, is it not? But proceed and be short!"

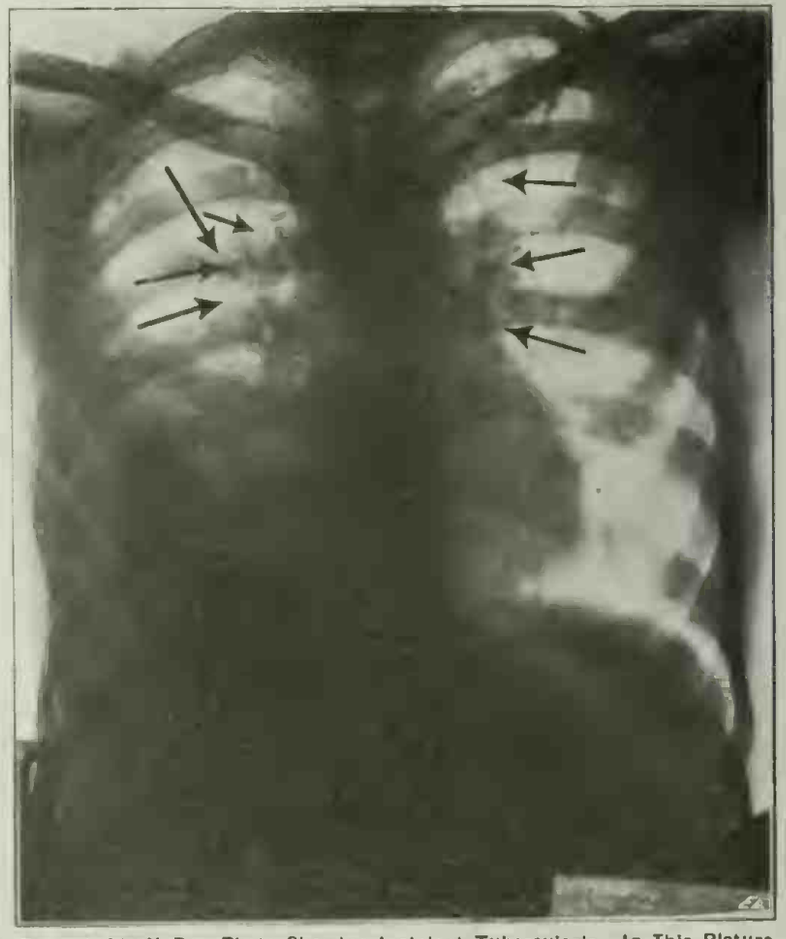
"Chief," I began, "it is of paramount importance to your readers, just where all those classical ideas of yours originate? Do they find their birth in these white, blank spaces, of which there are so many scattered thruout your reverend dome?"

The Chief grew pensive: "No not all of them," he said, "only strictly ethereal ones."

"What accounts for the extraordinary emptiness of the upper, back section of your skull, Chief?" I continued.

"Very simply explained. At the time the exposure was taken, I thought of you. Naturally my mind was blank!"

(*Continued on page* 488)



Remarkable X-Ray Photo Showing Incipient Tuberculosis. In This Picture Right Is Left and Vice Versa. The Air In the Lungs Photographs White. Note That Right Lung Is Deeply Affected with Pleuresy, One Half of It Showing Black. The Arrows Point to Sections of Lungs Diseased with Incipient Tuberculosis. Photo Courtesy Dr. B. Fidler, N. Y. C.

Electricity Aids Hun "Movie" Spies

By GEORGE HOLMES

AGAIN we have the unfailing "Movie" to supply the thrill which all must experience to get away from the humdrum of every day life. This time our reportorial eye was glued to see the "writing on the wall," as it were, and with a little sleuthing on our part we came back with some more scenes from that truly dramatic photo-play masterpiece —"The Eagle's Eye"—which is doing much to show our stay-at-homes what the vigilance of the eternal Secret Service has protected us against.

First is the plot to spread the dread epidemic of infantile paralysis thruout the land. Dr. Wolf is a chemist, German born and trained, who has a small laboratory in a tenement section of New York. (See Fig. 1.) In a medical journal he learns that it is possible to isolate the poliomyelitis germ, the cause of infantile paralysis. A scheme for causing an epidemic occurs to him. He goes to Heinric von Lertz and explains that the number of deaths which will result will so weaken the morale of Americans, that the possibility of the United States joining in the war against Imperial Germany would be removed forever. Von Lertz gives him money to carry out the plot.

Dr. Wolf prepares germ cultures and from it a paste impregnated with the living germs. Thru this paste he permits common house flies to walk, thus transferring the germs to them. Then the flies are released to scatter the germs to the food of the city.

He next begins drinking, in an excess of enthusiasm over the success of his plot. He falls, in a drunken condition on the table of his laboratory, cutting his hand on a broken culture tube. He is infected with the dread disease he has caused in so many helpless children, and dies in agony.

Petty jealousies on the part of women have caused some of the greatest catastrophies of history. Yet this trait on the part of the eternal feminine has often been turned to good advantage, and in one instance it was the direct cause of the Secret Service gaining the first information of one of the most gigantic plots planned by the Imperial German Government's spies and plotters in America. In this case resort was made to the use of a *dictograph* to listen in on the conversation of the plotters.

This instrument gained the first information which the Secret Service received in regard to the plan of the Imperial German Government's spies and plotters in America to destroy the Du Pont de Nemours munitions plant at Hopewell, Va. A woman suspected of being in sympathy and in the confidence of Ambassador von Bernstorff. Captains Boy-ed and von Papen, and Dr. Heinrich Albert, the four leaders of the Kaiser's spy army in America was shadowed to a hotel. The operative who had followed them had no trouble in obtaining the room next to the one assigned to the suspect. The microphone was then attached to the door between the two rooms and the operative affixt the head-'phones. (See Fig. 2.)

Information was not long in coming. The suspect had a caller, also a woman. A quarrel ensued in which the suspect accused the other woman of attempting to usurp her place in the confidence of the Imperial German spy leaders in America. The quarrel exposed the fact that the accusation was based upon some plot suggested by the caller in regard to the munitions plant at Hopewell.

(*Continued on page* 504)

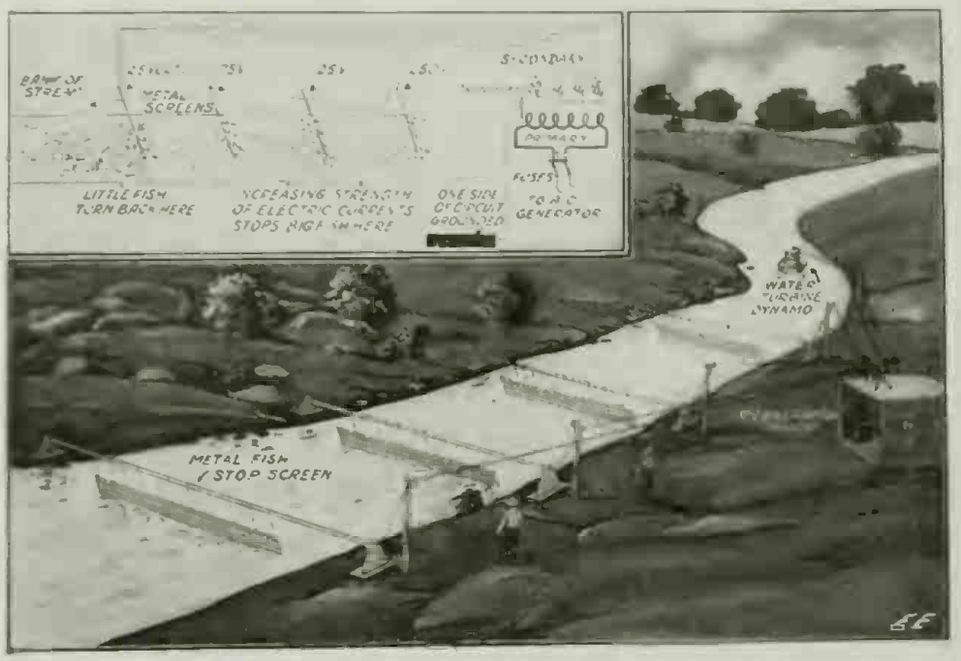
Below—Fig. 1. A Gripping Scene From "The Eagle's Eye," When Dr. Wolf, a German Born Chemist Residing in New York City, Determines to Spread Broadcast the Dread Epidemic —Poliomyelitis.

At Right—Fig. 2. Using the "Dictograph" to Get the Evidence on a Gang of Spys and Plotters. Thru the petty Jealousy of two Women the "Secret Service" Detective Learns All.

Below—Fig. 3. The Final Episode From "The Eagle's Eye" —Where the German Spies Try Their Best to Wreck a Big American Railroad. But Trust to Harrison Grant and Dashing Dixie Mason of the "Secret Service" to Watch the Telegraph Lines and Catch the Dastardly Plotters Just in the Nick of Time. This Movie Thriller Abounds in Electrical and Scientific Features.

Electrified Barriers Stop Fish in Streams

ON many occasions, particularly where large irrigating ditches are in use, and also in many large fisheries where fish are hatched and often are guided thru different water channels from one lake to another, etc., it is often very difficult to keep the fish from passing up undesired streams. It is not always feasible to prevent fish from following along such water channels by placing nets in the stream, for, in many cases, when a sufficiently small mesh net is available and placed in the stream, it will impede the flow of water too greatly. On the other hand, if a large mesh net is used, the small fish and young ones will readily pass thru the net. Not so, however, with the electrified fish-stop here illustrated, and which was recently patented by an Oklahoma genius, Henry T. Burkey, who often had the vexing experience of standing on the bank of one of his irrigation ditches, and seeing countless schools of fish of all sizes swarming along thru the ditch, even tho a number of nets had been properly placed to prevent their passing into that particular ditch.



The Old Way to Stop Fish from Going Up a Stream Was by Means of Nets, but the Newer Electrified Barrier Method Illustrated is Much Superior. By Means of a Water-Power Electric Generator, the Stream Is Made to Furnish Its Own Electrifying Current.

To circumnavigate the shortcomings of the net method of preventing fish migration along undesired water channels such as this, Mr. Burkey thought of providing a *graduated electric fish shocker,* such as the one shown in the accompanying illustration.

The electric power for charging such a fish-stop can, moreover, be derived from the the stream itself, by means of a small water turbine-dynamo placed into the stream. Electric power from the dynamo is carried to a small out-building housing a transformer which provides a series of graduated voltages. In other words, the transformer takes the current from the dynamo at a potential of, say, 110 volts, and converts it into currents of several gradually increasing voltages with potentials of 25, 75, 125 and 200 volts, for example.

The fish-stop barriers can be made from lengths of iron pipe supported on suitable insulating pedestals on the banks of the stream. The iron pipe carries a barrier composed of heavy iron or other metallic wire, which may extend nearly to the bed of the stream or ditch. The different strength currents are applied, as the illustration clearly shows, to the successive barriers, so that the weakest current of twenty-five volts is placed at the mouth or entrance of the ditch, and the current along the channel gradually increased in voltage to the rear of the outlet end, where a current of two hundred volts potential is met with—sufficient to turn back the largest fish.

In this way Mr. Burkey proposes to electrify any particular section of a stream or irrigation canal, with a gradually increasing intensity of electric current, whereby fish of all sizes at such places will be turned back without fear of killing the smaller fish, by subjecting them to a sudden charge of excessively heavy current, which might easily be the case if but one electrode charged at a fairly high potential were employed. As will be seen, one side of each of the transformer secondary coils is connected to a common conductor which is grounded, i.e., connected to earth. Thus, the current will pass thru the earth, thence thru the water to the respective metal wire barriers hanging in the stream. The metal barrier wires or rods do not need to be very close together, and yet they will protect as efficiently as a small mesh net.

According to a French electrician, the temperature of the carbon filament in an incandescent lamp approached 2,000 degrees.

THESE SPECTACLES CARRY THEIR OWN LIGHT.

By Frank C. Perkins

The accompanying illustration shows an electric spectacle lamp and frame developed by an Idaho inventor, Mr. Ladislaus Zachara. This electric spectacle lamp and frame provides means of bringing powerful electric lighting on a spectacle lamp and frame around the eye or eyes in the forehead, in order to exclude shadow from the side of the object where it is desired to see it clearly and yet leave both hands of the user free. It has an electric wiring system inside of the spectacle frame. For instance, a hollow socket and a passage thru the center of the lamps may be provided and a dark sleeve inside the passage of the lamp will enable the user to see the object clearer.

There is provided a cylindrical passage in the lamp which curves out on the point of the lamp and this curving can be shaped to any desired design. It is intended to give the eyes protection from overstraining by virtue of limiting the view thru openings in which dark tubings are mounted, thus protecting the eyes from too powerful light rays, the wide protecting frame catching the rays and throwing them back from the direction of the face. The bulb can be equipt with small reflectors if desired.

The Mystic Trio—Who are They? Ah! the Secret is out, they are Wearing the very Latest in "Spectacles." Each Pair of Glasses Carries Its Own Electric Light Between the Lenses, Current Being Supplied from a Small Pocket Battery.

How Can We Tell "Real" Death?

By H. WINFIELD SECOR

CONSIDERABLE research in the realm of that branch of medical science dealing with *real* and *apparent* death shows that medical men practically agree that in view of the facts available on the matter, and also in view of their various experiences, that it is possible for a person to apparently die, and yet be in such a perfect trance or state of *syncope* that they can defy practically every ordinary test which the physician might apply, to determine if life had entirely left the body. Briefly, the facts in a number of such cases show that the respiration or breathing function may drop to such a low point that it is imperceptible and will not show on any ordinary indicating apparatus, as for instance the well known mirror test. Also the person may be in a state of *syncope* with the heart functioning at such a low state of activity that it is impossible by any ordinary means employed by the physician, to determine whether the person is actually dead for all time or only in a temporary trance. These facts are of vital importance to all of us and of supreme interest to be sure, for we have all heard or read of persons being buried alive or while in a trance state.

Many people probably have scoffed at such statements or stories, but there are a sufficient number of cases on record to prove that we do not as yet know all concerning human life, and as to what the real germ of life is. For instance, if one will go down to the New York Academy of Medicine, and there consult the records of a number of eminent British physicians and scientists who visited India some years ago, they will find the official records, many of which are sworn to, covering the wonderful performances of the so-called Hindu fakirs. These exponents of advanced science can place themselves in a state of *suspended animation*, or syncope, for long periods; even as long as a month. During the time he is in this syncope, the subject appears to all intents and purposes to be actually dead, and can even be buried in the earth in a *sealed* coffin. After the prescribed time is up, the subject is revived by his friends and he is as much alive as ever. We have not the space here to discuss the most interesting phases of this entrancing branch of ultra-science, which has been but little investigated in a qualitative and quantitative way.

The writer has consulted a number of prominent New York physicians on this phase of medical science among others Dr. E. M. Overton, who attended the well-known actress Miss Anna Held, who recently died of pneumonia with complications. It was reported in the daily press that she manifested a remarkable state of suspended animation for two hours, but this is not true. The patient, however, did present a remarkable case, and a short syncope did occur. Dr. Overton recalled two cases in his experience where a syncope, or state of "suspended animation," occurred for a period of about five minutes. The patients were pronounced dead to all intents and purposes, after all tests, including those of respiration and heart action had been thoroly carried out. A very interesting and little known experiment was carried out in these two cases, that of injecting *adrenalin* into the heart proper with a long-needle syringe, a quantity of about one-half cubic centimeter being sufficient. These patients were brought back to life in this way (these experiments having been conducted at a well-known New York hospital) after all bodily processes and organic functions had ceased, in a period of *suspended animation* lasting about five minutes. One of these patients, a woman, was successfully resuscitated in this way and died eventually by contracting pneumonia. As Dr. Overton explained, "We cannot boost the heart or cause it to work beyond its limit, once the critical period in its life has been reached." But in this case the patient was an alcoholic and had been under severe exposure to the cold when received at the hospital. The second case was that of a man, and at last accounts he was still alive. The writer knows of a case where a woman thirty years of age past into a state of *suspended animation*, due undoubtedly to a severe sickness thru which she had past and who resuscitated herself after a syncope of twenty-four hours; this lady is alive and well today at the age of sixty-five years. The patient in this case had been pronounced dead by the attending physician, and came back to a regular state of life and activity when in her coffin.

The Principal Known Methods of Determining the State of "Real" Death from a Trance or "Syncope" Are Illustrated Above. This Is One of the Most Baffling Problems in Science.

Thus when all is said and done, we are vitally interested beyond the peradventure of a doubt in knowing what medical science has found out today in order to determine surely and accurately when life has past from the body, and below are given the principal tests which are used, as well as a number of newly suggested tests for this all important determination. Before going further it is well to remember that all undertakers today embalm the body, and the embalming fluid,

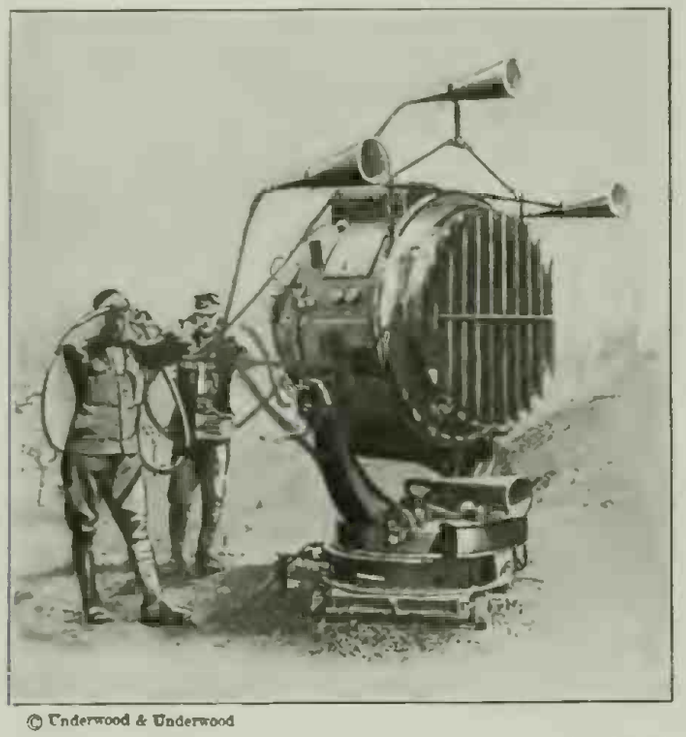
(*Continued on page* 498)

Searchlights With Aircraft Sound Detectors

The accompanying photograph shows one of the large Austrian searchlights used on the Italian front in the recent offensive by that country. As will be noted this searchlight is equipt with special sound detectors comprising a series of large megaphones mounted in circular fashion about the searchlight frame, so when the operators quickly move the searchlight and adjust the mechanism, an approaching aeroplane, or fleet of enemy aeroplanes, will produce the maximum sound in the acoustic receivers attached to the megaphones. Thus the searchlight beam will automatically and simultaneously be focust in the same direction to that in which the megaphones are pointing.

This unique arrangement for locating and revealing the enemy aircraft is used most efficaciously at night of course. It is quite surprising to learn that a simple megaphone of even small size, such as that here shown, will indicate the approach of an aeroplane, owing to the great volume of sound given off by the gasoline motor propelling the plane. The French Aërial Observation Corps have made very extensive use of these megaphone aircraft detectors. They have been much employed in the larger cities of France, including Paris, for detecting the approach of hostile aërial squadrons or even a single enemy plane, even when they are several miles away.

The object of using the megaphone horns is that they will respond with the maximum sound when they are pointed to within even a few degrees of the source from which the sound is emanating, which is in this case, of course, the enemy aeroplane motor. The photograph, as aforementioned, shows Austrian observers listening for the approach of Italian aircraft. With such devices available it is possible for the military intelligence department to ascertain the approach of enemy bombing planes when they are at a considearble distance, and when thus armed with this advance information, it is a simple matter to bring up the anti-aircraft artillery, many of the guns of which are mounted on high-powered automobiles, and provide a very warm reception for the enemy intruder when they arrive on the proposed scene of action.



© Underwood & Underwood

An Austrian Searchlight on the Italian Front Equipt With Sound Detectors. Austrian Soldiers Are Listening for the Approach of Italian Aircraft.

HEAT AND LIGHT TREATMENT LAMP.

The illustration shows a new and improved thermo light, which has been designed along scientific lines for the proper infusion of electric light and heat.

This unique reflector so directs the heat rays of the special lamp that they produce the best results with minimum current consumption and without the rapid deterioration of the filament.

The heat rays are effective over an area of approximately 50 square inches and not focust in a small burning spot.

The outside shell and inside reflector are constructed of aluminum, making the device very light in weight, which permits prolonged treatment without fatigue.

It comes complete with lamp, to operate on any direct or alternating circuit not exceeding 125 volts, 8 feet cable and attachment plug.

Heat and Light Treatment Will Often Work Wonders Where Medicine Fails. This Thermo Light Connects With Any Current Outlet.

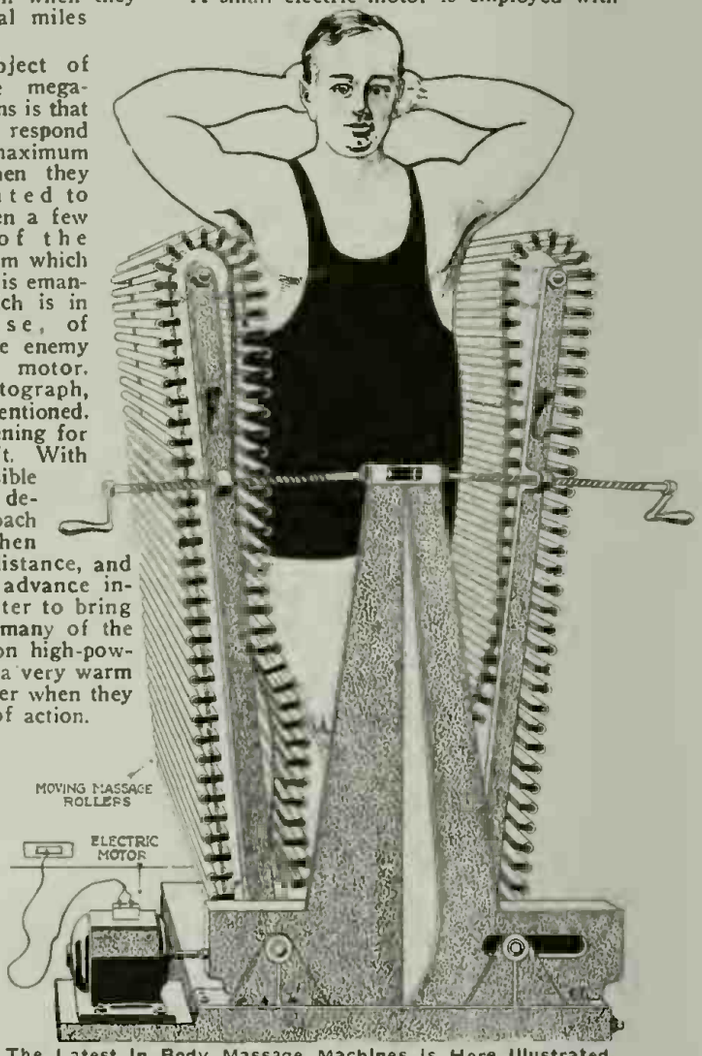
A group of European electricians decided, after experimenting, that better results were obtained by placing the carbons in arc lamps horizontally and one slightly above the other.

MOVING ELECTRIC ROLLERS MASSAGE WHOLE BODY AT ONCE.

Possibly you are one of those individuals who have become somewhat avoirdupois, perhaps, several dozen pounds too much; in that case you may have had recourse to a masseur specialist, as many people have. Again, it is also quite possible that you did not attain the reduction in obesity that you had expected. Body massage, like many other things, is efficient only when kept up regularly and very thoroly.

The machine here illustrated aims toward the end of perfect thoroness in body massage, and the reader will see at once that the inventor of this recently patented contraption, no matter how uncomfortable it may appear first-hand, has evolved a very ingenious, and apparently very efficient massage machine, which, when adjusted to the patient's form, will proceed to massage the chest and leg muscles in a much more thoro manner than is the case when this treatment is performed by hand.

A small electric motor is employed with suitable gearing, so as to cause the two sets of wooden or other rollers to travel on endless chains. By means of the two handles shown on the right and left hand sides of the machine, the two uprights carrying the moving roller belts, can be moved toward or away from the "patient's" body, until they are adjusted accurately for each particular case. Also the upper rollers carrying the drums over which the roller belts travel, are adjustable and can be moved up and down vertically, so as to permit the belts of the top rollers to conform accurately to the shape of the body.



The Latest In Body Massage Machines Is Here Illustrated. The Motor-Driven Rollers Fit the Exact Contour of the Body and Are Adjustable.

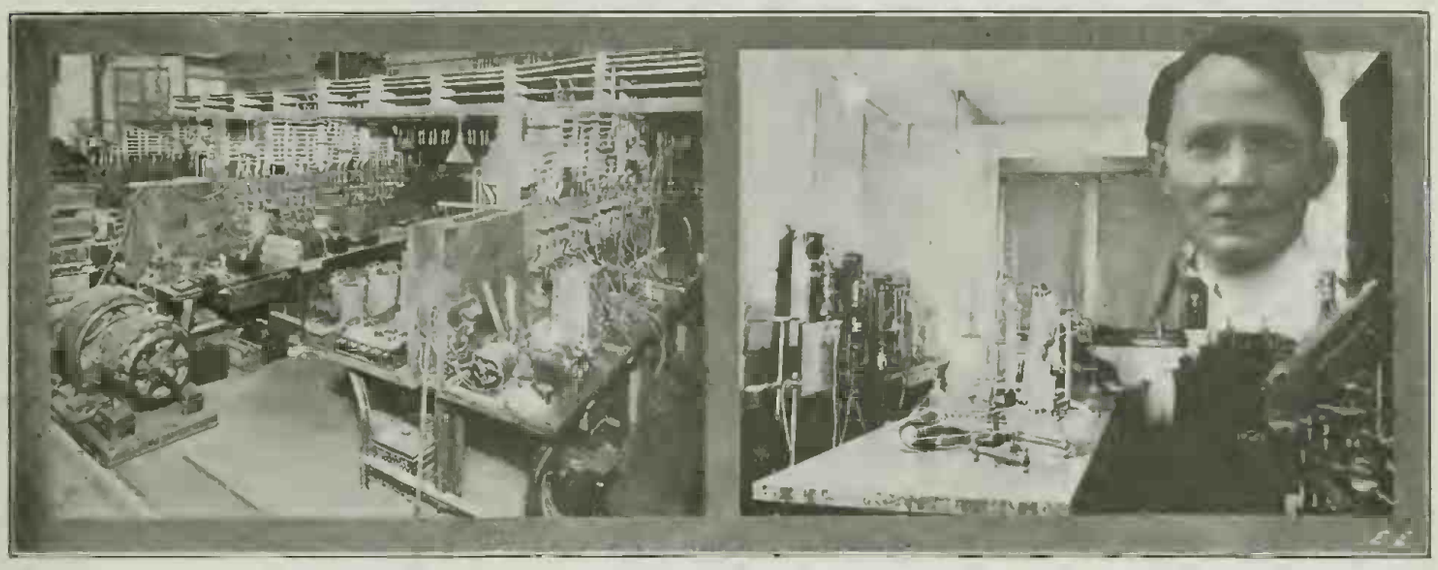
New Westinghouse Research Laboratory

THE research work of the great Westinghouse electrical concern has always been carried on under the direction of the engineering department. In 1906, the research division was organized as one of the several divisions of the engineering department, and it now has under its control seven laboratories.

The work of the division includes activities which are not usually clast as research work in other organizations. For example, it has charge of the preparation of all specifications for the purchase of the materials used by the company, together with the experimental and development work leading up to the writing of these specifications, says Mr. C. E. Skinner, the chief engineer and Mr. R. W. E. Moore, in a recent article describing these interesting laboratories. Mr. Skinner's photo is reproduced herewith. First there is a process section, which has technical control of all the various processes used by the company in the manufacture of its product. It has charge of the routine chemical and physical testing for all departments, including the inspection departments. It has technical control of the various metallurgical processes, such as those involved in the brass foundry, copper mill, scrap-recovery plant, et cetera.

The laboratories under the control of the division are the chemical laboratory, the physical testing laboratory, the process laboratory, the electrical laboratory, the molded-

(*Continued on page* 503.)



Two Views of the New Westinghouse Research Laboratories and the Chief Engineer—Mr. C. E. Skinner. Here Is Where Some of the Best Brains and Technical Talent in the Country Will Strive to Help Win the War for Uncle Sam.

Fair Telephone Operators Join Uncle Sam Overseas

HURRAH for the fourth unit of telephone operators, already taking its place in France beside the other three, and making things hum "over there!"

The cable "Arrived safely," is brief, to be sure, but what it really means to say is, *"Sixty more French-speaking American girls have arrived in France to operate war switchboards for Uncle Sam and our boys."* They have volunteered to do this as their contribution toward winning the war, because they feel that it is the thing that they can do best. As one of them put it, if they didn't go they would feel like slackers, and would be slackers just as much as any man who shirked his duty. More are ready to go, but they are not needed at present, and are continuing their training over here.

With minds filled with the end to be attained, these girls and those who preceded them, together with those who are to follow, have traveled from the four corners of the United States.

Since every little town and every big city in the United States produces a different type of individual, these girls, when they meet, cannot help being surprised at the ways and characteristics of one another.

These operators hold a unique position in the army, being pioneers in their line. Many things in connection with their status in the army are not well defined as yet, but will evolve with time. Need for such a unit was felt, the call went out, and the need was met. Minor details were left to time to be worked out.

For instance, after an elapse of several months, some changes have been made in the uniforms.

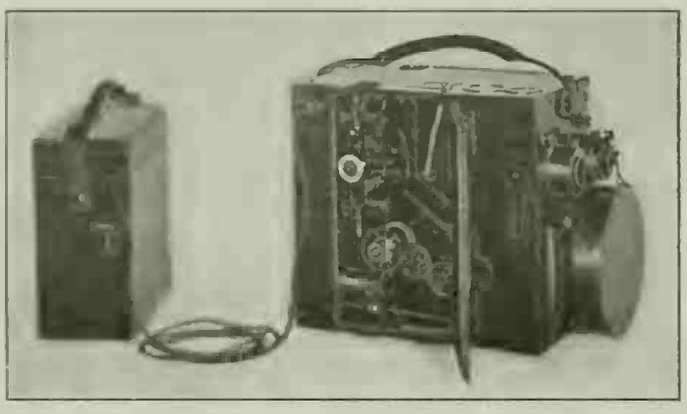
A summer outfit, consisting of a blue alpaca suit of the same cut as the heavy one, with a straw sailor, and a little aviation cap has been enthusiastically welcomed by the girls, who have felt the disadvantages of possessing one suit only, and that a very warm one for a hot day. Dark blue silk shirtwaists to supplement the white ones filled a much-felt need, and simplified the laundry question considerably, while rubber cloaks, arctics, and other accessories also helped to make up a complete, comfortable, and good-looking wardrobe.—*Photo, courtesy Telephone Review.*

Hats Off to These American Telephone Operators Now Safely Landed in France and Helping General Pershing to Keep His Lines of Communication Working.

An electrically controlled machine for sorting coffee beans has been invented.

A Gyro Electric "Movie" Camera for the Battlefield

PHOTOGRAPHY fills a most important niche in this business of Kanning the Kaiser! There is hardly a branch of the service that is lacking a cameraman, whose business it is to bring back an indestructible, true and vivid record of what is going on "Over There" in the fight for democracy. And thus will our children and their children's children be able to see the struggle that was made to preserve the liberty of the good old U. S. A.



The Latest Gyroscopic Electric "Movie" Camera for Use in Photographing Battlefield and Aerial Views. The Gyroscope Holds the Camera Steady at All Times.

The strides made in the art of recent years reflect what an advance has been made over the now seemingly antique methods of photography used in the Civil War.

In the days of '61 no great interest was evinced in the hazardous task of taking pictures under battle-front conditions and on the march. The very few men interested enough to undertake the task were mostly "free lances," doing things on their own hook. Considering everything we are to-day indeed fortunate in still having quite a number of these photographs, whose value shall increase in the years to come of that memorable struggle between the North and South.

All this is now changed. On every battle-front you will find the photographer. Whether on land, up in the air or on the sea, you will find him turning his crank or clicking his Graflex.

To overcome some of the difficulties experienced with the standard movie camera one large camera concern has devised a new type of machine adapted for use under the most adverse conditions.

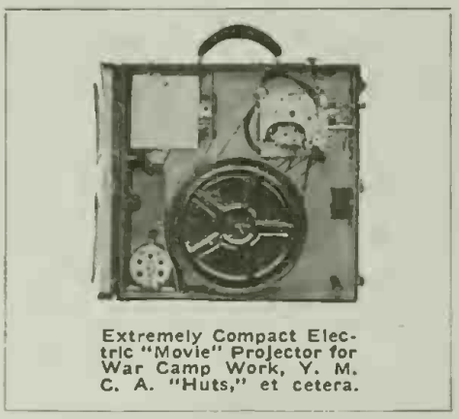
It is constructed on much the same lines as the usual motion-picture camera, but more substantially, so that it will outlast the wear and tear of service on the battle-field. The film magazines, shutter, take-up arrangement, lenses, etc., are located on one side of the camera and identical with the usual machine.

On the opposite side may be seen the electrical drive for the film. See cut above. The motor is self-contained and fitted with ball-bearings to reduce the friction and make the driving almost noiseless. The motor is geared up so that at its maximum speed the machine takes about 24 pictures per second; the speed of the motor as well as the starting is controlled by a small lever on the side of the case which, when prest, causes resistance to be cut out of the circuit and the motor gains speed. Two dials are set in the top of the camera to show the speed of the film.

The all important feature is the small stabilizing gyroscope placed on the front end of the camera and driven by a separate electric motor. After the gyroscope has attained its maximum speed of 5,000 r.p.m. (it takes about five minutes to do this) it becomes possible for the photographer to move about, run, walk, ride and do numerous other things, while he simply holds the camera by the two handles (one on each side). The camera will always maintain its horizontal plane and take distinct and clear pictures, without resort to a tripod or similar steadying device which would otherwise be necessary and always in the way.

The battery is carried in a separate cabinet and consists of a set of twelve storage cells, the casings of which are made of light celluloid and fixt into one solid unit. It delivers a maximum of twenty-four volts and about ten amperes.

The cells are so arranged that the acid cannot spill should the battery be overturned or upset.



Extremely Compact Electric "Movie" Projector for War Camp Work, Y. M. C. A. "Huts," et cetera.

Next after taking our pictures and developing and printing them comes the need of seeing what we have taken. The regulation

(*Continued on page* 504.)

IMPROVED LOUD-SPEAKING TELEPHONES.

The loud-speaking telephone has come to stay—only a few years ago it was practically unknown outside the laboratory. It finds many new applications daily and you are apt to meet it most anywhere nowadays.

A new type of duplex voice-transmitter is illustrated here. It is a very sturdy instrument manufactured for severe usage.

On quite a few installations of this apparatus as many as a thousand calls are made in twenty-four hours, day after day. Generally it is the telephone operator who uses this equipment. A telephone operator is always in a hurry and a transmitter designed for the operator to take up and lay down every time she uses it, does not stand up as well as a transmitter mounted on an extension telephone arm, one type of which is here shown. This improved type of transmitter is made without any movable joints and in as few pieces as possible.

The reproducer horns are located in the walls in flush type containing cabinets when possible, as this makes an unobtrusive installation. Since the reproducer horns are up out of the way where they are not subjected to wear, and because they have no moving parts to wear out, their life is practically unlimited.

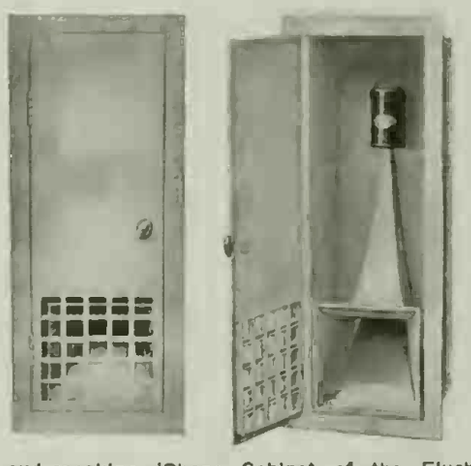
The reproducer itself is mounted in a dust-proof case, and is fully protected against rusting.

Ordinarily there is but one switch used on these loud-talking systems and that is used for turning the current on and off. Standard switches are used.

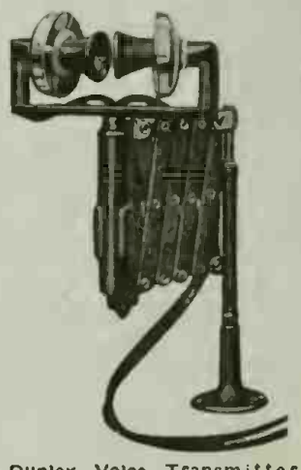
The latest type of reproducer has as nearly permanent adjustment as possible. The reproducers are "seasoned" before shipment, so as to take care of any settling of parts.

The duplex voice-transmitter is designed for use on installations of from ten to twenty loud-speaking reproducer horns. It is approximately twice as powerful as the single-voice transmitter, because each transmitter energizes it's own individual circuit of reproducer horns. Approximately half of the reproducer horns being energized by each transmitter, there is no electrical connection between these transmitters, except that they are energized by the same current supply.

The concealed type horn and cabinet shown has been designed particularly for use in hospitals. The horn is white enameled and the cabinet is given a final coat of paint after being mounted in place, of the same color used on the walls. The hinged door gives ready access to the interior when it is desired to clean or dust inside.



Loud-speaking 'Phone Cabinet of the Flush Wall Type. Sound Emerges Thru Grill at Base.



Duplex Voice Transmitter for Loud-speaker at Left.

Electric Trucks Aid War Work

ALONG with the great increase in woman labor in "the army behind the army," has come the use of a number of devices which make possible a much wider application of this labor than was originally thought of. Today women are making practically all of the great quantity of munitions that is being used by the British army.

One of the pictures herewith shows women workers loading shells on one of the trains of miniature railway cars, used for moving these shells about in one of the great British munition plants. Electricity is used wherever possible to expedite handling and delivery. Overhead cranes lift and carry the heavy shells and place them at their designated places in the shell warehouses. Women operators work the overhead cranes, direct the loading of the shells on the cars, as shown by the picture, and also drive the little storage battery tractor which transports these cars from building to building. It will be seen from the photograph that the girl in the foreground, driving the storage battery tractor, is quite youthful for the responsibility of this job. However, these tractors have been so simplified and safeguarded that their operation now can be performed by practically any person.

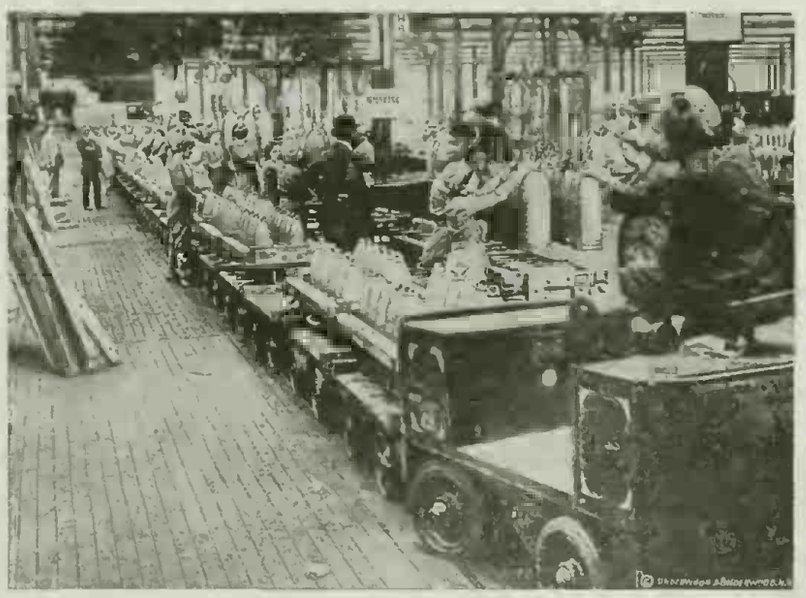
It is interesting to note that whereas the cars of the railroad trains run on tracks, the tractor which pushes these cars about does not do so. It can haul a string of cars in and then run past this string of cars, along the aisle, and do work elsewhere while this first string is being loaded. One of the desirable features of this storage battery tractor is that there is no overhead trolley and that all danger by reason of electric arcing, etc., is eliminated.

As our participation in the war assumes greater and greater proportions we may expect to see large numbers of these little tractors in use in our own munition plants.

The other photo shows how the electric storage-battery equipt truck is "doing its bit" in our own country. During the present freight congestion and shortage of locomotives these trucks have often proved useful in switching freight cars on sidings and in factory yards. The photo shows an electric truck hauling three hefty tank cars "somewhere in New Jersey."

The electric vehicle has a much wider range of service than most people appreciate. From the light 750-lb. delivery wagon to the 15,000-lb. truck, there is a choice for every industry.

The simplicity of the electric, whether small delivery or giant truck; its ease of operation and control, and freedom from mechanical troubles; together with the mechanical and electrical perfection of the storage battery, insure that money-making result—most days in service per year.



Miniature Electric Railway Used for Moving Shells in a British Munition Plant. Women Are Loading the Cars on the Second Track, While the String of Cars on the First Track Is About Ready to Be Moved Out. Notice that the Tractor for Moving the Cars Does Not Need to Run on the Rails. It Is a Mobile Unit, Able to Be Used Practically Anywhere. Electricity for This Tractor Is Furnished by Edison Storage Batteries in the Two Compartments.

PLAN TO COMBINE ELECTRIC PLANTS.

Combination of electric generating systems and eliminating of hundreds of isolated and uneconomical plants is under consideration by the Fuel Administration as a means of saving fuel supplies. Representatives of the Fuel Administration left New York recently to attend hearings before the Public Service Commission at Washington, D. C., at which the subject will be taken up as affecting New York City.

Millions of tons of coal would be saved, officials say, by centralization. The plan, too, if executed, they say, would go far toward relieving terminal congestion and lightening the loads carried by rail and barge lines.

The coal administration is conducting a general investigation to determine how centralization best could be accomplished without working undue hardships on the owners of plants which might be closed.

"It already has been demonstrated," said a recent Fuel Administration order, "that in many localities centralization may be effected without hardship and with a considerable saving. England and France long ago have taken steps in this general direction. In fact, a commission appointed in England to investigate the subject has described centralization as an economic necessity. It is estimated in this report that an economic saving of $600,000,000 would be effected and the fuel requirements of the industries now supplied with electrical power cut in half."

An Electric Truck "Doing Its Bit" Somewhere in New Jersey. This Truck, Equipt with Edison Storage Batteries, Is Hauling Three Tank Cars Without a Whimper.

Popular Astronomy

THE SPIRAL NEBULAE AND THE ISLAND UNIVERSE THEORY—FIFTH PAPER

By ISABEL M. LEWIS

Of the U. S. Naval Observatory

THE mystery of the spiral nebulae is still unsolved. These peculiar structures exist in the heavens by hundreds of thousands. They range in size from The Great Andromeda Nebula, which covers a space about one and

No. 3.—The Spiral Nebula In Centaurus (N. G. C. 5236) Photographed With the 40-Inch Reflector of the Lowell Observatory By C. O. Lampland. View of a Spiral Nebula Lying Across the Line of Sight.

one-half degrees in length by half a degree in width and is faintly visible without the aid of a telescope, down to the tiny flecks of light that are invisible to the human eye directly but appear on the photographic plates attached to our most powerful telescopes after an exposure of several hours duration.

Counts have been made of the number of spiral nebulae upon photographic plates within selected areas evenly distributed over the sky with a view to determining the probable number of these objects within the reach of great telescopes. It has been estimated as a result of these counts that there are at least seven hundred thousand small spirals photographically in reach of the largest reflectors, while the total number may easily exceed one million.

In some regions these spirals are crowded together in the greatest profusion. In a most wonderful region in the constellation Coma Berenices three hundred and four faint spiral nebulae have been counted upon a single photographic plate covering an area of about three-fourths of a square degree, tho a region of equal size only a few degrees distant contains but two spirals. Aside from a marked avoidance of the plane of the Galaxy and a noticeable clustering near the north pole of this plane and to a somewhat less degree near its south pole the distribution of the spirals is quite general thruout the heavens.

The reason that spiral nebulae should avoid the neighborhood of the Milky Way, which is the region favored by the gaseous nebulae, the planetary nebulae and the vast majority of the stars is not yet satisfactorily explained. The fact is most significant and must be considered in all theories dealing with the origin and nature of the spiral nebulae. The very fact that the spirals avoid the Milky Way shows that they are in some way affected by it.

A second most marked characteristic of the spiral nebulae is their extremely high velocity of motion thru space, the greatest for any class of celestial objects. The radial velocity, that is velocity in the line of sight, has been found for some of the brighter spirals and it is now known that a number of spirals have a radial velocity of several hundred miles per second. Since motion in the line of sight is but one component of the actual motion of a body and can be shown to be equal to one half of the actual space velocity of the object it follows that some of the spirals are known to be moving thru space with a velocity of more than one thousand miles a second. The velocity of the stars averages about twenty miles per second. A few stars spoken of as "runaway stars" have a velocity of one hundred or two hundred miles per second, but these are quite exceptional and they are sometimes referred to as visitors to our galactic regions from regions beyond. In fact celestial objects other than the spiral nebulae that have unusually high velocities of motion thru space such as the globular star clusters and a few isolated types of stars show the same avoidance of the plane of the Milky Way that is shown by the spiral nebulae. According to one explanation this is due to the fact that a strong gravitational field exists in this plane with its hosts of star clouds, and its vast tracts of nebulous matter, both luminous and non-luminous. Globular star clusters or spiral nebulae entering this field would not be able to remain intact but would be disrupted and scattered.

The spiral nebulae do not possess the "bright-line" spectrum characteristic of the strictly gaseous irregular and planetary nebulae that are found in the vicinity of the Milky Way but have the continuous type of spectrum such as comes from our own sun and such as would emanate from star-like bodies. The spiral nebulae are for this reason not considered to be strictly gaseous objects but a conglomeration of stars and nebulous matter. Dark streaks visible in a number of spirals that lie edgewise to the earth seem to show that these nebulae are surrounded by some dark gaseous matter

No. 4.—The Whirlpool Nebula (N. G. C. 5194) In Canes Venatici. One of the Most Beautiful of the Spiral Nebulae. Its Spiral Structure Was First Detected By Lord Rosse In 1845. Photographed With the 40-Inch Reflector of the Lowell Observatory By C. O. Lampland. This Nebula Also Lies At Right-angles to the Line of Sight and Therefore the Spiral Formation Is Very Noticeable.

that aborbs the light from the inner portions.

Believers in the *island universe* theory of the spiral nebulae consider that our stellar system is also a spiral nebula and that its form is essentially that depicted in the accompanying photographs of characteristic spiral nebulae. The spiral arms are represented in our system by the star clouds of the Milky Way. The well-known star streaming tendencies of the stars represent motions in and out along those spiral arms toward and away from the nucleus of the spiral. According to this theory dark nebulous matter may exist in outlying portions of the Milky Way similar to the nebulous matter producing the dark streaks in the accompanying photographs (Nos. 1 and 2). Such nebulous matter would hide from our view spiral nebulae lying in the neighborhood of the galactic plane and this would explain why the spirals apparently avoid the plane of the Milky Way. It has long been known that the vast majority of all the stars and the great irregular gaseous nebulae constituting what is known as our "stellar system," crowd toward one plane, that of the Milky Way; for all we know to the contrary all these stars and nebulae may form one vast spiral structure. The distance of the spiral nebulae is now known to be very great. At a distance of several hundred thousand light-years our whole system of hundreds of millions of stars would fade away into a small blurred speck in which no individual stars except the giants of the system would be distinguishable and we would appear as the faint spiral nebulae appear to us. So reason those who believe that the spiral nebulae are external universes separated from our Galaxy by distances so great that a ray of light travelling with the velocity of 186,000 miles per second would take not tens of thousands but hundreds of thousands years to span the abyss!

Until a year or so ago there appeared to be no way of arriving at a reliable estimate of the average distance of the spiral nebulae. Up to July, 1917, thirty two Novae or Temporary stars had been discovered. Of this number thirty were in the Milky Way. two were in spiral nebulae. No particular attention had been paid to the two exceptions. In July, however, Ritchey, at Mt. Wilson, found a faint star in a spiral nebula that had not appeared on earlier photographic plates. Now one or possibly two Novae might chance to be in line with spirals but hardly three. The discovery started astronomers examining past photographs of spiral nebulae for Novae with the result that eight additional Novae were found to be connected with spiral nebulae. The facts were then that all known Novae to date had appeared either in the Milky Way or in spiral nebulae. The appearance of Novae in the Milky Way is usually explained as due to the encounter of a star with nebulous matter. The Novae of the Galaxy are suns suddenly raised to abnormal brightness thru the friction arising from the encounter of star with nebula. How then should the newly noted Novae in spirals be explained since the spiral nebulae conspicuously avoid the neighborhood of the Milky Way? It was a point in favor of the *island universe* theory, for if the spirals are similar in structure to the Milky Way and are great aggregations of stars and vast gaseous nebulae the appearance of Novae in spirals is not so strange. This theory was further borne out by the fact that the Novae of the Milky Way average eight magnitudes or nearly sixteen hundred times brighter than the Novae appearing in spirals. Since the apparent brightness of stars of equal magnitude varies as the squares of their distances the Novae in spirals must be on the average forty times more distant than the Novae of the Milky Way, which are members of our own system of stars. We do not know the distance of the Novae of the Milky Way, but if we assume they are at an average distance of five thousand light years the average distance of the spiral nebulae comes out two hundred thousand light years.

There is another class of celestial objects, the globular star clusters, that are now known to be at distances ranging from twenty thousand to more than two hundred thousand light years from the earth. Each

(*Continued on page* 507)

No. 1.—The Dark-lane Nebula (N. G. C. 4594) In Virgo. Photographed With the 40-Inch Reflector of the Lowell Observatory By C. O. Lampland. A Spiral Nebula Viewed Edge-wise. This Nebula Is the First In Which Was Observed the High Velocity of Translation Thru Space Now Known to Be Characteristic of Many Spiral Nebulae. It Has a Velocity of Motion In the Line of Sight Toward the Solar System of About 685 Miles Per Second. Also the First Nebula In Which the Effect of Rotation Was Detected and Measured.

No. 2.—The Edge-view Spiral Nebula (N. G. G. 4565) In Coma Berenices. Photographed With the 40-Inch Reflector of the Lowell Observatory By C. O. Lampland. The Dark Streak Thru the Center Is Due to the Presence of Dark Absorbing Gaseous Material on the Perifery That Shuts Off the Light From the Central Portions of the Nebula.

POWERFUL LIGHT RELIEVES PAIN.

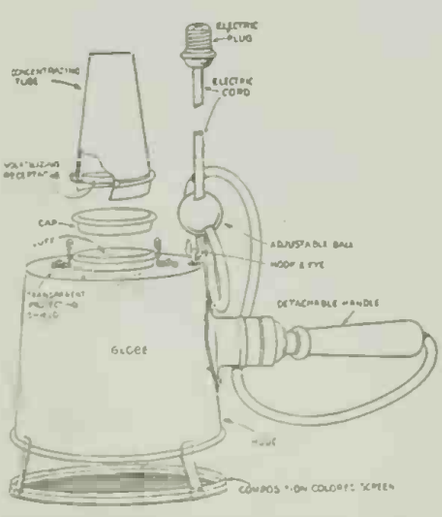
It is rapidly becoming the practise, both in private and professional circles, to apply the rays of a powerful electric lamp to

Showing Application of Rays Thru Concentrating Tube into the Mouth for Cold Sores, Canker Sores, Gum Boils, Toothache, Tonsilitis. May be Applied to the Nose for Catarrh and Inflammatory Conditions.

various affected parts of the body. They will conquer and banish pain and other symptons of most diseases, thereby giving Nature a better opportunity to overcome the underlying condition and lessening the amount of medicine required, it is said.

For instance, they will overcome the pain of wrenched or sprained muscles or pressure upon nerves, and help poor circulation, numbness and stiffness of any part following cold or injury. Nothing penetrates, heals and soothes sore areas and so promptly re-establishes the vim and vigor of the patient as the timely application of heat and light therapy.

When applied early after a bruise, as of the eye or face, they prevent swelling and discoloration of the skin. The light here shown is claimed to decrease the pain of a carbuncle, boil or abscess. In the early stages it may prevent the formation of pus; in the later stages it helps to ripen the abscess. The illustration shows a 400 candle-power cornucopia shape lamp, which consists of an aluminum hood, globe, handle, seven feet of cord, plug and adjusting ball for raising and lowering lamp over patient. There are also available colored, adjustable, transparent composition violet, ruby amber and green screens.



Semi-Sectional View of Powerful Light Treatment Lamp and Cone Reflector Illustrated in Use Above.

230,000,000 K.W. WATER POWER PER YEAR AVAILABLE, SAYS STEINMETZ.

Dr. Steinmetz, in a recent paper presented before the American Institute of Electrical Engineers, warned his hearers, that water power can never be expected to do anything more than supplement the use of coal. He estimated the possible hydraulic energy of all American water courses as 230,000,000 kilowatts a year, a little more than the total energy now produced in the United States, thru the medium of coal. "This means," he said, "that the theory by which we hope to use the water power of the country when coal begins to fail as an endless supply of energy is now a dream and must remain a dream. If all the potential powers of the land were now developed, and every raindrop used, it would not supply our present demand for energy.

ANNOUNCEMENT

With this issue the price of the ELECTRICAL EXPERIMENTER *advances to 20 cents a copy. We have delayed this move as long as we dared, but economical conditions made the change necessary if the publication was to survive. We are forced to pay 10½ cents a pound for text paper now—an increase of 116% SINCE 1916. Our cover paper now costs 11 cents a pound—AN INCREASE OF 91%. Printing, art work, engravings—all have advanced 50% to 90% and the end is not yet. Take only one item—the two carloads of paper that go into making a single edition of this magazine, they now cost us $2800.00 MORE than a year ago. The paper alone in a single copy of the* EXPERIMENTER *costs 5½ cents! Advancing the price of a publication never benefits a publisher. He loses a certain percentage of circulation, and his subscriptions fall off. New readers at the higher price are hard to find. We therefore can but hope that our old readers will bear with us, and support their* EXPERIMENTER *until such time when we return from a war, to a peace condition, and its accompanying recession of prices. In return for the higher price, we have already added a certain number of pages to this issue, and will continue to do so if we have the full support of our readers.*

It is our belief that we offer more actual instruction and information than any kindred publication, and having the confidence of our readers we trust that they will support us as enthusiastically, now during times of stress, as they have during normal times.

Subscription from 1 up to 5 years at the old rate of $1.50 (foreign $2.00) will be accepted up to and October 31st inclusive. After that date the new rate of $2.00 a year, ($2.50 foreign) will be in effect.

THE PUBLISHERS

A PORTABLE NITROGEN RADIATOR.

The latest offering to the public is the portable electric nitrogen radiator shown in the accompanying illustration. This radiator is said to be the only auxiliary electric

In this Newest Electric Radiator, the Heat-Element is Surrounded by a Chamber Filled with Nitrogen Gas. It is Absolutely Safe.

heating apparatus filled with nitrogen gas which is built on scientific principles adopted by heating engineers of standing—*i. e.*, the radiator.

It maintains an average temperature of 350 deg. Fahr. (176.7 deg. C.), it is said. The radiator contains an electric heating element surrounded by nitrogen gas. The gas fills the entire inside of the radiator, which is hermetically sealed. The gas serves to carry the heat from the heating element to the radiating surfaces at a temperature higher than that of a steam radiator. One feature pointed out for this device is that there is no way by which clothing, drapery or anything else can catch fire, as it has no exposed red-hot open wires. The cost of operation of this radiator is very low. The stock radiators are made in four, six, eight and ten sections.

STAND BACK! HERE COME THE ELECTRIC TANKS!

The very latest addition to toyland is the miniature *electric tank* here shown. The tank is a miniature model of the famous British Tanks which are playing such an important part in the Great World War at the present time, and it works to perfection. There is no end to the fun boys can have with this small war model and it will climb over anything that is in its path. No matter what is in front, it keeps right on forcing its way ahead.

The tank is driven by a powerful battery motor and can be supplied with current from battery developing 8 volts, or thru an A. C. step-down transformer on 12 volts.

The Electric Tanks Threaten to Invade Toyland in New York and all Other U. S. Cities and Towns on Xmas.

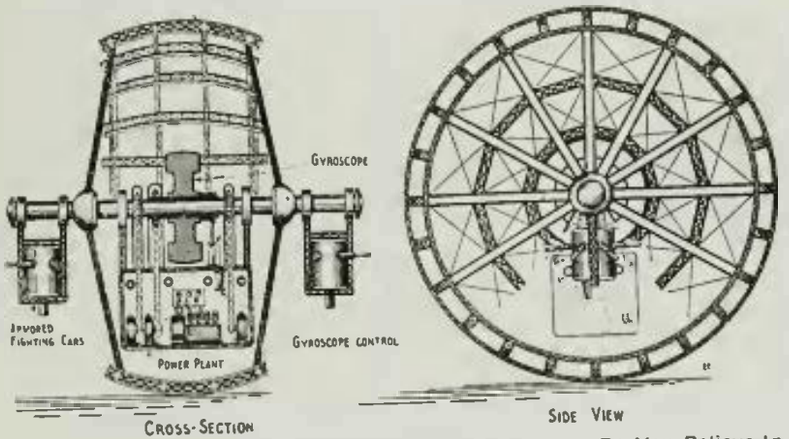
The Gyro Electric Destroyer

By H. GERNSBACK

WE reprint below a few paragraphs relative to the Gyro Electric Destroyer, originally described by the writer in the February 1918 issue of the ELECTRICAL EXPERIMENTER. This article was widely republished all over the country, from the New York *World* to the San Francisco *Chronicle*. We reprint part of the article for the benefit of those readers who did not see the original.

The great trouble with the Tank is its very slow speed. No tractors have been constructed so far that can move at more than eight to ten miles an hour, and as such they become easy prey to the enemy's guns which really get the range of the slow-moving vehicles, and begin to shell them. While the British claimed no losses in the last Cambrai offensive, the Germans claim that they shot twenty Tanks to pieces. Presuming that this amount is exaggerated, there probably is quite a good deal of truth to it.

Attention is called to the fact that the movable belt tread of the Tank is quite a sensitive affair. If hit, even the bullet of a small caliber gun will almost certainly cripple the Tank. The belt is the most vulnerable part of the tractor, and as soon as it stops moving, the Tank stops moving as well, and as far as offensive work is concerned, the machine is out of action.



Side and Sectional Views of the Gyro Electric Destroyer. Do You Believe In It? If So—Why Not Help to Build the First Model.

The present gyro electric destroyed is a single steel wheel, as clearly shown in our accompanying illustration, it is about 45 feet high. The top of the wheel is not flat, but is in the shape of an arc which makes running a good deal easier. The wheel itself looks like a huge *ferris wheel*, and is constructed of channel steel thruout; in order to make it as light as possible, it has no continuous tread or rim, but rather the steel pieces at the circumference are spaced about one foot apart, leaving a clear space for two reasons. First, the weight is cut down. Second, much better purchase is had on the ground, the machine not being apt to slip, as would be the case if the top of the wheel was solid.

The wheel has one large shaft passing thru the center and extending at each side, as shown in the cross-section in our illustration. This shaft is hollow and need not weigh very much. It is constructed of steel. At the hubs and at the ends of the shaft the latter is provided with armored projections, which will nto be damaged in case of shell fire. In the center of the wheel is suspended the engine cab which comprises a gasoline engine of some three hundred to five hundred horsepower, the energy being fed to a generator as shown. Two of the electric motors are used for propulsion of the wheel only; they are attached by means of a chain drive to the central shaft as shown.

Inasmuch as the wheel of the destroyer is not solid, but made of channel steel, it will be readily understood that even a large size shell will easily pass thru the lattice work of the destroyer without doing much damage, and here is where this machine shows its superiority over the tank. It will be almost impossible to damage this destroyer by means of shell shot. Even a "dead hit" from a medium caliber gun will not cause much damage, and even a good sized shot hitting the gyroscope will not hurt it very much, for the reason that the latter spins at enormous speed and it will almost certainly deflect the shot, unless, of course, it is a dead bit at right angles to the face of the wheel. The external chain drives are encased in heavy armor, and it should be as heavy as possible to prevent the machine being put out of action, and this can be readily done. It will be noted that this chain drive, the most vital part of the machine, presents but little surface to an on-coming shell. In contrast thereto you will notice the broad and very large moving tread of a British tank, which comprises almost one-quarter of the surface of the entire tank.

Imagine this machine starting on its offensive journey. It will first smash thru all the barbed wire entanglements without any trouble whatsoever. It simply mows them down as so many match sticks, thereby cutting open a path for the infantry that follows. Suppose a nest of machine guns is encountered. Their guns become practically useless, for if the destroyer runs over the machine guns or even threatens to do so, the enemy must of necessity abandon the guns, and the destroyer "walks" over them, crushing them into the ground. The same is the case with the large size guns. You may be quite sure that if the gunners see the machine coming, they will most certainly abandon their gun, and in this case the destroyer is powerful enough to run over the gun, thereby putting it out of action.

This machine is not designed, as might be supposed, to kill off as many of the enemy as possible. That is not at all its purpose. It is simply to put out of action other machines, preferably guns, not men. Its first purpose is to cut down barbed wire entanglements—second, to run over artillery, thereby putting it out of action. If we employed enough destroyers, it can be readily conceived how the enemy must invariably retreat as soon as these machines begin to advance, for the enemy denuded of all artillery must give up ground.

Many people, scientists and engineers, think the idea feasible, and all the details have been carefully worked out. A number of readers suggested that EXPERIMENTER readers contribute to a fund for actually building a model of the Gyro-Electric Destroyer. If enough money is forthcoming, an actual model will be built, which will be turned over to the United States Government in the name of ELECTRICAL EXPERIMENTER readers. The writer would refer to the September and October issues of this magazine for all further information on this idea.

If you are convinced that a machine of this kind will blast the Hun's artillery to pieces, then send along your contribution, using the accompanying blank. You might read the letters from enthusiastic readers who believe in the idea, reprinted herewith:

Editor Electrical Experimenter:

I enclose herewith $..... as my contribution towards building a model of your Gyro Electric Destroyer.

You are to build as large a model as the funds will permit and the money is to be used for the sole purpose of building this war machine. You agree to publish an exact amount of all funds spent and all contributions are to be acknowledged thru the columns of the *Electrical Experimenter*.

You pledge yourself to construct the machine as quickly as possible and you will turn it over to the U. S. Government immediately upon its completion.

Name.....

Address.....

"EVERY LITTLE HELPS."

"I sure would like to give more, as I think it will work out all right.

"Hays, Kans." Chas. Harkness, Jr.

"CALL AGAIN!"

"Enclosed find Money Order for $1.50 to go as part payment in the Gyro Electric Destroyer. I am sorry that I cannot at the present time give more, but if not enough is raised to build a fair sized model please call again. I am very glad you gave me the opportunity to do something of this sort before I am drafted, which I soon will be. When this Destroyer is completed, I should like to make a trip in it across No Man's Land. So tell the Military Authorities that I should like to be a part in the crew when it is completed. May I suggest that you submit the plans to Henry Ford. I would not be surprised if he could be induced to build it; this would save a lot of money which could go to build a larger model. He has the equipment and the experts to build it, also the steel to do it with. He would do it without any profit on his part and he will succeed in doing it. I am one of his employees in his Dearborn Tractor plant. Last March you answered my question in your Patent Advice column regarding an oil can for stocks and dies. The patent has been allowed to me by the U. S. Patent Office. Yours for a large Destroyer,

Fred Van Dyke.

52, Gibson Ave., Detroit, Mich."

"I HEARTILY BELIEVE IN THIS MONSTER."

". . . I heartily believe in this monster, and I hope that your experiment succeeds and that every reader of the "E. E." contributes as much as possible. I do not take the "E. E." and so did not see the Destroyer in the February issue, but am going to buy them from now on until the Destroyer is finished.

"Walter Holey,

"Norwich, N. Y."

"HE SAW THE 'POW-WOW'!"

"I saw the 'pow-wow" in the 'E. E.' and agree with you. While it never occurred to me, I am contributing to the construction of that Gyro Electric Destroyer, now that it has been proposed. Enclosed you will find $1.00. Since you have it up, get your battle-scarred brain to work and make it possible. Here's hoping that you will have the best of luck and the 'Bugs' all cooperate with you.

"Neil F. Beeson,

9 S. 3rd St.,
Marshalltown, Ia."

"A GENUINE BELIEVER."

"Please see my letter of August 19, in which I enclosed $1.00 as my share of building a model of our Gyro Electric Destroyer. In that letter I mentioned the

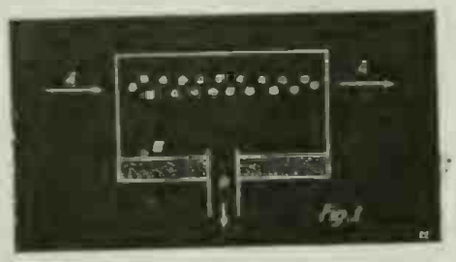
(*Continued on page* 488)

The Phenomena of Electrical Conduction in Gases

PART VI—MAKING IONS VISIBLE

By ROGERS D. RUSK, M. A.

An ion is a pretty small particle of matter to be made visible. It may consist of several electrically charged molecules grouped together, a thousand times too small to be visible in the strongest microscope, or it



Form of Special Chamber Connected With a Vacuum Pump as Employed by Wilson to Make "Ions" Visible for Photographing. "W" represents Water. The Space Above the Water was First Cleared of Ions by an Electric Field; then an Alpha or Beta Particle was Allowed to Pass Thru the Chamber in the Direction A-A. The Air was Expanded and the Water Vapor Thus Formed, at Once Condensed About the Ions. A Train of These Drops Could be Photographed, Wilson Found.

may be an electron or free atom of electricity which would be more than *one hundred thousand times smaller still.* As has been previously stated these almost infinitely small particles can never be seen by the human eye which has such a limited range of vision. However, tho they may never be directly visible they have already been made indirectly visible by the experiments of C. T. R. Wilson. These experiments not only are very striking in their nature but they have told us things about electricity and matter which we could have known in no other way. Electrons, and *alpha* and *beta* rays from radium may pass directly thru ordinary molecules, and molecules themselves are not solid discrete particles as they were once thought to be, but are spheres containing points of electrical energy far, far apart in relation to their size.

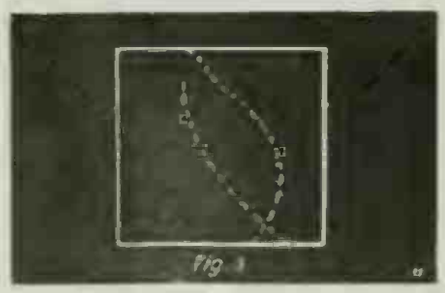
C. T. R. Wilson in 1912 made ions visible indirectly by photographing their path in the following remarkable manner: The principle made use of was the fact that an ion of high velocity forms other ions by *collision* with the ordinary molecules in its path, as mentioned in a previous article by the author. So he used a chamber of the form shown in Fig. 1, in which an expansion of the air could be obtained thru the opening P, connected with a pump. The space above the water W was first cleared of ions by an electric field and then an alpha or beta particle from radium or any other suitable ionizing agent was allowed to pass thru the chamber in the direction of the arrow A. Next the air in the chamber was allowed to expand suddenly and the water vapor thus formed immediately condensed in small drops about the ions just produced by the passage of the alpha or beta particle. A train of drops such as these could be actually photographed and it thus marks the path of the particle. A study of different types of paths gives us some surprising results. Wilson took photographs of the paths of alpha particles, beta particles and gamma and X-rays. Fig. 2 represents the paths of alpha particles as photographed in the manner explained above. Fig. 3 represents the paths of beta particles and Fig. 4 represents the paths of X-rays. It will be noticed that these paths are strikingly different. The alpha particle travels in a straight line and the ions produced by it are so close together that it makes the line look continuous. The beta particle travels in a fairly straight line but it produces fewer ions. Each speck represents a drop of water which has condensed about an ion, but they were not numerous enough and close enough together to make the path appear as a continuous line. This is what we might expect, for the alpha particle is known to be an atom of *helium* and the beta particle is known to be a free electron of only 1/8000 the mass. Naturally the larger particle would be expected to collide with more of the molecules of the air and produce more ions than the small electron. At length, however, the alpha and beta particles are deflected, and this is shown most clearly in the case of the alpha particle, whose path suffers a sharp turn near the end which indicates that the speed of the particle was decreasing and that finally it suffered a collision which deflected it. From measurements of these paths it is found that alpha particles may travel 12 cm. in air and beta particles may travel 7 cm. and more and on account of their small size may even pass thru appreciable thicknesses of glass or metal.

The most surprising fact is yet to be obtained from the photographs of the paths of these particles. It is known that the distance an ordinary gas molecule travels between collisions is many, many times smaller than the distance, given above, that an alpha or beta particle may travel. Evidently these particles do not stop for the molecules in their way, nor are they deflected by them. Still they must hit them or else they would not produce ions as they pass along. The only alternative left is that they must pass directly *thru* them.

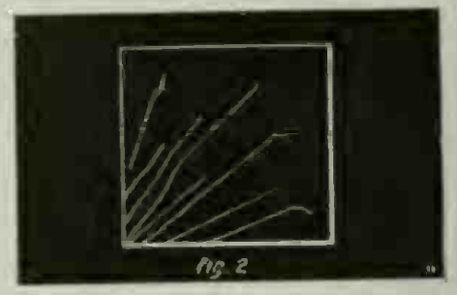
If that is the case it can be computed, from the size of a molecule and the number per cubic centimeter, how many will be past thru in this manner. In the case of the alpha particle it is about *half a million* during its average flight, and in the case of the beta particle, which is so small it misses more of them completely, about *ten thousand* are past thru. Evidently a molecule is far from being a *solid* particle.

Let us see then what we can learn from these facts concerning the nature of the *molecules of matter*, and the *atom of electricity*. If some of the older scientists had been told that one molecule might pass completely thru another molecule and not even touch it, they would have held up their hands in amazement, and yet an alpha particle, which is a positively charged atom of helium, *passes thru half a million oir molecules before it encounters any force strong enough to deflect it!* This completely disproves the old idea that a molecule is a solid discrete particle something like a marble of ultra-microscopic size. It shows more than this that there is very little really material in the atom and that practically the whole of the *electron* is empty, or as one writer puts it, consists of "betweens." The fact that ions are produced by these particles may indicate some degree of collision in the passage of a particle thru a molecule, and yet by the photo-

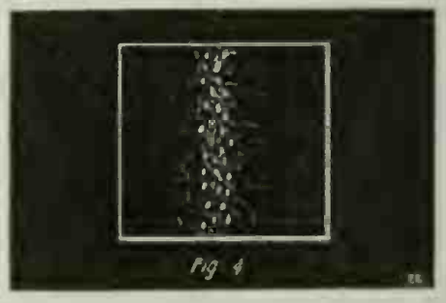
(*Continued on page* 513)



This Chart Shows the Paths of "Beta Particles"—After Photograph by Wilson. Note the Difference Between Path Routes of Alpha Particles Delineated in Fig. 2. The Alpha Particles Travel in Nearly Straight Lines, While the Beta Particles Follow a Slightly Crooked Path, and Produce Fewer Ions Than Do the Alpha Particles. Beta Particles May Travel 7 Centimeters in Air.



The Paths Taken by "Alpha Particles" in Air—After Photograph Taken by Wilson with the Arrangement Described and Illustrated at Fig. 1. Alpha Particles May Travel 12 Centimeters Thru Air.

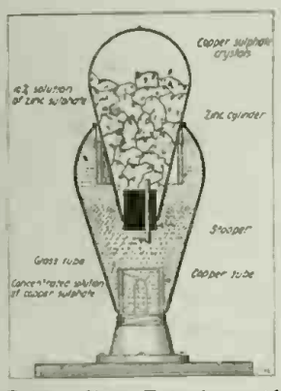


This Shows the Paths of X-rays. The Study of Such Photographs as These Has Brought to Light the Fact That the "Molecule"—Which Scientists Once Thought Solid—Is Mostly Made Up of "Betweens." Why Do X-rays Pass Thru Body Tissue, Wood and Stone? The Electron Theory and Structure Makes It Perfectly Clear.

Burnt-Out Lamp Contest

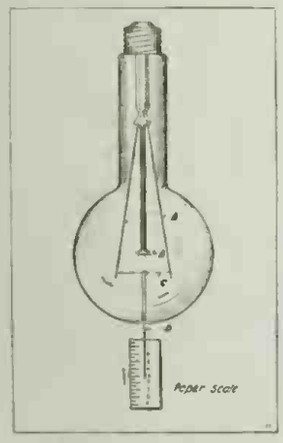
By H. GERNSBACK

THE present article which closes our contest on Burnt-Out Lamps illustrates that the idea has not been entirely exhausted. Since we publisht the results of our last contest in our June, 1918, issue, we have received over two thousand more suggestions from contestants located practically all over the world. Most of these of course were duplicates, and were along the lines of the ideas which we had publisht in former issues, or otherwise were variations of them. There were all kinds of fantastical ideas, and we give below a few of the suggestions which came to the editor's desk, but which were not of sufficient importance to warrant publishing separately. Among these were the following: Gold fish globe, a sort of steam turbine, stocking darner, cord (ball) holder, a swimming device, an apparatus to catch fish, and last but not least, a transparency representing the Kaiser to be shot at with a gun.



From the Trenches of France; a Meidinger Battery.

Perhaps the most original one which we publish here comes from France from M. G. Mohr-Desforges, Roullet, France. M. Desforges, who serves in the French army, has evolved a really good battery which we are pleased to illustrate and describe in full herewith. While it cannot be used for lighting or similar work, forty of them would certainly make a very fine battery for audion circuits, while for measuring work, etc., the Meidinger battery can hardly be surpast. Of course, all copper sulfate batteries must be used on closed circuit, they cannot be left on open circuit.

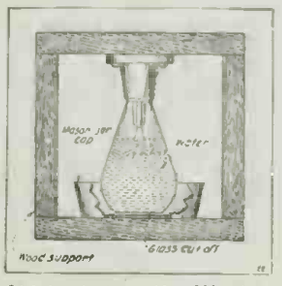


Novel Hot-Wire Ammeter Made From Old Bulb.

Meidinger Battery.

This idea is submitted by M. G. Mohr-Desforges, Sapeur Télégraphiste, 8e Génie, bie. D/T Détachement, Armée d' Orient, Roullet (Charente), France. It is a very clever design of a Meidinger type battery with two solutions. This battery is well-known in Europe and works almost automatic. It must be used on closed circuit, open circuit work not being permissible. M. Desforges constructs his battery as follows:

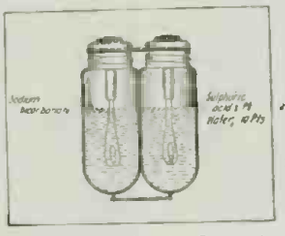
A large burnt-out lamp globe is cut off at the top to accommodate another similar globe as shown in our illustration. After removing the glass stem of the lower globe, a small copper tube is soldered to the former filament; connections as shown. This forms the positive pole of the battery. From the stationary globe is suspended a zinc cylinder made of sheet zinc of suitable thickness and about in proportion as shown, which is suspended from the globe by means of wires. These wires may be copper, but in order to safeguard against local action, they must be well painted with asphaltum before being inserted in the solution. One wire forms the negative pole.



Chick Automatic Water Fountain.

The other globe is filled with copper sulfate crystals and the open end is closed by means of a paraffined cork thru which a short piece of glass tubing passes. M. Desforges continues as follows: (French translation). "This is how I accomplish it:

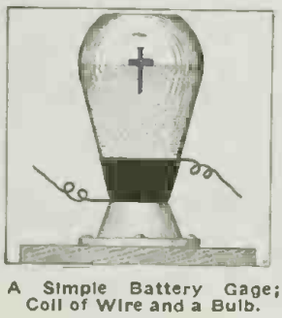
"I first fill one-third of the lower globe with a 10% solution of sulfate of zinc. Then by means of a glass funnel which must go all the way down, I pour a concentrated solution of sulfate of copper, which being of a heavier specific gravity stays at the bottom and raises the sulfate of zinc solution. A sharp dark blue markation shows the line separating the two liquids. The lower globe will now be found to be about three - quarters full. I now insert the upper globe carefully, taking care not to shake the liquids which would otherwise mix. The battery is now ready for work. It gives approximately 1.07 volts.


A Useful Hand Grenade Fire Extinguisher.

"As the battery works, the copper sulfate at the bottom is used up, but a new supply is always at hand on account of the upper globe being filled with crystals that dissolve very slowly, the resultant solution descending by gravity to the bottom."

A Simple Hot-Wire Ammeter.

An efficient yet simple hot-wire ammeter can be constructed at small cost from a 100 watt Type "C" lamp. First break off the tip of the bulb, leaving a hole about ⅛ of an inch in diameter. Insert a forked wire with which to remove the spiral filament, and carefully bend the small supporting ribs "B", back so as not to short-circuit the main leads.


A Simple Battery Gage; Coil of Wire and a Bulb.

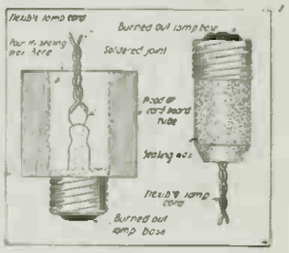
Next get a piece of No. 32 Manganin wire about two inches long, and solder each end firmly to a six-inch piece of iron wire for a handle. Having first arranged the ends of the lead wires so they are about an inch apart, insert the fine wire and wrap a half inch of each end about each lead, and break off the iron wire. Solder the joints by using a piece of resin core solder as one electrode of a storage battery circuit, the joint as the other, and the arc developed will melt the solder. It may be necessary to spread the leads "A" slightly after this operation to tighten the hot-wire "C".

A short piece of No. 14 aluminum wire "D" is hung over the center of "C" and the ammeter is complete. Hang in an inverted position, and a current passing thru "C" allows it to sag, increasing the length of "D" protruding at the tip of the lamp.

Arno A. Kluge,
Lincoln, Nebr.

Chick Automatic Fountain Cup.

My idea makes use of a burnt-out electric light bulb. It is an "automatic chick fountain." Fill the bulb, (which is broken off at the bottom for about one-half inch down) with water and invert it in a "Mason" jar top. You could cut a bulb off at the top and use that for a receptacle for the water in the bulb.



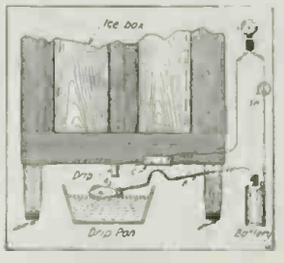
A Handy Attachment Plug From Lamp Base.

James B. Walker,
Waterbury, Conn.

Fire Extinguisher Grenade.

Make up two solutions, one of one part of sulfuric acid and ten parts of water.

Make up a second solution of five parts sodium bicarbonat and five parts of water. Break off the tip of one of the show case bulbs under the acid solution and break off the tip of the other under the sodium bicarbonate solution. Close the fine holes with sealing wax. Bind the two bulbs tightly together, and when a fire breaks out in the laboratory or elsewhere, just hurl the two bulbs at the flaming place, the two bulbs will burst, their contents will unite in mortal contest, liberating much carbon dioxid gas, which will extinguish the flames.



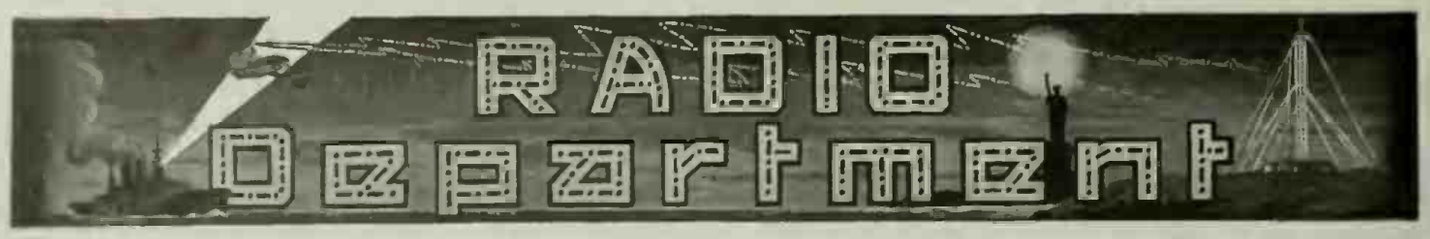
Ice Box Float Switch for the Drip Pan.

Benson Freeman.
Atlanta, Ga.

Battery Tester.

Take a burnt-out lamp, it does not matter what kind, and cut the top off with a three-cornered file as shown at left. Also pull out all lead wires. Just above the base of the lamp wind 15 to 20 feet of No. 22 wire. Then take a ⅞-inch nail and a small bit of cork. File off the nail as shown and cut the cork so that there is *just enough* cork

(*Continued on page 471*)



Notice to All Radio Readers

As most of our radio readers are undoubtedly aware, the U. S. Government has decided that all Amateur Wireless Stations, whether licensed or unlicensed, or equipt for receiving or transmitting, shall be closed.

This is a very important consideration, especially to those who are readers of the ELECTRICAL EXPERIMENTER, *for the reason that we desire to continue to publish valuable articles on the wireless art from time to time, and which may treat on both transmitting and receiving apparatus. In the first place, there are a great many students among our readers who will demand and expect a continuation of the usual class of Radio subjects, which we have published in the past four years, and secondly, there will be hundreds and even thousands of new radio pupils in the various naval and civilian schools thruout the country who will be benefited by up-to-date wireless articles treating on both the transmitting as well as receiving equipment. Remember that you must not connect up radio apparatus to any form of antenna.—The Editors.*

Senatore Marconi Head of Italy's Banking System

WE have not heard a great deal of Senatore Guglielmo Marconi of late, due no doubt to the enormous weight of the several large enterprises and governmental positions of which he is the dominant figure. The recent reports of his activities state that he was to have come to the United States as the High Commissioner representing Italy. However, his country's need of him was so urgent as to cause a cancellation of this particular mission. We, in a way, regret this decision as men of Marconi's calibre are a valuable asset to any nation, locality or city which they may honor with their presence.

Senatore Marconi has rendered a very great service to Italy, and the nations of the world in general, by his abolishment of all traces of the Teutonic financial supremacy, which, up to the time that his revision became effective, had been paramount, and the Germans had wielded a very powerful persuasive, namely the capitalization of very nearly all of the large enterprises in Italy. Dr. Marconi originated and organized the new banking system now in vogue in that country, and with him as the "moving spirit" of the undertaking, its future success is amply assured. As an irrepressible worker, Dr. Marconi possesses animation, vigor and vivacity, and corrals all prizes. He is ever "on the job" whether it be day or night.

He last visited this country as a member of the Italian Mission to the United States, and the photograph which accompanies this note, was taken at that time, when he received fifty young ladies from the *Wireless Class* of Hunter College, New York. He spoke to these women on their work as an aid to the Government. The highest title Guglielmo Marconi has had bestowed upon him is the one of Senatore. He is one of the youngest Italian Senators. A title second in importance is that of Chief of Communications of the Italian Navy. Dr. Marconi is a member of the Institution of Electrical Engineers and numerous other well-known electrical and scientific societies thruout the world. His work has been recognized by many governments and seats of learning; he has been decorated by the King of Italy and the late Czar of Russia; he is an honorary doctor (LL.D. D. Sc.) of many universities, including Oxford, Glasgow, Aberdeen, Liverpool and Pennsylvania, besides having received the freedom of the principal Italian cities. He was accorded the Nobel Prize for Physics, which is perhaps the highest distinction that can be obtained by any scientist. He has also been the recipient of scientific rewards granted by many and various societies and other institutions thruout the world.

Senatore Guglielmo Marconi, LL. D., D. Sc., Appointed Head of the New Italian Banking System. Besides This Responsibility He Serves as Chief of Communications to the Italian Navy. He Is Also at the Head of the Italian Radio System.

RADIO FLASHES 12,000 MILES.

Direct communication with Australia is the latest development of radio-communication.

Connection was establisht on October 1st, when Commonwealth Premier Hughes and Sir Joseph Cook, Minister for the English Navy, sent two messages to the Amalgamated Wireless Company of Australia at Sydney from the new Marconi station at Carnarvon, Wales, and altho the distance of direct transmission was fully 12,000 miles the messages were received with perfect clearness. The Hertzian waves of wireless message move equally in all directions. If, therefore, the messages between Wales and Australia went half way round the globe in one direction, they did so in all other directions, and these messages may be said to have enveloped the globe.

U. S. MAGNETIC SURVEY.

The Magnetic Survey Vessel, *Carnegie*, arrived safely at her home port, Washington, D. C., on June 10, where she will be put out of commission probably during the period of the war. During her cruise from Buenos Aires, Argentina, round the Horn to Valparaiso, Chile, Callao, Peru, thence thru the Panama Canal to Newport News, she was in command of Dr. N. W. Edmonds; the other members of the scientific staff aboard were: Messrs. A. D. Power, Bradley Jones, L. L. Tanguy, J. M. McFadden, and Walter E. Scott.

DO YOU KNOW?

That hydrogen and ozone play the most important part in your make-up. Your body is more than three-quarters water, the water is two-thirds hydrogen and one-third oxygen.

PLAN 4,600-MILE RADIO STATION TO SERVE JAPAN AND U. S.

The installation of a new high power wireless system between Japan and the United States is actively occupying the Department of Communications. Officials announce that the project is a result in part of the congestion and delay in cable transmission which prevents the desired freedom of communication between Japan and the United States.

The present Japanese high power wireless station communicates direct with Hawaii. The proposed station will work with a station on the Pacific Coast, the site of which probably will be near San Francisco, a distance of 4,600 miles. This will be one of the longest direct wireless services in the world. The estimated cost of the system is about $400,000. While another cable linking the two hemispheres is desired a line from Japan to Guam alone would cost $3,000,000.

NEW CUTTER USEFUL IN QUENCHED GAP MAKING

The new adjustable cutter consists of a steel casting, on which are mounted two cutting tools which may be adjusted to various diameters. This part of the device is rotated by means of a ratchet wrench. Pressure is applied to the cutting tools by means of a heavy coil spring. The device is held in place by a round stud, which is placed thru a ⅜" pilot hole in the metal to be cut (in the case of iron conduit boxes) and fastened on the back of this metal by means of a flange nut.

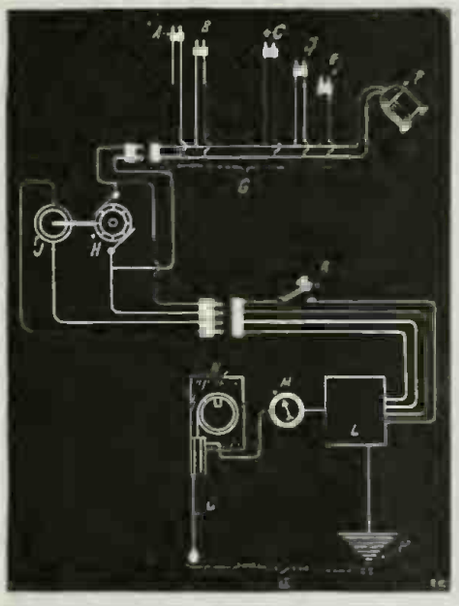
It is obvious that this cutter can be operated in positions that would otherwise be inaccessible.

The old method of drilling a large number of small holes and then punching out the metal makes a crude job at the best and is slow, costly and very laborious. Not only can this device be applied to cutting holes and grooves in steel cabinets, boilers, tanks, etc., but also can be used for cutting metal, such as slate, marble and fibre. It is used for cutting holes or grooves 1¼" to 3". The larger size cuts holes from 1⅜" to 6". A still larger size cutter will cut holes or grooves up to 12" in diameter.

A New Cutter which Lends Itself Well to the Making of Amateur Quenched Spark Gaps.

GERMAN RADIO APPARATUS ON AIRPLANES.

Lieutenant Jean-Abel Lefranc, writing in a recent issue of *La Nature* on the evolution of German Aviation, states that for some little time the enemy machines have been occasionally equipt with continuous wave receivers of the valve type. Regarding the transmitting apparatus, Lieut. Lefranc says that the generator produces alternating current (270 volts 3 amps.) and continuous current (50 volts 4 amps.) The machine is driven either by a small airscrew rotating at 4,500 revolutions per minute, or by the motor. The alternating current produced by this generator is utilised by the *oscillating circuit* which gives rise to the oscillations creating the Hertzian waves. The Telefunken *sender* consists of a rectangular box containing a transformer, a condenser, a plate discharger and a wave-meter. Special arrangements permit of variation of wave length and intensity of transmission.



Radio Outfit on a German Airplane.

The aerial consists of a copper wire approximately 35 to 40 meters in length. On the ground this wire is rolled up on a bobbin. During flight it is suspended from the machine.

The range of these sets is about 35 km. (21 miles) and their weight in all 26 kg. (about 60 lbs.) The latest giant airplanes guide themselves at night by *radiogoniometers*, as the Zeppelins do.

It will be noticed from the diagram reproduced herewith that the generator supplies current for several purposes. Thus the leads A go to the electric warming apparatus in the pilot's clothes; B to the lamps on the instrument board; C to the observer's clothes; D and E to heating apparatus on the camera and machine gun respectively. F is the searchlight for night landings. All G is therefore concerned with lighting and heating. H and J are the D.C. and A.C. sides of the generator, while K is obviously the transmitting key. L contains the Telefunken transmitters; M and N and O are the aerial ammeter, the aerial reel and the antenna itself. All Q is the purely *wireless* apparatus.

NEW METERS FOR RADIO AND HIGH-FREQUENCY WORK.

A high grade hot wire measuring instrument designed particularly for wireless and other high-frequency work, depending for its operation upon the expansion of a metal strip which is heated by the current to be measured has recently been developed. The slight sag in this conducting strip is magnified several hundred times on the scale by means of a combination of wires and a deflecting spring.

Two New Radio Frequency Ammeters.

The conducting strip is made of special non-corrosive material. The separating posts have the same temperature coefficient of expansion as the conducting strip, so that the changes in room temperature do not cause an error in the reading of the instrument.

The scale plate is made of metal, and the scale subtends an arc of 90 degrees, being 2⅜ inches long.

The flush-mounting type meters have a guaranteed accuracy of 2 per cent, while the portable type, with hand marked scale, can be expected to show an accuracy within 1 per cent of full scale. Standard meters are for 1, 2 and 5 amperes. Care must be used not to subject the instrument to more than 200 per cent load.—*Photos courtesy Westinghouse Electric & Mfg. Co.*

NEW HIGH-POWER RADIO STATION AT ANNAPOLIS, MD., IS OPENED.

The new high-power radio station at Annapolis, Md., the most powerful in America, was formally opened recently, Secretary Daniels signalizing the occasion by sending messages to the first lord of the British Admiralty, London; the French minister of marine, in Paris; and the Italian minister of marine, in Rome.

The station completed cost about $1,500,000, and is capable of maintaining uninterrupted communication over a distance of at least 4,000 miles.

There are four steel towers, each 650 feet high supporting the antennae which, with the ground system, required 160 miles of wire for their completion. The power installations is in duplicate, so that it will always be possible to maintain communication. The operation of the station requires the services of 100 men, all of whom are drawn from the enlisted force of the Navy. Suitable provision has been made for the protection of the station.

These messages were transmitted to London, Paris, and Rome with the utmost ease, which is especially gratifying to Navy officials, since this powerful plant was erected and equipt by the Navy in the short space of 10 months. Under conditions that prevailed before our entry into the war its erection would have taken two years.

Bunque

By ALAN C. ROCKWOOD

Greetings.

* * *

FOR those people who insist on blowing out the gas the following scheme is suggested when they have only electric lights at hand: 1. Fill mouth with water. 2. Tip the socket so the key is upward. 3. Place mouth above the opening around the key. 4. Blow. If this does not succeed, take off the shell of the socket and repeat the operation.

God's Death!!! as Shakespeare says—what next?

* * *

Unconscious sarcasm.—The official abbreviation of the United States Navy (USN) is assigned to the *Kaiserin Elizabeth* of the Austrian Navy as a radio call letter.

* * *

Speaking of call letters—some of the pleasures still to come are the calling up of some station as RAH RAH RAH when you feel like applauding; the calling up WOW WOW WOW when happy; or WAT WAT WAT when curious. These calls are still unassigned according to the last issue of "Radio Stations of the World."

* * *

Here are epithets which are used or can be used as call letters. See if you can't find your favorite call letter among them:—BAD (H.M.S. Albemarle, British); DAM (Germany, unassigned); MAD (Musician, British); MUG (British, unassigned); MUT (Pembrokeshire, British); PIG (Netherlands, unassigned); HOG (unassigned); DOG (Germany, unassigned); PUP (Jequitinhona, Brazil). Too bad more of them are not assigned. The operators could then throw mud about a little more freely.

* * *

Dippy Diversions Number 1.—Receiving Arlington with the aerial grounded.

* * *

Radium at $36,050 a gram gives off emanations for 2500 years before changing to polonium. Limburger cheese costs 45 cents per pound and sapsago cheese even less. They have the advantage over radium that their radiations constantly *increase* in strength. If any intelligent inventor has an idea for an armor steel motor to use such power he should send it to the Fony Patent Offis at once.

* * *

The latest scheme of *Wireless Telegrafy* is to use trombones, tubas, or sousaphones; playing a quarter note for a dash and an eighth note for a dot. This has been tried once and was successful, but there was an inexplicable diminution of population in the immediate neighborhood.

I recently saw the advertisement of a Chronic Plunge Battery. I don't know about Chronic Plunge batteries but I've certainly had plenty of experience with Chronically Discharged Batteries.

* * *

A prominent radio experimenter who has been using his three-step electron relay (amplification 1000 times) in connection with his fonograf for dancing purposes, says that he found a sixteen pound sledge on his porch the other morning and wonders why it was left there.

* * *

Since the attempt to use our large stock of copperheads as the rotors of alternating current generators has failed the outcome of the experiments to see if they can be used to relieve the copper shortage is awaited with interest.

* * *

Do you know that the human finger nail grows .000,000,002 yard per second?

* * *

If all the inventions contrived to end the war were tested out by one man, that man would need to live as long as Methuselah.

* * *

The following poem was found on the fly-leaf of a book in the Crear Library:

If there should be another flood,
For refuge hither fly;
Tho all the world should be submerged,
This book would still be dry.

Pretty appropriate for some *electrical* textbooks, isn't it?

* * *

Are you a quodlibetarian? Many experimenters are, to the annoyance of their friends. What is it? Webster defines the word as "one who discusses any subject at pleasure."

* * *

Dire secret!!! This column of mental wanderings may appear again. The compiler, however, needs some help on the job. If you have any electrical or radio quips send them along. Full discredit will be given or withheld as desired. Address "Bunque" care of the publishers of Electrical Experimenter.

* * *

Thank you.

"Great Moments We All Have Known!" Fellow Radio Operators. Sent to this Journal by a Knight of the Key—One, Mr. H. B. Burney, H. M. C. S. Stadacona. Mr. Burney Draws as Well as He Operates.

A RADIO ECHO FROM THE PAST.

Mr. Godfrey Isaacs, in the course of a recent address in London referred to the achievements of wireless telegraphy and the progress that had been made in the twenty odd years of Mr. Marconi's labors. This reference on the part of the Managing Director of the Marconi International Company brought forth a reminiscence from a Member of Parliament which appeared in the pages of *Town Topics*, and is worth reading again:

"It is just twenty years ago since Mr. Marconi, now Senatore Marconi, gave an exhibition of his wireless invention to members of the House of Commons. He wanted to prove that a wireless message could be sent from the Terrace to St. Thomas's Hospital, some three or four hundred yards across the river, and members flocked to the Terrace to witness the experiment. There were considerable doubts as to the result. John Burns busied himself in the arrangement of the small instrument in one of the passages leading to the Terrace, and in fixing, to Mr. Marconi's instructions, the eight- or ten-foot pole that stood against the Terrace wall some thirty feet from the instrument.

"When arrangements were completed, Mr. Marconi invited the writer of these notes to send any message he liked to the party in charge of the machine at the hospital.

"At that moment the news came in that Gladstone had died, and the message transmitted recorded that fact, and added a few words about the great statesman. The instrument was set to work, and scarcely had the words been tapt off when acknowledgment was announced from the other side. Hearty cheers were given for the great inventor, but still there were some present who doubted whether the invention would ever be of any practical use."

A scientist in Sweden has advanced the theory that bearded grains draw electricity from the air to aid them in their growth.

By liquefying the gas helium a European scientist has succeeded in reaching temperatures within six degrees of the absolute zero.

A Sensitive Wireless Recorder

By ARNO A. KLUGE

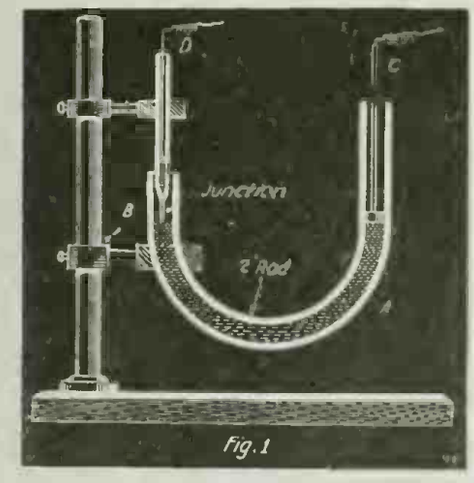
NOW that the radio experimenter is taking an enforced "vacation" which may continue for some time to come, altho we hope not too long, perhaps it would not be amiss to attempt the construction of a more difficult piece of apparatus than the ordinary instrument, and yet one which has great possibilities for the operator.

With this thought in mind, I present herewith the details for making an *ultra-sensitive relay*, one which can be used for amplifying weak radio signals, so that they actuate a tape recorder or an audible buzzer. At first thought this device may seem rather complicated, but with a little skill, patience, and the expenditure of very little money, a suitable relay can be constructed that will rival any in existence.

The principle of this device is that of the capillary electrometer, which was first discust by Prof. Lippmann several years ago. A "U"-shaped glass tube, A, Fig. 1, about ¼ inch inside diameter, is filled with chemically pure mercury, so that it comes within ½ inch of the top of the shorter arm. A small quantity of 20 per cent sulfuric acid is then poured in on the top, at B. A plunger, C, carrying an electrode, is inserted in the long arm for varying the height of the mercury, and the whole apparatus is supported by a laboratory standard or a board.

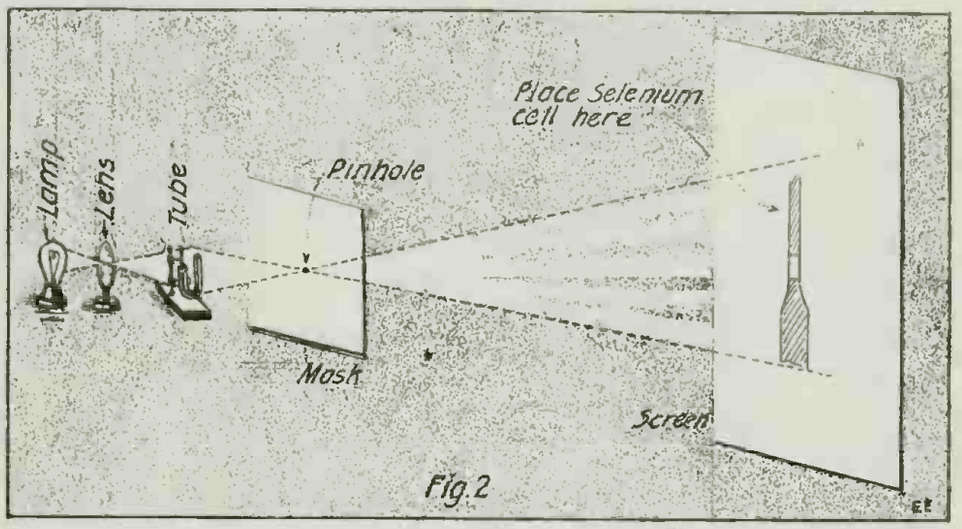
Next we take a small glass tube that will fit inside the large one, and draw one end out into a fine capillary tube, by heating in a Bunsen flame. The bore of this tube at the capillary end should be about the size of a human hair, but it is best to make several different sizes to find the right diameter. This tube should be about two inches long, and is supported directly above the short arm of the large tube, so that it just dips into the sulfuric acid. A small quantity of mercury is then poured into it, connections are brought out at C and D, and the apparatus is ready to adjust.

This is done by blowing in the tube D until a small stream of mercury is forced thru the capillary tube into the acid. The pressure is then released, and, due to the capillary action, the mercury will recede a trifle, and will draw a quantity of the sulfuric acid up with it. The separation between the two mercury columns is now regulated by the plunger C, until the instrument works best.



The Capillary Electrometer Used in Building the Radio Recorder Here Described. It Employs a Fine Jet of Mercury Which Coacts with the Column of Mercury in Large Tube "A", the Junction Between Them Rising and Falling as Radio Currents Are Applied to It.

To test the instrument, it is only necessary to place the moistened fingers across the binding posts, and the difference of potential between the two masses of mercury will affect the *surface tension*, and cause the point at the junction of the liquids to move up and down. The movement from such a slight potential is very small, visible only with a magnifying glass, but with strong wireless signals it becomes more pronounced, and is visible even to the naked eye.



A Novel Radio Recording Apparatus Which Can Be Easily Built in the Experimenter's Laboratory and Tested Out Without Radio Apparatus; Simply Connect Up a Buzzer Exciter Thru a High Resistance to Give Imitation Received Radio Currents. The Instrument Acts on the Principle of the Capillary Electrometer.

To apply the instrument in operating a relay or recorder, it is necessary to use a beam of light, as shown by Fig. 2, playing upon a *selenium cell*, the construction of which will be evident to the experimenter. The same beam of light could also be used in giving a screen demonstration of radio, or a photo-recorder could be built, and the signals recorded upon sensitive paper, as the operator chooses.

And while it is not possible to use this device in wireless at present, it has many other interesting uses which will suggest themselves to the experimenter, such as recording the fluctuations of the voice upon the screen, recording the sine wave of an alternating current by means of a revolving mirror, etc.

BURNT-OUT LAMP CONTEST

(*Continued from page* 467)

to float the nail. Now fill the lamp with water and drop the cork with the nail in the water. By connecting the two leads of the magnet coil to a battery the cork will go down and rise again as soon as the current is shut off. The harder and faster the cork goes down the more current the battery contains.

EDWARD N. HEUBNER,
New York, N. Y.

CONNECTING PLUG.

First break away the glass globe down to the brass base of a burnt-out lamp bulb; leaving the glass part which holds the two wires. Next solder on the two ends of a flexible lamp cord to the two wires projecting from the glass.

Then take a brace and 1" bit and bore a hole thru a short piece of 2" x 2" wood. Into one end of the hole start the brass base just enough to hold it tight; and let the wires extend on thru to the other side. (Or otherwise use a tight-fitting paper or cardboard tube.)

Next heat some sealing wax and pour into the mould, being sure that the wires do not touch where they are bare and that they are in the middle of the casting. The base should be heated gradually so that the hot sealing wax will not break the glass projection when poured into the mould. Now remove the block of wood (or paper tube) either by splitting or slipping off, when the wax has cooled. Next smooth the casting off and bevel the corner down to the wires as shown.

DONALD WILSON,
Monroe City, Missouri.

DRIP PAN ALARM

All that is needed in constructing and installing this drip alarm is a burnt-out lamp bulb, batteries, wire, electric bell and a strip of brass about a foot long, ½-inch wide, and ⅛-inch in thickness.

The burnt-out lamp bulb is soldered to the brass strip "B" while the other terminal should be pivoted. Fasten the bell where you desire it and connect the batteries as shown with a switch. When the drip pan fills the float rises and the brass strip "B" contracts to "C" and closes the circuit, thus giving the alarm.

CAESAR HASIMOTO.
Honolulu, T. H.

A French system of rapid telegraphy, by which 40,000 words an hour can be transmitted, has worked successfully for distances up to 900 miles in that country.

The government of Ecuador has establisht seven land wireless stations and equipt three war vessels with radio telegraphy.

The How and Why of Radio Apparatus

By H. WINFIELD SECOR, Assoc. I. R. E.

No. 10—Radio Amplifiers.

From time to time we will describe one particular instrument used in either the radio transmitting or receiving set, explaining just how it works, and why. We have received so many requests from new readers asking for such explanations that we have decided to publish this matter in serial form. In the course of several issues all of the principal transmitting and receiving apparatus will have been covered. The subject for the tenth paper is RADIO AMPLIFIERS.

RADIO amplifiers of many kinds have been tried out in the twenty years that wireless telegraphy has been with us. The more prominent types of current intensifying devices will be discust here, reference being made to some of the novel or interesting ones. An amplifier is usually considered to be a device acting by electro-magnetic or other means so as to boost the strength of a received radio signal. Such apparatus is of the greatest importance in radio work, not only for the purpose of intensifying weak signals to audibility, but also for the control or modulation of heavy radio-telephonic transmitter currents.

The electro-magnetic amplifier illustrated in Fig. 1, known as the "Multi-Audi-Phone," is claimed to boost incoming wireless messages *fifteen hundred times* their original audible strength of signals.

The amplifier consists of a special chemical placed between two electrodes, which arrangement changes the resistance by virtue of a diafram attracted to an electro-magnet. This will be more clearly understood by referring to a cross-section view of this instrument, Fig. 1. It consists of a permanent magnet A, supporting a metallic case N, having a threaded screw cap M. The case contains the amplification parts, comprising the electro-magnet B, which has a small iron core E connected to a very fine steel diafram D, carrying a cup F upon its surface. Another cup G is placed on the opposite side and within it, the special chemical is placed at I. A tube H is provided so that the material is retained within the cups. The cup G is connected to a threaded rod J and lever K, supported by a rubber standard L on the steel magnet A. The diafram D is gold-plated in order that the chemical will not affect the steel. The electro-magnet B is connected by means of the wires O, while diafram D is joined to wire P. Rod J connects to terminal Q.

In order to regulate the pressure on the chemical mixture between the cup electrodes, adjustment is made by nut K.

The action of this amplifier is somewhat microphonic, and as the diafram is caused to vibrate by the incoming signals it varies the distance between the electrodes, consequently varying the resistance of the chemical and thus also the 'phone circuit. A 5-ohm 'phone is used in connection with this amplifier, so it is evident that a large current is used in this secondary circuit. A horn is usually fitted to the receiver, so that messages can be heard about the room without using a pair of head 'phones. If two or more of these units are used in cascade, signals can be boosted to such an audibility that one can hardly stay in the room on account of the loudness of the signals.

The "Brown" Radio and Telephonic Relay.—The electro-magnetic telephone and telegraph relay designed by Brown, of England, is widely used for telephone current intensifying, and has been successfully employed for boosting radio signals.

Its make-up will be gleaned from Fig. 2, where N S is a permanent steel magnet frame surmounted by two magnetizing coils K, and two 4,400-ohm coils H (same size pole-pieces, etc., as used in a telephone receiver). A light spring or reed P carries a soft iron head to be attracted by the pole-pieces. Attached to the moving reed is a rod joined to a delicate microphone M, filled with polished carbon grains.

Referring to the diagram of connections in radio circuits we see that terminals A are joined in place of the regular telephones. The magnet coils K are energized by current from a battery of six volts thru the primary (17 ohms) of an auto-transformer P. S. Across the transformer secondary (26 ohms) at 3, 1, is connected a 2 M. F. condenser in series with a pair of 120-ohm telephone receivers. Its action will now be clearly understood. The varying Hertzian currents react thru coils H on the relay magnetic circuit balance, and cause its armature reed P and the microphone M to vary their positions. The microphone thus changes the resistance of the circuit, and these changes are transmitted thru the transformer P S and condenser to the head telephones.

This style of Brown relay has an intensifying factor of about 20 times received strength of signal. Newer types can intensify 100 times and more, or several may be joined in cascade to give as high a ratio as required.

The "Telefunken" system utilizes a unique amplifier of the tuned reed microphone type, which is outlined at Fig. 3. A radio coupling circuit is joined to a "tuned" reed microphone relay F1 M1, and this reacts or controls the battery thru a second "tuned" reed microphone M2, etc., etc. Three microphones are commonly used. Two of these "tuned" amplifiers can receive two distinct messages on an aerial simultaneously without interference, if they and the incoming waves have a tune frequency differing by 20 per cent or over, it is claimed. Such microphonic apparatus is extremely delicate and must be very carefully adjusted and supported on elastic bands or otherwise supported in a shock-proof manner by employing felt, etc. The third microphone circuit may control a "loud talker" or Morse tape recorder as desired. These microphones are extremely well built to permit of the most exact adjustment. The resistance of each microphone circuit, as well as the potential applied, is made finely adjustable.

The "Detectiphone" Amplifier.—We come to an interesting application of the "Detectiphone" or dictograph, in the form of an amplifier for feeble or weak electric currents. At Fig. 4 there is outlined a system which has been tried out and which, when carefully and properly made, will yield good results.

Considering first the regular radio receiving instruments, with aerial A, ground G, loose coupler L C (or tuning coil), we see that the regular sensitive telephone receiver R 1, is mounted close up to a "Detectiphone" transmitter. An ordinary detector, finely adjusted, is connected at D, while C is the usual blocking condenser. The detector may be a crystal type or a Radioson, which requires no adjustment. This circuit, shown schematically at Fig. 4, is for a 2 stage amplifier, but a 3rd "Detectiphone" set gives better results of course. The batteries A and B are the regular ones supplied with the instruments, or they may be ordinary 4½-volt flash-light batteries. At T 1 is the first transmitter of a "Detectiphone" and its receiver at R 2; T 2 is the second transmitter and R 3 its regular receiver. The only high resistance wireless type receiver is that indicated at R 1. This should be a first class 'phone, and have at least 1,000 ohms resistance, and better yet 1,500 to 2,000 ohms; so as to be as sensitive to the rectified detector currents as possible. This arrangement of the apparatus works on the principle that if a faint sound, such as a radiotelegraphic signal, be reproduced close to the ultra-sensitive transmitter of the "Detectiphone," then that faint signal will cause the diafram of the transmitter to vibrate, and thus cause variations in its resistance; which in turn are manifested in the receiver of the first "Detectiphone." These signals actuate the second microphone, and this in turn controls the third and final "Detectiphone" receiver R 3. It is well to place a 10-ohm adjustable rheostat in series with each amplifying circuit, to enable the battery current to be regulated to a nicety. Not over 6 to 7 volts should be applied in any case to these "Detectiphone" circuits.

Several different arrangements and modifications of the apparatus may be made, and thus the experimenter and student is left a good chance for research work along this line. Step-up transformers can also be employed, as well as telephone induction coils, etc.

In making up such an amplifying set, care should be exercised to have the receivers and transmitters very close to each other, each unit mounted in a sound-proof, air-tight wooden box packed with felt, or other sound-deadening material. This is ensured by carefully removing the front threaded

(*Continued on page* 507)

THE HOW AND WHY OF RADIO APPARATUS
Series to Date

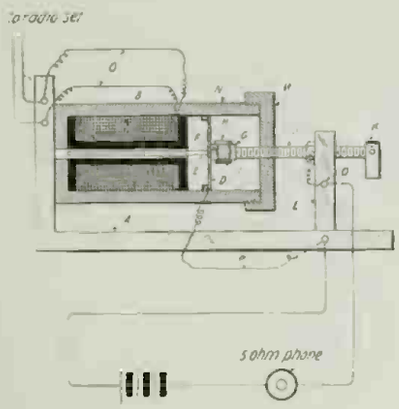
No. 1. *The Induction Coil, Page* 493, *November*, 1916.
No. 2. *The Transformer, Page* 656, *January*, 1917.
No. 3. *Condensers. Page* 735, *February*, 1917.
No. 4. *Spark Gaps, Page* 113, *June*, 1917.
No. 5. *Radio Transmitting Inductances, Page* 537, *December*, 1917.
No. 6. *Radio Receiving Tuners, Page* 685, *February*, 1918.
No. 7. *Radio Receiving Condensers, Page* 766, *March*, 1918.
No. 8. *Detectors, Page* 30, *May*, 1918.
No. 9. *Telephone Receivers, Page* 176, *July*, 1918.

Radio men everywhere will undoubtedly like to obtain the complete set of these specially prepared papers on the "How and Why of Radio Apparatus." Also the following three important and timely papers on the "Calculation and Measurement of Inductance," by Mr. Secor and Samuel D. Cohen.

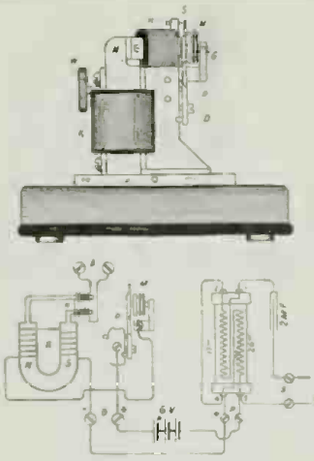
Nos. 1, 2 *and* 3 *"Calculation and Measurement of Inductance," appearing in the March, April and September*, 1917, *issues.*

Those interested in these valuable papers can obtain prices of individual back numbers containing them by writing to the "Circulation Department."

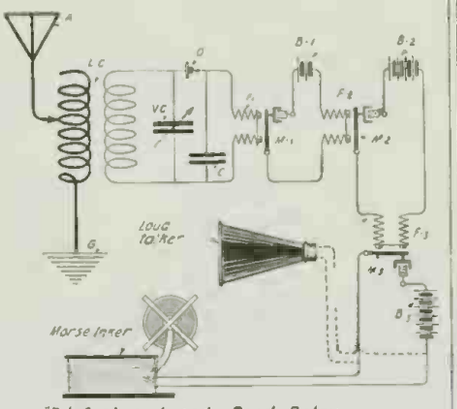
THE HOW AND WHY OF RADIO APPARATUS—RADIO AMPLIFIERS



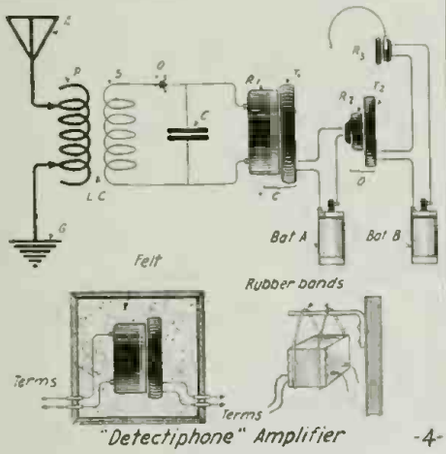
Multi-Audi-Phone Amplifier -1-



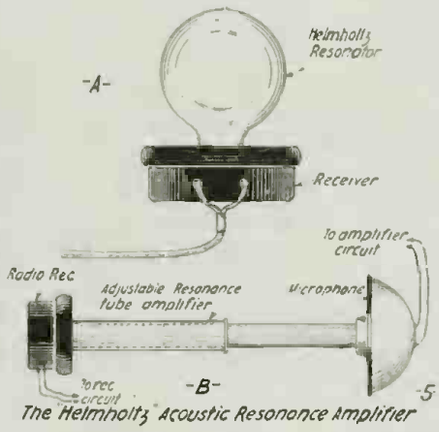
The "Brown" Relay -2-



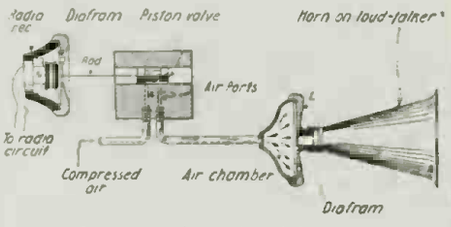
"Telefunken" tuned Reed Relay -3-



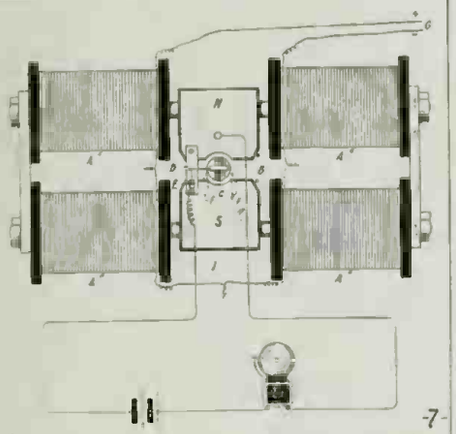
"Detectiphone" Amplifier -4-



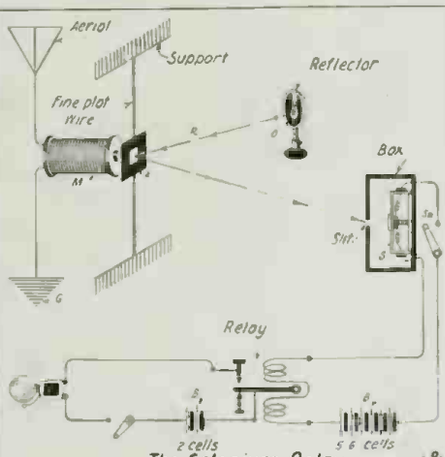
The "Helmholtz" Acoustic Resonance Amplifier -5-



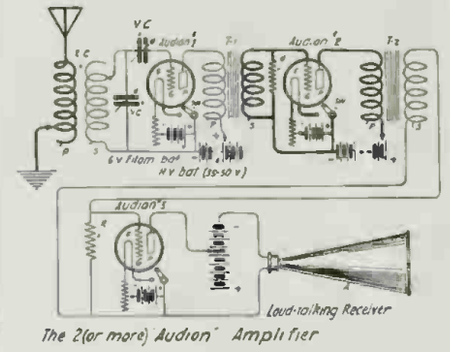
Compressed air Amplifier -6-



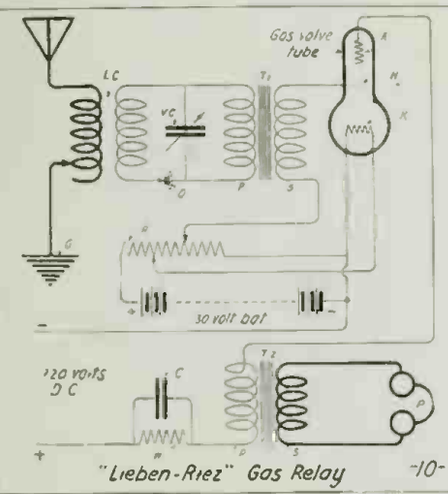
Lowenstein Magnetic Relay - 1 micro-amp sensitivity -7-



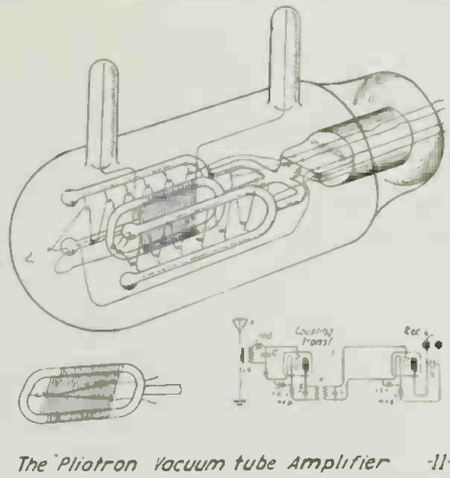
The Selenium Relay -8-



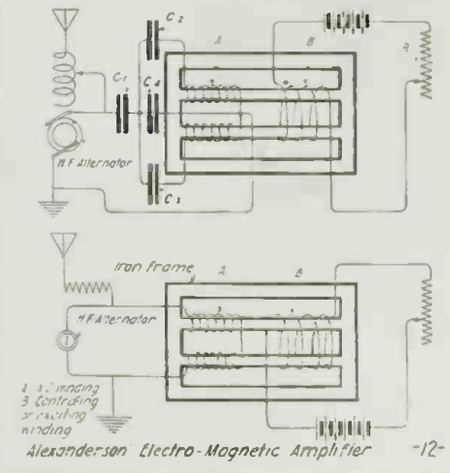
The 2(or more) Audion" Amplifier -9-



"Lieben-Riez" Gas Relay -10-



The "Pliotron" Vacuum tube Amplifier -11-



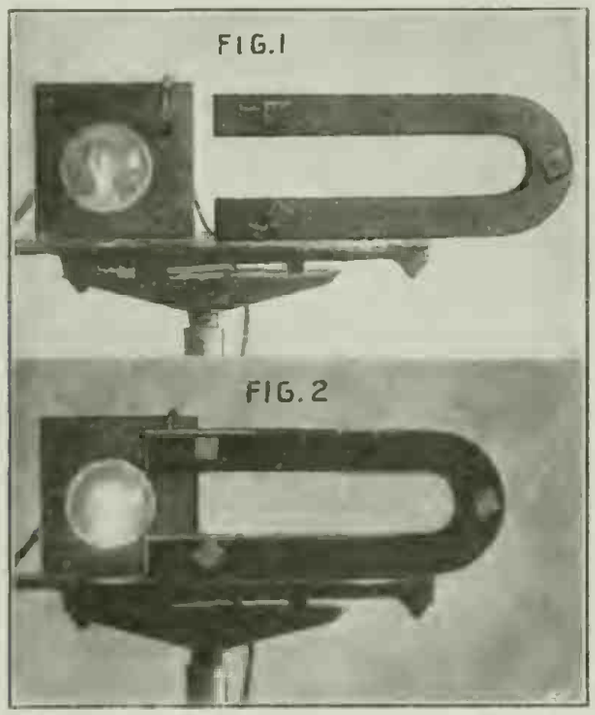
Alexanderson Electro-Magnetic Amplifier -12-

(For Description See Opposite Page)

The Oscillograph—How It Works

By PROF. LINDLEY PYLE, Professor of Physics, Washington University

THE oscillograph is one of the simplest yet one of the most marvelous of our electrical instruments,—simple because it consists of a single loop of wire hanging in the air-gap of an electromagnet, and marvelous in that it takes a moving picture of the behavior of an electrical current showing variations occurring in a time interval of *one-thousandth of a second or less.*



Figs. 1 and 2—Showing the Effect Produced by Bringing a Steel Magnet Close to a Carbon Filament Lamp Operated by 60 Cycle A. C. Magnet Away—Filament Still; Magnet Close—Filament Twisted Back and Forth 60 Times Per Second. This is the Fundamental Principle of the Oscillograph.

The principle of the oscillograph is made clear by reference to figures *1* and *2*. Figure 1 shows an incandescent lamp burning on a 110 volt, 60 cycle A. C. circuit. The carbon filament in this lamp takes the form of a long single loop (hair-pin type). The tip of the lamp is toward the observer and the incandescent filament is clearly observable, along with some bright reflections in the glass globe. The horseshoe magnet in the illustration 1 is drawn away so that it has no appreciable influence. Now note in Fig. 2 the behavior of the loop filament when the magnet is brought close:—the filament is thrown into a violent *twisting* vibration. When one leg of the loop moves toward the magnet the other leg moves away, and when the first mentioned leg starts back the second starts forward. It is only necessary to recall that —*a current-carrying conductor extending across the lines of force of a magnetic field is urged sideways by a force* PROPORTIONAL TO *the strength of the traversing current.* In the case of a loop the current at any instant is in opposite directions in the two legs; the two forces are therefore opposite and the filament is twisted. If the current is reversed the electromagnetic forces change direction and the loop is twisted the other way. The amount of twist depends upon the strength of current in the loop. Since the lamp in the illustration carries a current alternating in direction at the rate of 60 complete to-and-fro oscillations per second, the lamp filament is thereby forced to make 60 to-and-fro twists per second, or 120 *single* vibrations per second. Now this motion is too rapid for the eye to follow and the incandescent filament spreads out into an apparent ribbon of light as illustrated. So much for the illustration of the principle.

Fig. 4 is a diagrammatic sketch of the commercial type of Duddell oscillograph. *N* and *S* are the two poles of an electro-magnet; *L* is a loop of fine phosphor-bronze wire, the ends of which, *b*, *b*, are attached to binding posts. A spring, *s*, attached to a small spreader (sometimes a small pulley) at the turn of the loop, exerts a stout pull. The parallel wires of the loop are close together, a thirty-second of an inch apart or less and a small mirror, *m*, is fastened across the wires where they pass thru the magnetic gap. The resemblance to Fig. 2 is very clear. With a steady current traversing the coils of the electromagnet and an alternating current thru *L*, the behavior of the loop is exactly like that of the filament of the lamp in Fig. 2. If one wire of the loop *L* is moving forward the other is moving backward and the little mirror, *m*, wags to and fro in accordance with the behavior of the current in the loop. How shall we now interpret what the mirror is trying to tell us?

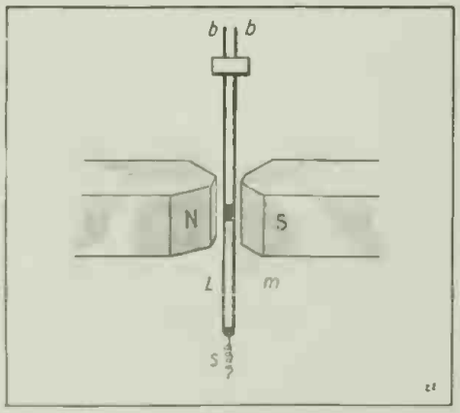


Fig. 4. Arrangement of Moving Element—Wires "b b" and Tiny Mirror "m"—Used in the Commercial Oscillograph. N-S Are Poles of Powerful Electro-magnet.

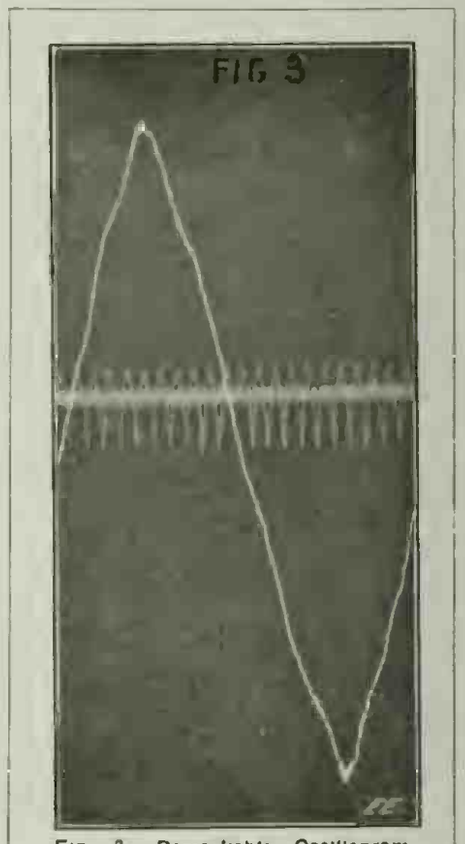


Fig. 3. Remarkable Oscillogram Taken by the Author. The Large Curve Shows 1 Cycle of a 60 Cycle A. C. The Small Ripples Show the Record Made by a "Howler"—a Microphone Held In Front of a Receiver—the Ripple Frequency Being 1380 Oscillations Per Second.

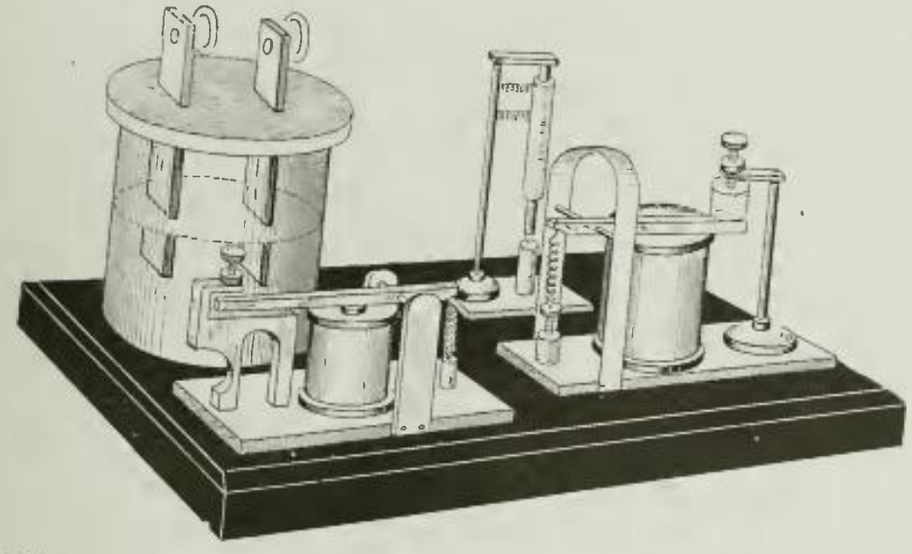
Imagine the whole apparatus to be in a darkened room and allow a beam of light from the sun or an arc light to enter the room thru a small hole and to fall upon the moving mirror. The *reflected* beam of light will sway to and fro in accordance with the movement of the mirror. Take an unexposed photographic plate, hold its face toward the mirror, and *chop* it down across the reflected beam. Develop and fix the plate and a wavy line will be shown on the plate representing the displacement of the mirror at every instant. This method of registration is easy to understand if one takes a pencil and draws on a sheet of paper a line parallel to the top edge of the sheet. Now while running the pencil to and fro across this line, take hold of the top of the sheet and *pull it out from under the moving pencil.* The result is a wavy line drawn on the sheet of paper. If the

(Continued on page 488)

A Thermostatic Time Switch

By ALBERT H. BEILER

I'LL admit right at the start that this thermostatic time switch might better be placed in the E. E. category of "phoney patents." If you ask me what real use it has, I can't tell you, but if you are the sort of "bug" who occasionally wants something novel—the commercial use



When You Close the Circuit Containing This "Thermostatic Time Switch," the Lamps Connected in the Circuit Light Up About Two Minutes Later—Why? Read the Article. It Explains Just How to Make This Mystic Apparatus.

go hang—then continue reading, my Boy!

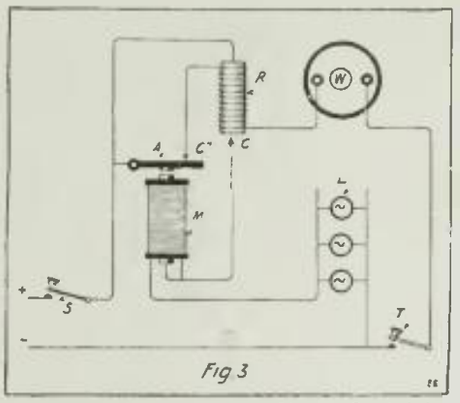
The thermostatic time switch is as complicated as its name sounds when multiplied by two. And all it accomplishes is to light some lamps about two minutes after you close a switch. No time clock. Oh, no! nothing that simple! It works on the *thermostat principle.*

"Oh, I know all about it," some of you will say. "Heating effect of resistance coil expands a rod which makes contact and closes circuit after a minute or two. Nothing simpler." However, there's a bit more to it than that. Most of you are more or less familiar with the principle on which those signs work when the lights flash on and off at intervals of a minute or so. To briefly explain the principle: In Fig. 1, L is the sign lamp and R a metal rod having some thin resistance wire wound on it. One end of the wire is connected to the rod. C is a contact separated from R by a very small distance, so small that when R expands, due to the heat of the coil, it touches C. When the switch S is closed, current passes thru the lamp and the heating coil. The resistance of the latter is so great that the lamp lights dimly or not at all. The coil heats rod R, which eventually touches C and lights lamp L brightly by short-circuiting the coil. After a minute or so the rod has cooled sufficiently to contract and break contact at C and the process is again repeated.

This on and off cycle is just what is desired on a sign in order to attract attention. But suppose it were required to light lamp L by the thermostat and keep it lit permanently? That is quite another problem. At first thought it seems that an arrangement as seen in Fig. 2 will solve the difficulty. Here when the switch is closed the coil heats up and after a while R touches C and the lamp lights. Very fine, but meanwhile what about our friend the heating coil? If it is kept on for any length of time it will soon burn itself out and no more thermostat. Also if you try to arrange to cool it, then when R contracts what is to keep the circuit from being opened at C?

Our problem, then, is this: Let a circuit be closed at C after a minute or so by the expansion of R, but as soon as this is done let the heating coil circuit become opened. Further, when R contracts on cooling let it have no effect on the continuity of the lamp circuit.

To accomplish this we will use our old friend the *stick relay* which the writer



Thermostatic Time Switch Circuit Containing the Thermal Element R, Water Rheostat W, "Stick" Relay M, Lamps L, Etc.

described in his article on "Burglar Alarms" in the July, 1917, issue of the ELECTRICAL EXPERIMENTER. Fig. 3 illustrates the circuit, and the mode of operation is as follows:

M is an electromagnet, one end of whose coil is grounded to the core. R is the rod with the heating coil wound on it, W is a water rheostat to regulate the current of the heating coil. T is the time switch, S the main switch and L the lamps. C is the thermostat contact and C" is a rear contact for magnet M.

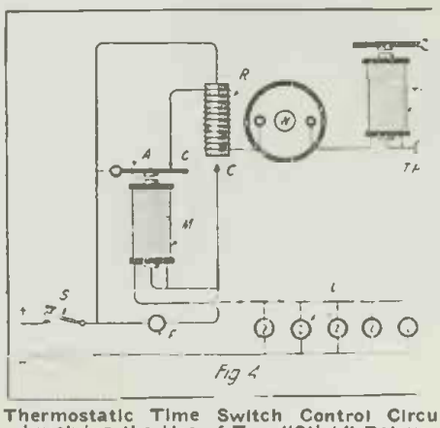
When S is closed but T open all circuits are open. When T is closed current travels from the + main thru switch S, armature A, contact C", heating coil, rheostat, switch T and back to the negative main. Soon the coil heats up enough so that R touches C. A circuit is then completed from the positive main thru the rod R, contact C, magnet M, lamps L and back to the negative main. The lights light and the magnet attracts its armature A. As soon as A leaves C" the thermostat circuit is opened and it commences to cool.

"But," you will say, "as soon as it cools armature A will——" Well, wait a minute. Give me time. As soon as A touches the core of M, it closes the magnet circuit independently of rod R and contact C as follows: From the positive main thru S, armature A, core of M, magnet M, lamps L and back to the negative main. R can cool all it wants to now. Magnet M doesn't care a rap. Its circuit is complete and the lamps remain lit until the switch S is opened again. In actual practise a slightly different arrangement was employed. The front contact C" carries the current for the heating coil, which is about 3 amperes. When the break occurred, a bad arc formed and so an oil switch was employed to quench it. This oil switch uses glycerine and was described by the writer on page 403 of the October, 1917, issue of the ELECTRICAL EXPERIMENTER. The details of construction of M are so simple that they hardly require any explanation. The thermostat used was a zinc rod 3/16 inches in diameter and 4 inches long, wound with four layers of No. 26 D. C. C. copper magnet wire for a distance of 3 inches o he rod. See illustration.

In conjunction with the time switch a short-circuiting push-button to light the lamps without the time element was employed. Also instead of the time switch being a knife or other closed-circuit switch, a push-button was used to obviate the necessity of adjusting any switch but the main S. To affect this substitution, another *stick relay* had to be shunted around the time push-button to keep the circuit closed, once the time push had closed it for an instant.

The complete wiring as installed in the writer's home is shown in Fig. 4 and may be briefly explained. The push P lights the lamps instantaneously and the circuit remains closed because M is a *stick relay.* To light the lamps on the time push, T P is deprest. The stick relay T M keeps the circuit closed when T P has opened. After the heating interval when R touches C and closes M's circuit, M attracts A and opens the circuit of the heating coil and T M at C". Thus as soon as A leaves C" and goes down, the armature of T M goes up.

(*Continued on page* 496)

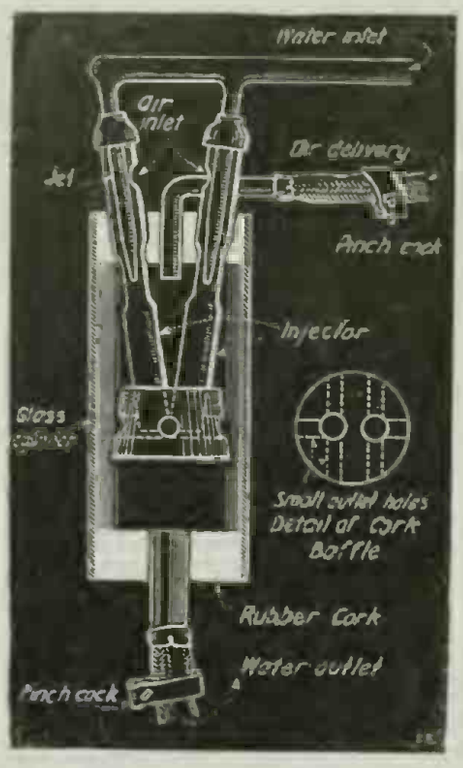


Thermostatic Time Switch Control Circuit Involving the Use of Two "Stick" Relays.

A Water-Jet Blast Apparatus

By Professor HERBERT E. METCALF

ONE of the handiest articles around the laboratory is a blast lamp. Usually it is not extensively used because of the fact that most laboratories are not fortunate enough to be equipt with comprest air, and are



A Home-Made Water Jet Blast Apparatus for the Amateur Scientist. Hook Up Your Spigot to the Water Inlet and Presto! You Have a Fine Blast of Air, Sufficient for Two Blast Lamps. It Will Yield at Least Five Pounds Air Pressure.

obliged to make use of a foot blower to obtain the necessary air pressure. The foot blower has a number of disadvantages, such as giving an unsteady pressure, awkwardness in handling, and deterioration of the rubber back. Also its first cost is considerable. The *water-jet blast apparatus* to be described costs only a fraction as much as a foot blower, will deliver a steady stream of air, and can be made in a very short time with but little knowledge of glass blowing.

In general the water-jet blast apparatus consists of two injectors, a baffle plate, and a large collecting tube. The injectors are the essentials of the outfit, and upon their efficiency depends the amount of air finally obtained.

A piece of heavy walled glass tubing, about 12 inches long is drawn out in the flame making a constriction about one inch and a half from one end. This constriction should be made so that its walls are as thick or thicker than the original wall of the tube, as otherwise they will break in handling. This is done by thickening the glass tube at the point of the constriction by heating it and pinching it together, heating and drawing out very slowly. The lumen of the constricted portion should be straight and about 2 - 3 millimeters in diameter.

Next plug one end with a cork. Center a very fine flame on the short part of the tube just above the constriction until that portion of the wall is white hot and bending in under the flame. Then blow gently into the open end. A bubble will blow out from the heated portion which may be chipt off. Thus a hole is formed. This is the air inlet. Another tube is now made exactly like the first.

A piece of tubing which will fit inside the injector tube loosely, should be drawn out into a constriction so that the final lumen of this smaller tube will be slightly smaller than the constriction in the lumen of the injector tube. This, if cut in the middle of the constriction, will furnish *jets* for both injector tubes.

The two jets are then sealed firmly in the short end of the injector tubes by means of sealing wax. The point of the jet should be as near the constriction as possible, leaving only enough distance to allow sufficient air to be carried by the end of the jet.

The large collecting tube should be as long as possible and may be made out of tubing, a bottle or a broken graduate. If a bottle is used the bottom may be cut out by winding string around it, saturating the string with alcohol, burning and plunging into cold water. The two large rubber corks which are used one in each end, should be of a size to fit very tightly when forced into the tube. The upper cork is perforated with three holes, two for the injectors, and one for the air outlet tube. The lower cork should have a large hole for the water outlet. This outlet tube should be plenty large enough to allow all of the water to escape. In the apparatus as made, the lower tube consisted of a cut-off test tube.

The two injectors are now put thru their holes and adjusted in their final positions. A large cork will do for the baffle plate. This is to break the force of the water, and to allow the air bubbles to rise in the collecting tube. This cork should have two holes bored partway thru to receive the ends of the injectors, and then a series of small holes aroundd the outside so as to allow the water and air to come out at right angles to the injectors.

The air delivery tube is then put in the top rubber cork, the baffle plate cork adjusted and paraffined, and the top cork prest firmly into place. The bottom cork with its outlet tube in place is then forced in also. In order that both jets function, a double delivery tube is made from glass, and connection made with the faucet with heavy-walled pressure tubing. All joints should be wired because of the high pressure caused by the small size of the jets.

On the water outlet tube, and on the air delivery tube, there should be placed adjustable pinch-cocks over rubber tubing. These are very important because without their proper regulation the apparatus will not function. Turn on the water full force. If water rises rapidly and threatens to come out the air delivery tube, the air pinch-cock must be tightened. The back pressure of the air will cause the water to go down. If too much air escapes out

(Continued on page 504)

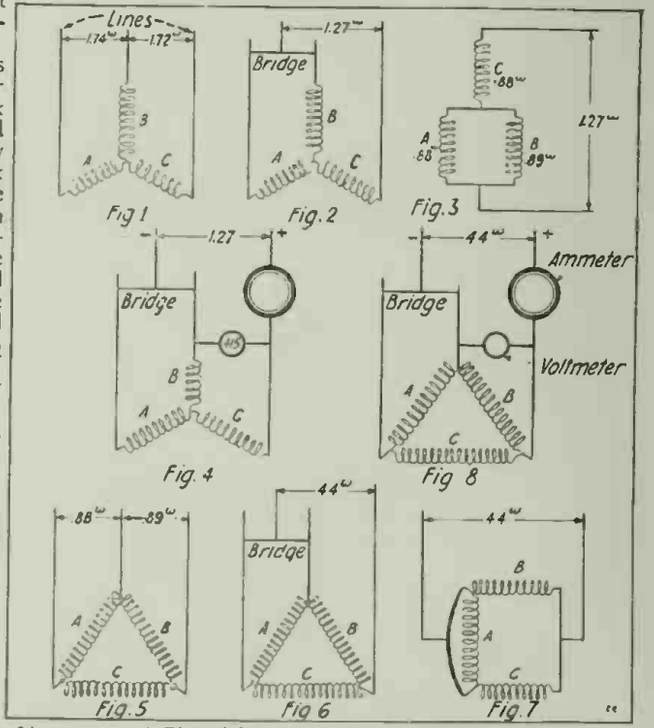
TESTING THREE-PHASE MOTORS FOR CONNECTIONS.

By HERBERT J. MALONEY, Engineer. (Australia.)

Many times electricians working among alternating current machinery are called upon to ascertain whether a three-phase motor is *star* or *mesh* connected. Little difficulty is experienced when the motor is of open type, where the wiring can be easily traced, but the difficulty arises when they are confronted with a totally enclosed motor with only three connecting leads projecting. The method here described is a simple way of tackling the situation by means of a megger and bridge, Wheatstone bridge or volt and ammeters. The resistance between the *stator* leads is taken; after that is obtained bridge two of the leads and measure the resistance between the two bridged leads and the remaining one. If the resulting resistance is half of that obtained by the first reading, it is a *mesh* connected motor, but if it is more than half or near the result obtained in the first reading, the motor is *star* connected.

The author used for tests for this article two Siemens 3 H.P. induction motors, one mesh and the other star connected. Fig. 2 shows the motor of star connection with two of the leads bridged. Fig. 3 is Fig. 2 in simpler form; as seen, we have phases A and B in parallel and C in series with them, with a resulting resistance of 1.27 ohms, according to the motor used, which is more than half of 1.72 (see Fig. 1) the resistance before the bridge was placed proving that it is a *star* connected motor. Fig. 6 shows the mesh wiring with two leads bridged. Fig. 7 is Fig. 6 simplified—phase A is shorted or bridged with phases B C in parallel. The resistance of which is equal to .44 ohms, which is half of .88 ohms, the resistance minus the bridge. Fig. 5 proves that the motor is of *mesh* connection.

Fig. 4 and Fig. 8 show star and mesh motors respectively, with two leads bridged with volt and ammeters, using Ohm's laws to find resistance ($R = \frac{E}{C}$) and either D. C. or A. C. can be used. A study of the diagrams shows the simplicity of the method.



The Practical Electrician Will Appreciate the Methods Above Outlined for Testing Three-Phase Motor Connections, Especially in the Case of the Star-Connected Winding, Where the Center Lead Is not Accessible. Both Star and Mesh (Delta) Connections Are Considered.

Experimental Mechanics

By SAMUEL D. COHEN

LESSON VII.

LATHE CHUCKS

THE next exercise of importance which the novice should try, is to locate the cutting of shoulders on a piece of work. One way is to mark the actual position and then proceed to cut down the material to the mark and to the required diameter as indicated in A, Fig. 1. To accomplish the same result with better accuracy and speed, the use of the cutting-off tool is employed as indicated at B of the same figure, which shows a typical job with proper dimensions to be turned out on the lathe.

To proceed with the job it is first necessary to obtain a piece of material one inch in diameter and eleven inches long. Square up both ends by placing the material in the *live* chuck and using a side cutting tool. Drill a counter-sink hole on the square faces and set stock between *live* and *dead* centers, securing material to live center with a lathe dog. Adjust the tail stock center so that the shaft plays slightly on the centers. Fasten the tail stock spindle by binding clamp, and keep dead center well oiled. Mark cutting position on work, starting from dead center towards live center. The cutting-off tool is started about 1/32 of an inch from the finishing line of the shoulder, and kept in position until the required diameter is reached, plus 1/32 of an inch more so as to allow for clean finishing. In this case it will be necessary at first to set the outside measuring calipers to read 17/32 inch. Then with the aid of a diamond-point tool, the remaining stock is cut off. To finish the face of the shoulder, use a side cutting tool. The final step is to measure nine inches from the dead center and set the tool to cut off the stock to its proper length, in this particular case nine inches.

Altho this job seems to be quite simple at first glance, yet ninety-five per cent of the beginners will find it difficult to produce the work with the required dimensions. A great deal can be learned from this job. First and foremost the use of the cutting-tool, which gives most trouble to the novice; and secondly, accuracy in laying out work to rigid specifications.

While preparing this lesson the writer thought it well to omit giving exercises at this early period and considered that further details on the use of the lathe and other tools should supercede everything else. This was found to be essential in that it is important to know practically everything about tools and their uses before it is possible to proceed with building a machined article or working on exercises, altho the last two mentioned are of importance, as they give the amateur the fundamental practise necessary to become familiar with the working of the lathe.

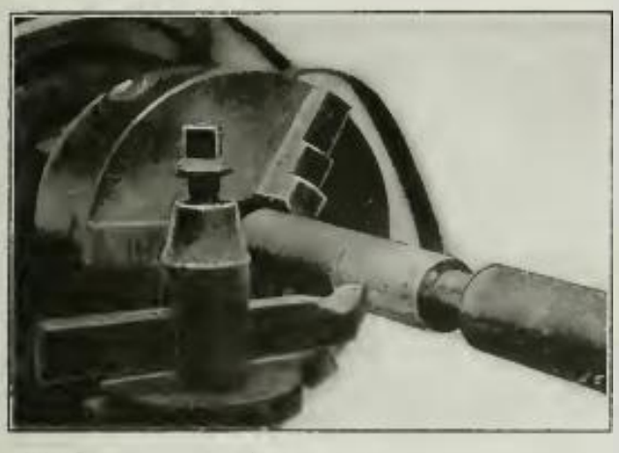
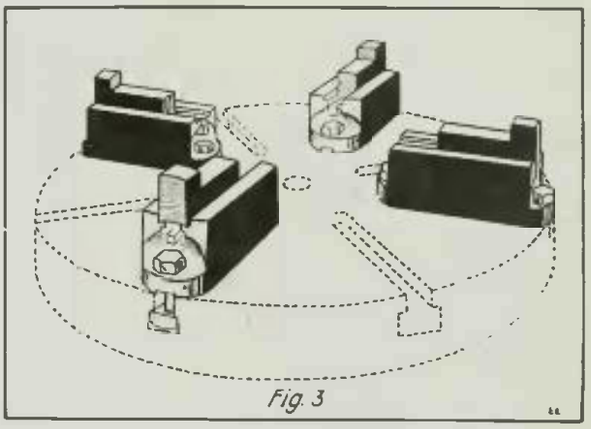


Fig. 2. Appearance of a Three-Jaw Automatic Universal Lathe Chuck. A Speedy Chuck and a Type Widely Used in All Machine Shops. The Jaws Can Be Reversed, Thus Giving a Very Wide Scope of Action.



Converting a Face-Plate Into a Four-Jaw Independent Chuck, Capable of a Wide Variety of Machine Shop Work. The Jaws Can Be Purchased Separately and Fit Any Face Plate.

Owing to lack of space and the great number of new feature articles we have had to postpone publishing the following articles this month:

"Spectroscopic Methods and Spectra"—Part II—by D. S. Binnington.

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

"A Practical Electrical Photo Printer," by Dr. E. Bade.

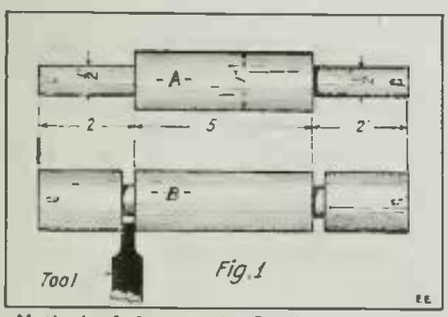
But these, as well as a host of other "brand-new" features, will all be in the DECEMBER number.

In order that various shapes of work may be held on the lathe, special tools called *chucks* are used. There are many different forms of chucks on the market, depending upon their use. The chuck is one of the handiest tools that can be attached to the lathe, increasing its usefulness many times.

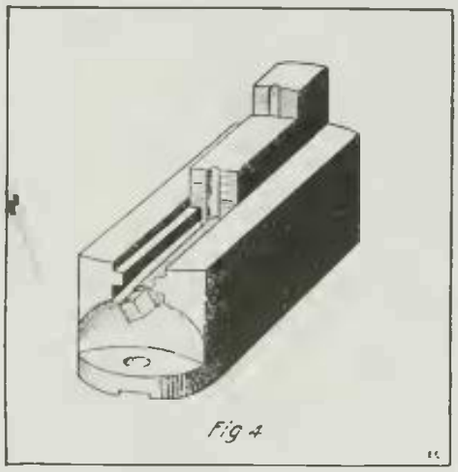
One of the commonest and most used chucks is the so-called self-centering chuck, which is shown in photograph, Fig. 2. This particular chuck has three jaws. However, there are chucks equipt with four jaws. The jaws are usually opened and closed *simultaneously* by turning the handle which is attached to a screw, the screw being geared to a worm connecting all of the jaws. As each jaw moves thru exactly the same distance toward or away from the center, it is obvious that a drill or any piece of work placed between the jaws will be held directly in the center. For holding twist drills, metal rods, bolts and small castings, these chucks are particularly useful and great time savers. Another type of chuck is shown in Fig. 3. This is called an *independent* chuck, and each jaw is moved in or out by its own screw, which works independently of the other jaws. In this device the work is chucked by moving the stept (knurled) jaws in or out by the screws with which they are controlled, the jaws sliding in the block grooves. The jaw blocks are bolted against the face plate of the lathe as shown in the figure. A single jaw is shown in Fig. 4. These jaws are adaptable for face plates, also for a great variety of work, and are rapidly taking the place of the larger sized chucks for several reasons. They are better adapted for use, being easily attached to the machine, and may be connected to or taken off the plate by one man alone without the use of tackle.

These jaws are reversible, facing them in or out. The sliding jaw may be quickly run out and turned end for end, also the blocks may be reversed if necessary. The last, but not least, item is their cost, and in this case they are much cheaper than other jaws, as they can be secured to the face plate furnished with the lathe. The independent chuck is very handy, especially in working with irregular shaped articles,

(*Continued on page* 488)



Method of Accurately Cutting Shoulders On a Lathe and Turning Down a Piece of Shafting to a Smaller Diameter at the Two Ends.



Single Independent Chuck Block of the Type Illustrated in Use at Fig. 3. A Worm Screw and Key Moves the Knurled Jaw Back and Forth.

Experimental Chemistry

By ALBERT W. WILSDON

Thirtieth Lesson

THE HALOGENS.

Continued.

BROMIN, FLUORIN, AND IODIN

BROMIN: History.

THIS element was discovered in 1826 by Balard, who obtained and isolated it from the bittern or mother liquor of common salt. It was the last non-metal discovered previous to fluorin and argon.

Occurrence.

It occurs chiefly as magnesium bromid in sea water, and as the magnesium, calcium, and sodium salt in many rock-salt deposits and salt wells. It never occurs in the uncombined state in Nature. Large quantities of this element are produced at Stassfurt, and a considerable quantity is manufactured from the residues after the preparation of iodin from kelp, but the larger portion of our supply is derived from "bittern", the mother liquor of the salt industry. Bromides and chlorides of sodium, potassium, calcium and magnesium are contained in the natural salt brine.

Preparation.

1. For preparation in the laboratory, it is liberated from its most common compound, potassium bromid, by the action of manganese dioxid and sulfuric acid, analogous to the preparation of chlorin from sodium chlorid.

$$2KBr + MnO_2 + 2H_2SO_4 = K_2SO_4 + MnSO_4 + 2H_2O + 2\,Br$$

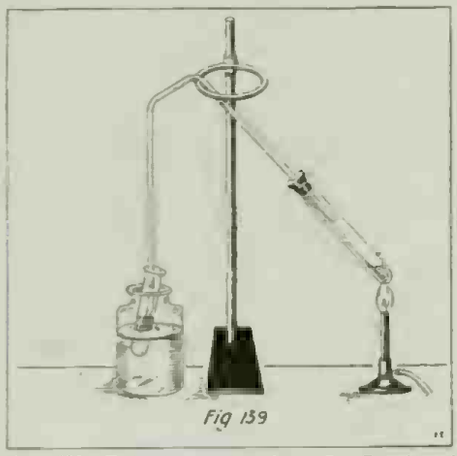


Fig. 139—This Apparatus May Be Employed for the Preparation of Bromin or Iodin on a Small Scale, Where a Retort Is Not Available. The Operation Is the Same as With the Retort.—See Figure 138.

Observe that oxygen and all the hydrogen combine to form water, and that each metal forms a sulfate, leaving bromid free. Compare, chlorin and iodin.

2. On the large scale from brine springs, the water is partially evaporated, leaving sodium chlorid to crystallize out. The thick liquid left, called *Bittern* or *Mother Liquor*, and containing in solution salts like magnesium bromid, is separated from the crystals, and to it are added manganese dioxid and sulfuric acid. Heating caused the same reaction as above, in addition to which some chlorin is set free from the sodium chlorid. This reacts with the magnesium bromid, sodium bromid, potassium bromid, and liberates bromid.

$$KBr + Cl = KCl + Br$$

Properties.

PHYSICAL. 1. It is a thin, volatile, deep red liquid.

2. It possesses a very pungent, stifling odor as a gas.

Fig. 138—Retort Method of Preparing Bromin from Potassium Bromid, Manganese Dioxid and Sulfuric Acid.

3. Its specific gravity is 2.99 at 15 degrees.

4. It is intensely poisonous, attacking the membranes, especially the eyes. It burns into the flesh and makes sores difficult to heal.

5. It is soluble in 28 parts of water. Its water solution being commercially known as Bromin Water. It is more soluble in carbon disulfid, alcohol or ether.

6. It freezes at —7 degrees, but rapidly evaporates at all temperatures above that.

7. At 1200 degrees the bromin molecule splits into its atoms. This makes one atom per molecule.

CHEMICAL. 1. Its chemical properties are very much like those of chlorin.

2. It has great affinity for hydrogen, and for metals, with which it forms bromides.

3. When dissolved in water it gradually combines with hydrogen and frees oxygen.

4. Antimony powder burns in bromin as in chlorin.

5. Bromin will not unite with oxygen, and no oxid of bromin is known.

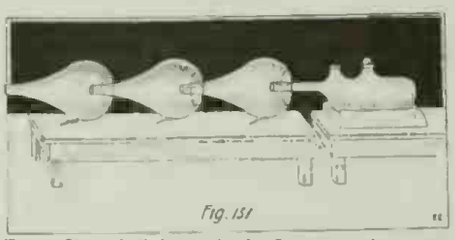


Fig. 137—Aludels, Which Consist of Flask-Shaped Glass Vessels With Circular Openings in the Bottom to Admit the Necks of Other Flasks, Used in the Commercial Sublimation of Iodin. Over the Furnace at the Right Is the Retort Where the Reaction Takes Place. The Hot Iodin Vapor Sublimes on the Sides and Necks of the Aludels.

Uses.—In the free state it is employed in the manufacture of bromides and of many bromin derivatives of the coal-tar compounds. It is also used somewhat in the manufacture of anilin colors. Potassium bromid is employed in medicine, and is the basis of other bromin compounds. Silver bromid is employed extensively in photography, especially for the negative.

FLUORIN: History.

The art of etching glass by means of a mixture of fluorspar and sulfuric acid was known as far back as 1670. Many attempts have been made in recent years to isolate this element. In 1886, Moissan, by passing a current of 50 volts and 15 amperes thru anhydrous hydrofluoric acid, cooled to —23 degs., and contained in a U-shaped platinum tube, succeeded in obtaining the free element fluorin, as a colorless gas which has since been obtained in solid liquid form. Fluorin was liquefied by Moissan and Dewar, by utilizing liquid air as a refrigerant, at the temperature of —187 degrees.

Occurrence.

It occurs chiefly as calcium fluorid—Fluorspar — CaF_2, which is widely distributed over the globe, and as sodium and aluminum fluorid — Cryolite — ($Na_3\,AlF_6$) which is found in deposits in Greenland. It has been found in small quantity in sea water, in many mineral waters, in the bones and teeth of man, and in milk.

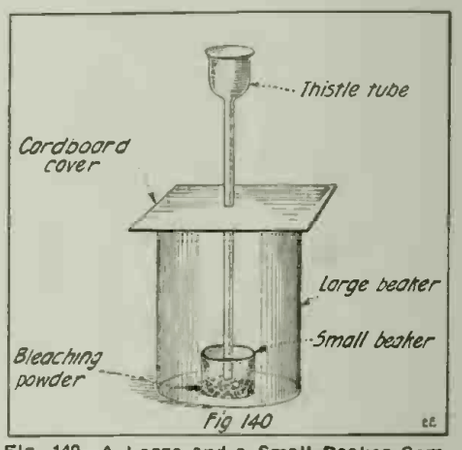


Fig. 140—A Large and a Small Beaker Comprises the Apparatus Necessary for Obtaining Chlorin from Bleaching Powder.

Properties.

It is a pale greenish-yellow gas, possessing a very penetrating odor. It is chemically the most violently active of all known elements. It combines with all of the common elements except oxygen, platinum and gold. It readily and energetically attacks silica—glass—thus its application for etching glass.

Its most important use is for etching glass, when in the form of the compound hydrogen fluorid—hydrofluoric acid.

IODIN: History.

In 1811 or 1812, Courtois, a soap-boiler of Paris, observed a peculiar corrosion of his copper kettle during the evaporation of kelp liquor, after crystallizing the sodium carbonat from it. Subsequently he obtained

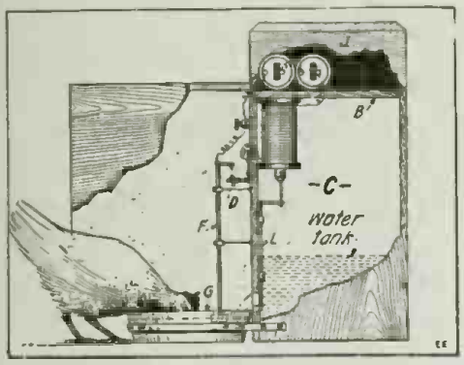
(*Continued on page* 491)

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 **SECOND PRIZE, $2.00** **THIRD PRIZE, $1.00**

AN ELECTRIC POULTRY WATERER.

When the family is gone for a long while an electric waterer will come in very handy. A lump of ice may be added in the



An Automatic Electric Waterer for the Chickens. A Dry Cell Or Two Runs the Outfit for a Long Time. In Making the Contact At "D" Be Sure to Form It of Springy Brass So the Magnet and Valve Have a Chance to Function Before the Circuit Is Opened.

summer time to keep the water cool. C, is a waterproof box made by putting on about two coats of waterproof varnish. B, is a board 1 inch wide. This is nailed at the sides of the box so that it will extend across the box. The box can be of any width and height.

An electro-magnet is screwed to the bottom of the board B. On the top of this door is soldered a clamp attached to the solenoid. The water pressure will hold the door tight against the hole in the box to prevent leakage. The pan G should be right under the door L.

A piece of heavy wire F, should be sharpened at one end and stuck into a cork. The rod F, is put in the pan G, with the cork at the bottom. At the other end is fastened a piece of brass an inch long.

A piece of brass D, is mounted as shown so the bottom will be as far below the contact on the rod F, as the pan is deep. The wiring is shown clearly. The pan G, is filled with water; so is the box C. As the water is drunk by the poultry the float F, goes down with the water. Finally when the pan is empty the contact on the rod F touches the fixt contact D—this closes the circuit and the solenoid draws the door L up, the water in the box C rushes out of the hole in the side of the box which was closed by tin door L and starts to fill pan G. The float F goes up and the contact on the upper end breaks the circuit; the door drops down and the water stops flowing.

One battery is sufficient to run this waterer for a long time.

Contributed by WILBUR BRITTON.

PHENOLPHTHALEIN POLARITY INDICATOR.

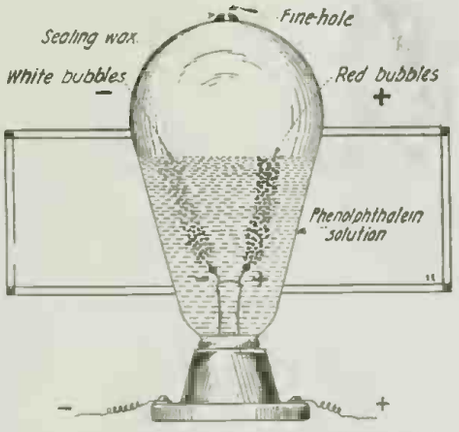
The accompanying illustration shows a very simple and accurate way to make a polarity indicator. Altho there have been many articles on a simple way to make polarity indicators many of them have failed, because they did not prove accurate when a small current was past thru it.

For this indicator, make a 25% solution of phenolphthalein, which can be bought at any drug store or chemical supply house. Then take a carbon filament bulb and file the tip off; pass a wire into the bulb and break the filament as in illustration, and fill the bulb about ¾ full of phenolphthalein solution, and seal the tip of the bulb with sealing wax. By passing a current thru the indicator, the wire leading to the positive

LAST CALL

On November 1st the subscription price of the "Electrical Experimenter" advances to $2.00 in U. S. (Canada and Foreign, $2.50.) This is the last chance to subscribe at the old rates ($1.50 in U. S., Canada and Foreign, $2.00). No subscription for more than five years at the old rate accepted.—THE PUBLISHERS

filament, will give off red bubbles, while the negative filament will give off white bubbles. After the current is shut off shake bulb so



An Excellent Idea In "Polarity Indicators" for the Shop Work-bench. It is Made From a Burned Out Incandescent Lamp. The Tip Is Broken Off and the Bulb Filled With a Phenolphthalein Solution.

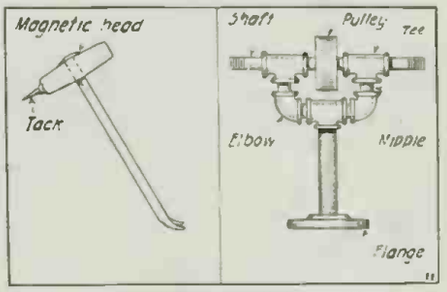
as to make the coloration about the positive filament disappear. It is then ready to be used again. With this indicator no one can hardly make a mistake, even when passing a small current thru it.

Contributed by THOS. A. HORIWITZ.

USE A "MAGNETIC" TACK HAMMER.

! ? * & ! ? ? that "blankety-blank" hammer! That's the third time!

For the benefit of the reader I will say that the above is not a new form of writ-



At Left—The "Cuss-less" Magnetic Tack Hammer. At Right—Home-Made Pipe Frame for Polishing Head Described In Detail Below.

ing or sign language, but merely a pleasant way any man has of expressing his candid opinion of the common indoor sport of laying carpets. For some reason or other, when one tries to indulge in this pastime the hammer has a cute and exasperating practise of colliding with the thumb or forefinger, and the result is far from agreeable.

But here's a little idea that will not make friend wife hold her ears in horror and bid her better half to "remember that the children are around." As intimated by the title, it consists merely in having the hammer head magnetic, which may be done by bringing it in contact with a permanent or electo-magnet, in the usual method of magnetizing. The tack will then be held in the proper position, as shown by the sketch, without the necessity of using either the thumb or forefinger, as heretofore.

Contributed by JOHN T. DWYER.

HOME-MADE POLISHING HEAD.

The sketch above shows a practical "Polishing Head" made of ordinary pipe and pipe fittings. First secure from a plumber the following pipe and fittings:—3 tees, 2 male-female elbows, 2 nipples 1 inch long, 1 flange and one piece of pipe 5 inches long.

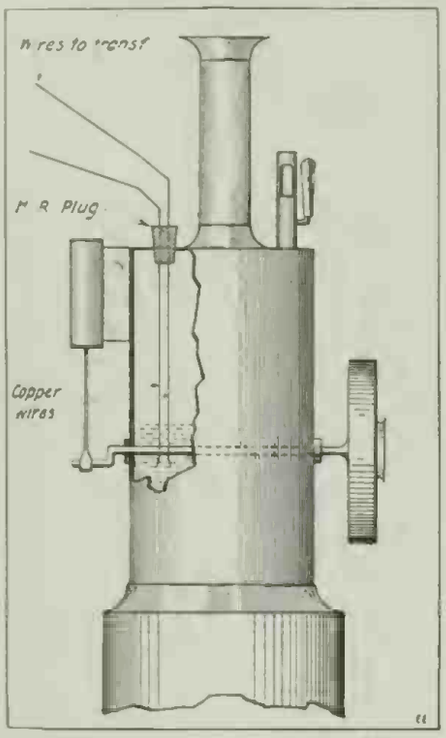
Fit them together according to the accompanying diagram, and thread a shaft of the right size 2 inches on each end. A pulley, either flat or grooved is fastened in the middle of the shaft by a set screw.

This can be used as a polishing head or for a grindstone.

Contributed by L. H. DECKER,, JR.

ELECTRICALLY OPERATED TOY STEAM ENGINE.

The accompanying sketch shows how to operate a model steam engine by electricity.



Running a Toy Steam Engine With Electrolytically Produced Steam. Two Wires Are Past Thru a Rubber Plug and Connected With a Step-down A. C. Transformer.

Procure a firm rubber plug the size of the water hole in the boiler. Bore two small holes thru it, then force two pieces of copper wire thru the holes—No. 20 B. & S. will do. Fill the boiler about half full of water, then insert the plug in the water hole so that the ends of the wires will be about one-half inch in the water. Have the wires as close together as possible without letting them touch.

Connect the protruding ends of the copper wires to a transformer that gives 25-30 volts, switch on the current and the engine will run as good as if a spirit lamp was used to heat it. The resistance of the water between the two wires will, of course, cause the water to boil and therefore generate steam.

By using this method and starting with cold water I have had steam up and the engine running in *two minutes!*

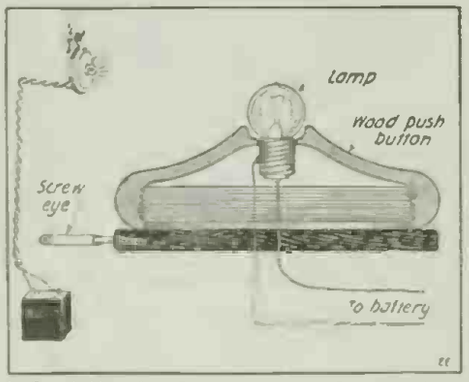
Contributed by A. E. WOODHOUSE.

A "PUSH-BUTTON" LAMP SOCKET.

Secure an ordinary wooden push-button and remove the button, inside contacts, etc. Enlarge the hole in the front of it so as to admit the socket part (base) of the lamp and fasten it in place with a little sealing wax.

Next pass the wires thru the base of the push-button and screw it to wall. Solder the wires to the base of the lamp, and fasten the two parts together by screwing on to the base.

Contributed by HORACE C. LEEDS.

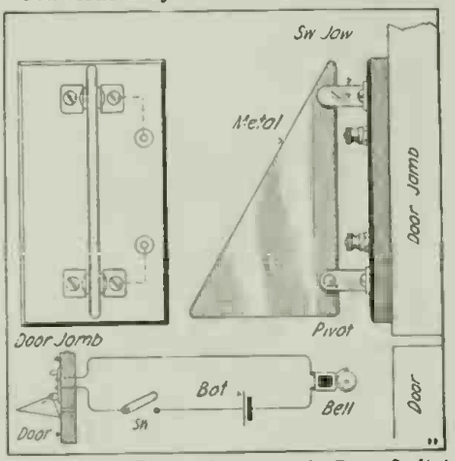


A Good Use for Old Wood and Composition Push Buttons—Make Lamp Sockets Out of 'Em. A Screw-eye Permits Them to Be Hung Anywhere.

ELECTRIC DOOR ALARM.

This device can be made of material found in every amateur's junk box. The materials needed are: 2 switch jaws (one drilled), 2 binding posts, and a right-angle triangle of any material. Size is left to the maker. This door alarm will ring if the door is moved, even if only one inch, and won't stop its noise until the proper concealed switch is thrown off.

Contributed by H. PIERVIS.

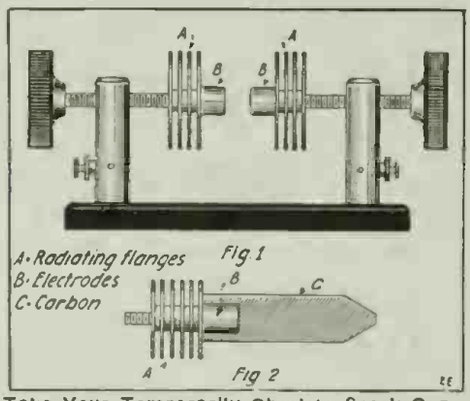


Easily Made Form of Automatic Door Switch Which Gives Alarm As Soon As Door Is Opened.

EXPERIMENTAL ARC LAMP FROM SPARK GAP.

Wishing to pass on a little idea to fellow experimenters I respectfully submit the following:

Any one possessing a spark gap such as in Fig. 1 can make a good experimental



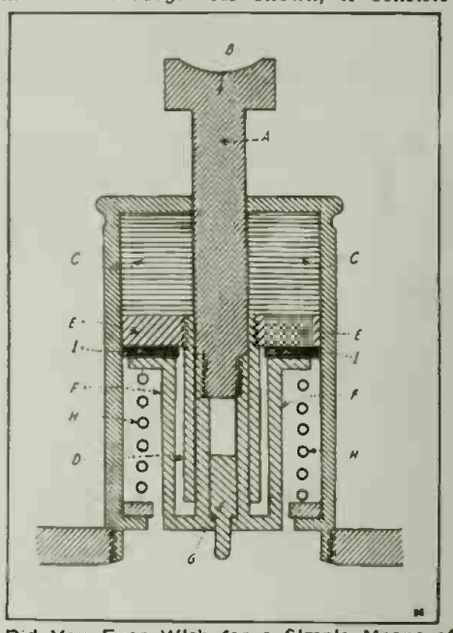
Take Your Temporarily Obsolete Spark Gap, Fit It With Carbon Electrodes, and Presto! You Have a Fine Experimental Arc Lamp.

"arc" out of it without changing it at all. Secure a piece of carbon and drill a hole in one end the size of the electrode. After pointing the carbon force it on until it reaches the flanges. Fasten a similar piece on the other electrode and it is ready for use. The radiators tend to prevent overheating. These arcs work best on from 50 volts to 220, suitable choke coils or resistance being used, of course.

Contributed by N. KENNETH MEHAFFIC.

AN AUTOMATIC ELECTROSCOPE CHARGER.

Did you ever want a means of charging an electroscope quickly and at any time? An illustrated description of a convenient automatic device for charging a sensitive aluminum-leaf electroscope for laboratory and field work with radioactive minerals, is given by L. Kolowrat in the *Philos. Mag.* As shown, it consists

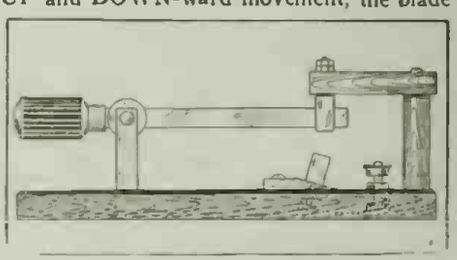


Did You Ever Wish for a Simple Means of Charging An Electroscope Quickly? Here's a Simple Device for Doing Just This Thing.

essentially of an ebonite rod *A* which, while being pushed down by means of the button *B*, is rubbed against cloth placed at *C—e.g.*, in form of a pile of perforated disks. During the subsequent motion the charge thus produced is collected on the fixed brass tube *D*, insulated by the ebonite collar *E*. This tube remains, on the other hand, in permanent connection with the piece *FF*, consisting of two coaxial cylinders and moved together with *A*. When the rod is at the end of its path a small finger *G* lightly touches the support of the leaf to be charged. By releasing the pressure on *B* the spring *H* brings the rod to its original position, simultaneously connecting *F* with the brass disk *I*, and consequently with the electroscope case. The dimensions being chosen consistent with the capacity of the leaf support, things are easily adjusted so as to produce a convenient deflection of the lead with a single push of the button. A good plan is to overcharge the leaf a little and to keep the button down until the system has discharged itself to the desired point.

HANDY QUICK THROW SWITCH

Here is a switch of novel design allowing quick changes and at the same time is well constructed, besides being very easy to insulate. As will be noticed it works on the UP and DOWN-ward movement, the blade



For Many Purposes a Rapid Quick-throw Switch Is Often Necessary. This Design Gives a Good Contact With Plenty of Speed.

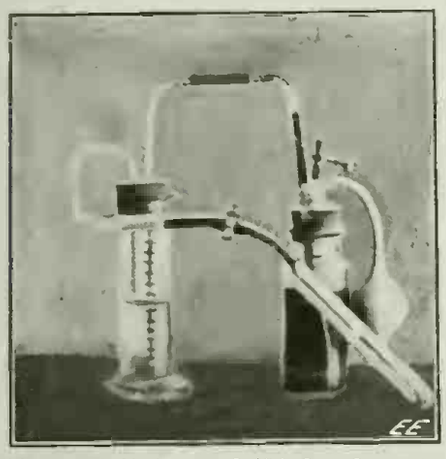
revolving near the handle on a shaft secured to two wooden or other posts. Two blades or even three could be used.

Contributed by E. T. J.

A PRACTICAL HYDROGEN SULFID GENERATOR FOR THE CHEMIST.

By K. BURNETT

HYDROGEN SULFID is an absolute necessity in every laboratory where analysis is carried out, but, as this gas is quite poisonous and, furthermore, pos-



This Novel Hydrogen Sulfid Gas Generator Can Be Constructed from Parts Found About the Workshop.

sesses a characteristic, disagreeable odor, it is essential that it be generated at the time of using.

Below is described a simple generator of my own design, which, from my experience, has proved a complete success. As will be seen, the action is essentially the same as in the well-known "Kipp", but, as the construction of this differs somewhat from my own design, I have found it necessary to add certain additional parts.

The materials needed are:

1 Wide mouth glass bottle G.
1 Gas cylinder.
1 Tube (6" x 1" diameter) made from narrow bottle.
1 Atomizer bulb.
3 Glass taps, or pinch cocks.
3 Rubber corks to fit tube, cylinder and bottle.
1 Thin one-holed cork (to hold FeS in tube).
Rubber connections and glass tubing.
Chemicals:—Ferrous sulfid.
Hydrochloric acid.

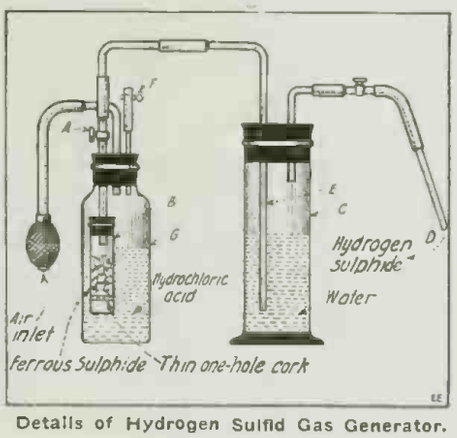
The esential working of the generator is as follows:

When tap A is turned (see figure) the acid rises in tube B, coming in contact with the ferrous sulfid, thus generating hydrogen sulfid gas, which, passing thru the wash bottle C is purified and escapes at D.

Use of the Bulb.—The pressure in tube B required to overcome the counter pressure exerted by the water in the wash bottle is often strong enough to force down the acid in tube B, and thus from further contact with the ferrous sulfid. The result is "no gas". Upon squeezing the bulb, however, the pressure is overcome and the acid rises in tube B, thus forcing out the gas.. I have proved this in practise. It is essential that a bulb having an air inlet is employed, otherwise it is useless.

Use of the Pinch Cock "F".—In order that the acid may rise in tube B it is necessary to open the pinch cock F to admit air. This is also necessary, when shutting off the generator, in order to expel air, but it should be kept closed when the acid has reached "low level", to prevent rise in case of leakage or lessening of pressure, due to the hydrogen sulfid dissolving in the acid.

Any amateur chemist may set up this apparatus without much expense and I am



Details of Hydrogen Sulfid Gas Generator.

confident that, if constructed upon this plan, it will give no trouble and the result is an odorless and convenient generator which makes a fine looking piece of apparatus for any laboratory.

A SIMPLE WAY TO MAKE YOUR OWN VELOX PAPER.

Take any smooth piece of paper about 4"x4" (glossy paper is best) and cover with a coating of silver nitrat (Ag_3NO_3) using a camel's hair brush. If this is exposed under a good negative toward the sun a fine print will be obtained of a delightful dark brown. It can be fixt in sodium thiosulfate (hypo.) about 5 grams to 200 c.c. of water. Do not leave in solution over three minutes, as it will take the color out of the print. Then wash.

A Simple Freezing Mixture: Take a tumbler full of powdered sodium sulfate and drench with common hydrochloric acid (HCl). Then plunge a test tube of water into the mixture and in two minutes it will freeze.

Contributed by IRVING ROTH.

HOW TO MAKE BENGAL LIGHTS.

Take 8 parts saltpetre, sublimed sulfur 4 parts, and antimony 1 part and mix well into powder. Beat firmly in stout iron cup and set on fire. Such lights are made use of for signaling long distances at sea. If a little camfor is added it will burn brighter.

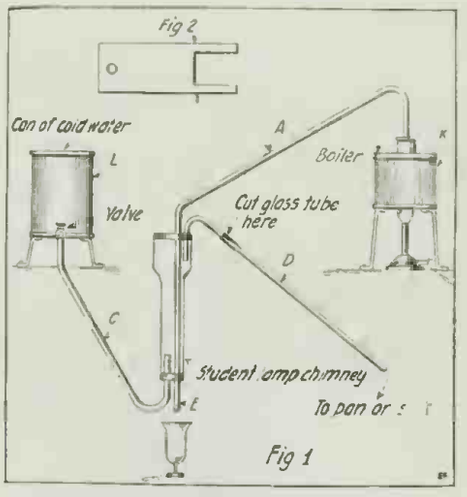
Waterproofing paper: Plunge unsized paper once or twice into oil of turpentine, and dry by gentle heat.

To handle fire without harm: Mercury neutralized in vinegar and the white of an egg smeared on will preserve anything from fire.

Contributed by WORTH C. KNOWLES.

HOME-MADE DISTILLING APPARATUS.

The accompanying sketch illustrates a home-made Distilling Apparatus. The condenser is made from a student lamp chimney. Insert a cork at both ends and bore them for glass tubing. Tube A should extend straight thru the condenser; tube D should extend about an inch below the cork. I found that if tube D is cut off about four inches below the bend and a long piece of rubber tubing used instead of a



Easily Made Distilling Apparatus Which Every Amateur Chemist Will Find Extremely Useful About the Laboratory.

long glass one it would cost less and be more serviceable. Tube C should extend about 1 inch above the bottom cork. The condenser is held in place by a piece of wood, shaped as in Fig. 2, fastened on a shelf above the bench.

The boiler K is an empty coffee can. A hole is cut in the cover and the neck of an empty maple syrup can is soldered over it. The cover is then soldered on the can so that the steam cannot escape. Three pieces of tin are next soldered on to form a support.

Another can L is fitted with a small faucet which can be obtained off an old gas jet. This can is supported on legs like the boiler. Care should be taken that the bottom of the can L is on a level or higher than the top of the condenser.

When the water boils in can K, the steam passes thru tube A. The faucet on can L is turned on; *cold* water flows thru tube C and circulates thru the condenser and flows out thru tube D into a sink or a large pan. The distillate is caught at E.

If, when the water is turned on, the lower cork leaks some melted paraffin should be poured slowly into the tube and allowed to harden. This may be done on both sides of the lower cork.

If anything besides water is to be distilled a glass flask must be used instead of can K.

Contributed by
FREDERICK REYNOLDS.

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

"Amateur Electrical Laboratory" Contest

THIS MONTH'S $3.00 PRIZE WINNER—ELLIOTT C. WOODFORD

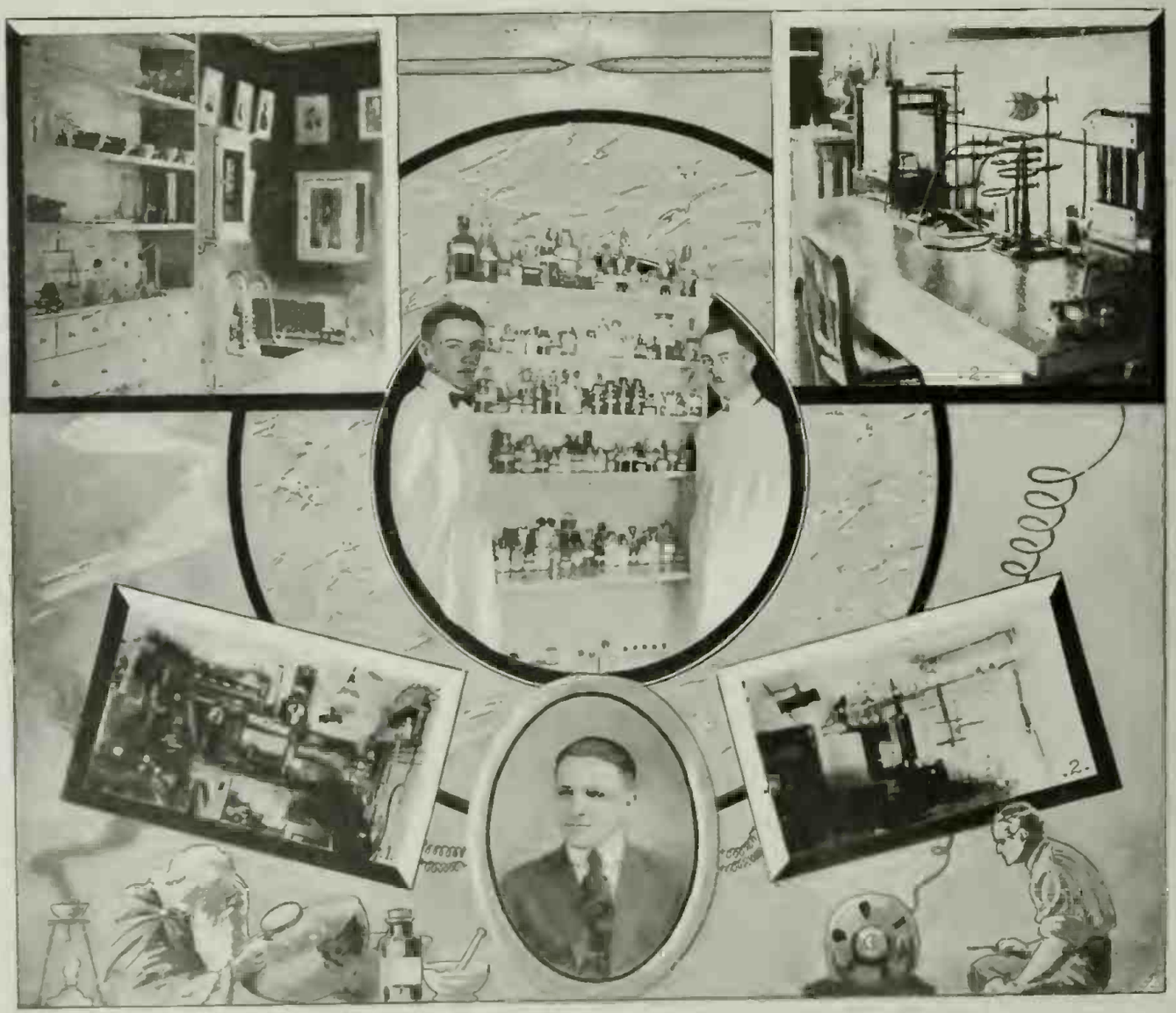
I PRESENT herewith three pictures of the chemical laboratory that Eugene Cortright and myself are using at the present time. One of the photos (top center) shows the chemical cabinet containing over two hundred and fifty chemicals, all labeled and arranged in alphabetical order. This photo shows Eugene Cortright standing at the left of the cabinet, and yours truly at the right. Another photo, figure 1, shows the shelves of chemical apparatus, including burettes, crucibles, evaporating dishes, Florence flasks, Erlenmeyer flasks, funnels, graduates, mortars and pestles, retorts, wash bottles, condensers, hydrometers, beakers, U-tubes, and chemical thermometers. To the right of these shelves is the medicine cabinet, and below the medicine cabinet is a soapstone sink with hot and cold water. Another table contains a ring stand, gas taps, Bunsen burner, rack of test tubes, gas mask, and electric tap. Also a compound microscope. One of the tables contains a chemical balance, a ¼ K.W. transformer, condenser, and spark gap (part of the wireless station that we had at one time, but which is dismantled now), and which material we intend to use in building an X-ray apparatus. Our stock cabinet contains extra test tubes of different sizes, pipettes, glass tubing, rubber tubing, electrical supplies such as switches, fuses, bulbs, sockets, and adapters, ad lib, ad infinitum.

ELLIOTT C. WOODFORD, Owego, N. Y.

HONORABLE MENTION—MILFORD H. COHEN

ABOUT four years ago, being interested in Electricity, I started a small experimental shop, which I have by the dint of hard work built up to quite an efficient electrical and chemical laboratory. I have an arc light which throws a beam from a mile to a mile and a half. I have constructed many, but this has been my most successful one. A choke coil is used for its resistance which has proven very satisfactory. When battery current is necessary I have a one-eighth horse-power motor, which drives a small fifteen-volt D. C. generator, and this supplies ample current. I also have an old-style graphophone, which plays the cylinder style records; with this graphophone I secured a recorder, and a few blank Dictaphone records. This outfit is excellent in receiving wireless messages coming at a fast rate of speed, for as soon as the message is completed, the reproducer may be changed, instead of the recorder, and in this manner the message may be repeated at a slow rate of speed. This was before the wireless stations were dismantled by our Government, of course. On the side wall of one of the photos (lower group) you will see a very efficient electric furnace, from which a very high degree of heat may be obtained. I am now engaged in making an auto, which is to be driven by a Smith Motor Wheel. My shop is very handy in many other ways, as it allows me to construct various models described in THE ELECTRICAL EXPERIMENTER. In my chemical laboratory I am also doing some very interesting experiments.

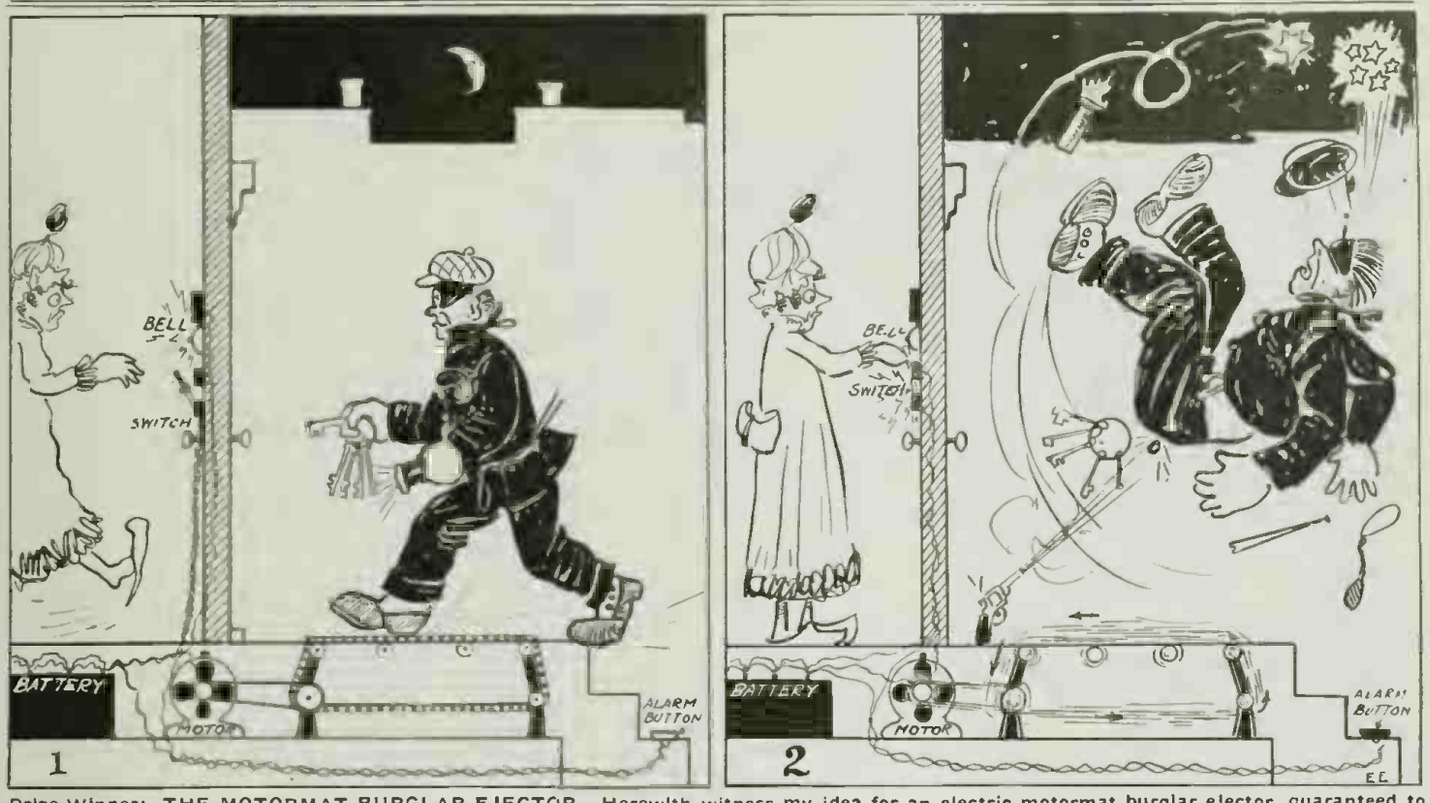
MILFORD H. COHEN, Charleston, W. Va.



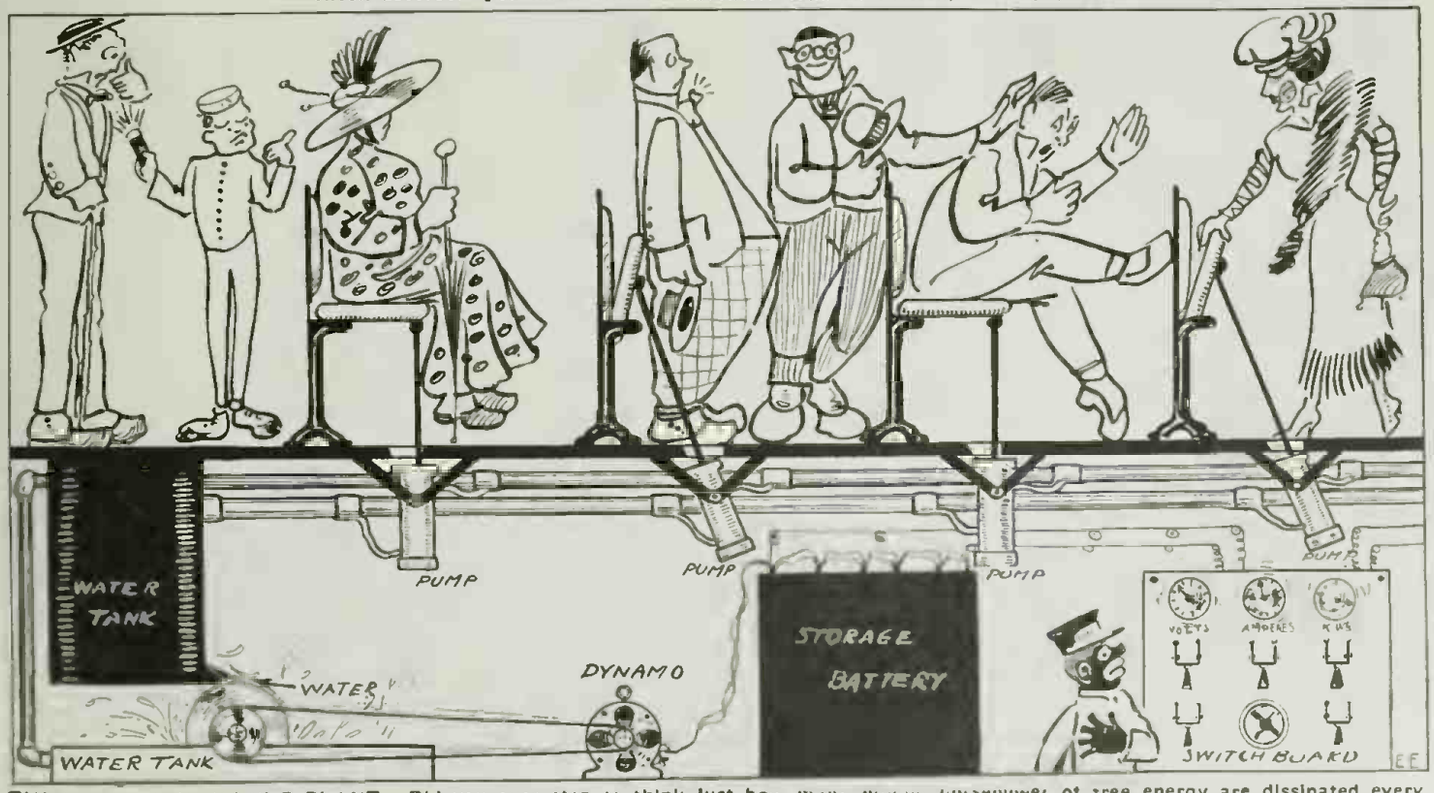
Phoney Patents

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

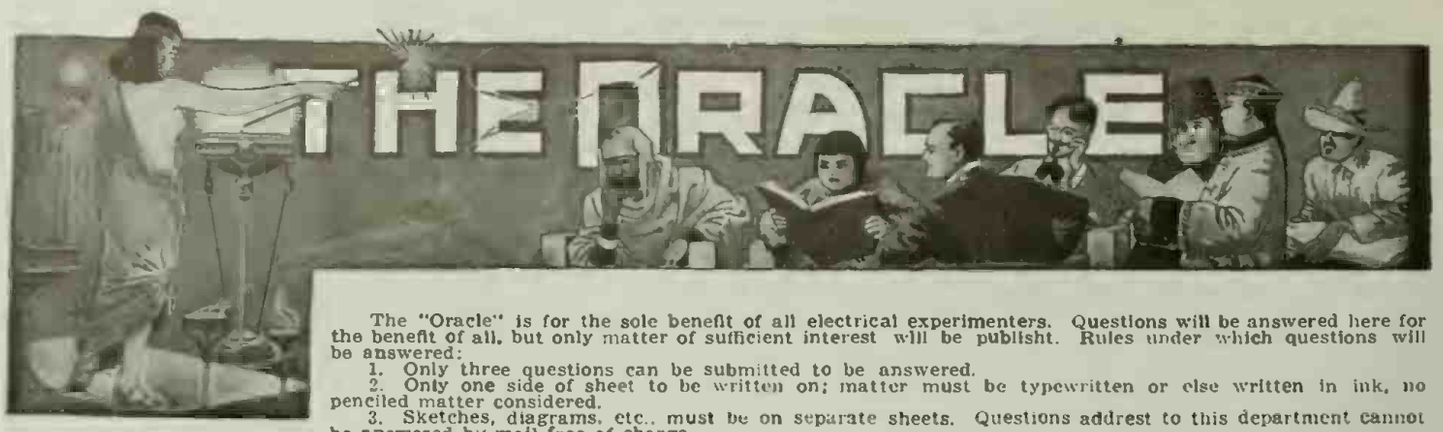
We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of a Patent yet. After they have allowed the Patent, you must pay another $20.00 as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



Prize Winner: THE MOTORMAT BURGLAR EJECTOR. Herewith witness my idea for an electric motormat burglar ejector, guaranteed to work without a hitch in 101 per cent of all cases. Mr. Burglar approaches the stoop and on his first step upward depresses the electric alarm bell button indicated in the S.E. corner of the map. You've got me, Steve! The knight of the black-jack hits the button—the bell rings—the hero of the family (he, she, or it) arises and sneaks up to the front door—beholds intruder on motormat and does his duty by throwing in the motor switch. The result is illustrated at the right. I said it was 101 per cent efficient—the extra 1 per cent is the time it "gets" you, when wifie sees you first as you rise up the front stoop about 3 G. M. in the morning after the night before. Take a tip, Brother Yelps, wear a shock absorber—you know where! Inventor, Wm. A. Fritsch, Brooklyn, N. Y.



THEATER-CHAIR POWER-PLANT. Did you ever stop to think just how many million horsepower of free energy are dissipated every single night by the thousands of theater-goers in such a large city as New York, when they sit down and get up? It amounts to something like 49,580,666½ H. P. per evening for New York City alone, according to my figures. So, hence and thus, I collected my brains together and eventually devised the astonishingly simple chair pump and dynamo plant here shown. Each chair is connected by a lever with a water pump under the floor. The pump sucks water up from the tank below the water-wheel, forces it out thru another pipe back to the supply tank above the water-wheel, etc. The same water is thus used over and over again. The water-wheel drives the dynamo, which charges a storage battery. Thus the electricity required for lighting up the theater, "movie" machine, etc., is all provided by the unsuspecting audience. The manager gets his money's worth and the Public is pleased!!! Inventor, Paul Austin, Phoenixville, Pa.



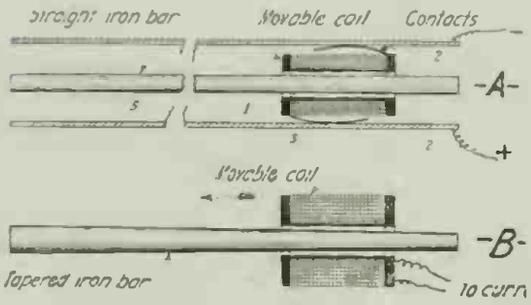
The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

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

MAKING SOLENOID MOVE ALONG IRON BAR.

(959) W. Doherty, New York, N. Y., sends us a proposed scheme for creating axial movement of a solenoid along an iron bar and wishes our advice on it.

A. 1. To our best knowledge, there is no practical way of creating motion or traveling of the solenoid along a straight iron bar in the way you show in your diagram,



Method of Causing a D. C. Solenoid to Move Along an Iron Bar Without Any Commutating Device or Motor.

(see sketch "A"), but it is possible to accomplish this by simply having the iron bar slightly tapered (sketch "B") and you will find a very long treatise on this very subject given in U. S. Patent No. 1,248,273, copy of which we can supply at 10 cents. The ELECTRICAL EXPERIMENTER for February, 1918, page 702, contains a brief digest on this interesting patent.

CAN HIGH VOLTAGE ALONE KILL?

(960) W. A. J., New York, asks:

Q. 1. We ask you to kindly answer the following question, in order to settle a dispute between two friends:

A says that a wire charged with 75,000 volts of electricity, without a fraction of an ampere in it, would kill a person touching it. B says that altho the wire is charged with such a large voltage and there isn't the least part of an ampere in it, that a person touching it would not be killed.

We have asked several persons about this matter but in view of the fact of their varied answers we have decided to let yours be the last word. We would appreciate it very much, therefore, if you would kindly inform us what the effect would be on a person touching the wire. In case it would kill him we would also like to know if the killing would be instantly, gradually, or finally.

A. 1. In the first place it is impossible to have a wire charged to 75,000 volts without a fraction of an ampere in it. You cannot have voltage without ampereage and vice versa. In order to kill a person a good many conditions are necessary. It has happened repeatedly that people who touched wires charged to 100,000 volts were not killed, while others took only a 110 volt current and were killed instantly. The point in contact with the human body makes all the difference. For instance, when the hands are wet, the effect will be much more pronounced than if the hands were dry. Also various people have various thicknesses of skin, and the thicker the skin the more it protects. Thus, workmen using pick and shovel after a while acquire a very thick skin on the inside of their hands which forms a protection against the electrical current. Therefore, you will see that just touching a highly charged wire without knowing all the other surrounding conditions itself is meaningless.

Speaking generally, it is not volts that kill. It is the amperage. High voltage by itself is not dangerous as you can take several hundred thousand volts thru the body by means of the so-called Tesla *high frequency* currents without feeling anything whatsoever. Take an ordinary *violet ray* machine—it gives a voltage usually above 50,000.

Nor is it necessary to use high frequency currents. Large spark coils which give a tremendous amount of voltage while dangerous are not often fatal to the human system unless a charge is taken into a vital part of the body. The editor has seen a man get a fairly good charge in both hands from an eight-inch spark coil giving somewhat over 300,000 volts (maximum or peak value). While it threw the man down, the effect was not fatal. He recovered in a few minutes without ill effects.

IN THE DECEMBER "E. E."

How ships are "arc welded" instead of riveted—resulting in better ships and faster production. The latest advance in ship-building science.

Turning Air Into Bread—The Electrical Fixation of Atmospheric Nitrogen, by Robert H. Moulton.

Electrical Testing Engineers Made to Order, by C. M. Ripley, of the General Electric Co.

Flying Across the Atlantic on a 10,000 H.P. Aërial Liner, by W. Edouard Haeussler, aviator.

Carbon Lamps versus Tungsten Lamps—The A. B. C. of the economy of Tungsten filaments.

How to Use Electric Fans in the Winter, by Pauline Ginsberg.

How to Make a Seven-inch Reflecting Telescope—For astronomical observations. Details for grinding lenses, etc., by Latimer G. Wilson.

A Practical and Useful Laboratory Switch-board, by H. Danner.

The Edison Storage Battery—Its Operation and Maintenance, by J. F. Springer.

New Wireless Ideas, Rules, Wrinkles and Formulas—Including Description and Drawings for a new vertical type cabinet coupler; also a Rotary Quenched Spark Gap Unit and another cartoon by Burney.

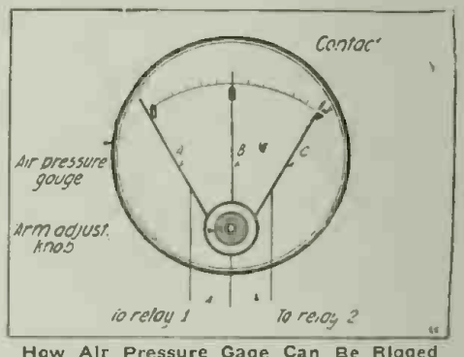
Popular Astronomy—Sixth Paper—"The Total Solar Eclipse of June 8, 1918", with some wonderful photos, by Isabel M. Lewis.

AUTOMATIC AIR PRESSURE REGULATION.

(961) M. B. Pedersen, Tooele City, Utah, writes:

Q. 1. How can I rig up an automatic air compressor regulator so that the electric motor driving the compressor will start and stop at low and high pressure.

A. 1. In the diagram a front view is shown of your air pressure gage. It will be noted that there are two adjustable arms, A and C, which can be regulated for any pressure by means of an adjustable finger, also shown in diagram. These arms, A and C, should be fitted with suitable contact points. They should be insulated from each other, and should be properly connected to external relays for starting and stopping the motor. The pointer (B) should also have a contact point on it and a connection to an external circuit, as shown in diagram. This scheme has been used successfully for more than two years.



How Air Pressure Gage Can Be Rigged Up With Two Electric Contacts, So That Compressor Motor Starts and Stops at Low and High Pressure Respectively.

SPONGY PLATINUM.

(963) Sylvan D. Rolle, Philadelphia, Pa., asks:

Q. 1. Questions on spongy platinum.

A. 1. You are right relative to the matter of spongy platinum. It will only in-

(Continued on page 488)

THE ORACLE.

(*Continued from page* 486)

candesce when in the presence of two or more gases, which readily combine, and the incandescence is due to the liberation of heat thru the combination of the gases, in which case the action is accelerated due to the presence of the spongy platinum, which acts as a catalytic agent.

EXPERIMENTAL MECHANICS.

(*Continued from page* 477)

where it is necessary to obtain a central point, irrespective to the character of work.

A *dog-chuck* is one containing independent jaws. Many lathes are supplied by the makers with a four-jaw chuck of this kind.

NOVEL X-RAYS.

(*Continued from page* 454)

"What are these branch-like marks at the upper and lower side of the skull?"

"Evidently something 'flashed' thru my mind just then—perhaps the birth of an idea. The plate recording the flash, which is just like lightning."

"How is it that your brain does not show at all?"

"As you know the X-ray picture was taken immediately after I concocted next month's cover design. *All* my brains went into making *that*, which explains the discrepancy!"

X-RAYS IN TUBERCULOSIS.

In the finished *positive* photographic print, the lungs of a normal person show white—this representing the air contained in the cells of the lungs. If the lung is diseased—as in pneumonia— it will show dark, i.e., the cells being occluded with matter. Tuberculosis is diagnosed by the spotted, mottled appearance of the affected lungs.

In our illustration which shows a clear case of incipient tuberculosis, the arrows point to the seat of the disease. In this print the patient's right is left, and left is right. The right lung, which is quite dark, except for a small upper portion, shows an advanced stage of pneumonia, as well as tuberculosis. The left lung is comparatively free from pneumonia, but shows traces of tuberculosis as well. In this lung, beginning right under the last lower arrow, we note a semi-circular bulge: this is the lower part of the heart. Right underneath the heart is the *diafram*—the part dividing the chest from the abdomen.

Photo courtesy Dr. B. Fidler, N. Y. C.

THE OSCILLOGRAPH—HOW IT WORKS.

(*Continued from page* 474)

paper be pulled at a *known* rate (say one inch per second) one can study the history of the moving pencil as regards its motion in time. Similarly if the photographic plate in our imagined experiment be moved at a *known speed*, we can then study the variation from instant to instant of the current traversing the loop. If the plate be chopt thru the beam when no current passes thru the loop and then, with the test current on, chopt thru again and in the same place as before (using guides to make the plate follow the same path) then upon development of the plate we obtain from the first operation a straight line (the so-called *zero line*) and from the second operation the *curved* line showing the variations occurring in the test current. Where the curved line crosses the straight line the current is zero and is changing direction.

Figure 3 represents a record taken by the writer with a modern type of Duddell oscillograph. The prominent wavy line shows the variations occuring in a commercial 60 cycle alternating current circuit. Figure 3 is a print from the film negative, the film having moved at the rate of 111 inches per second. Notice how the curve varies from the smooth *sine* curve usually used to represent the alternating current. Just one cycle is represented. What happened in figure *3* took place *in one-sixteenth of a second*. Certain kinks in the curve do not last longer than 1/2500 of a second. No zero line is recorded. If it were it would lie practically halfway between the upper and lower peaks of the curve.

The other smaller curve or ripple of Fig. 3 represents the current fluctuations in the receiver of a telephone when the receiver is held against the mouthpiece of the transmitter and is thereby made to emit the familiar high-pitched *howl*, which gives the device its name the—*howler*. Note the broad zero line recorded in this curve. This, too, is an alternating current, tho of very different *shape* from the 60-cycle one. Further, it has a much *higher frequency*. Reference to the figure shows that 23 cycles of the high frequency current take place during one cycle of the commercial current. In other words this *howling* telephone receiver was traversed by an alternating current of *1380 oscillations per second*.

THE GYRO ELECTRIC DESTROYER.

(*Continued from page* 465)

fact that some of my friends here in the office would be likely to subscribe to this fund. I am, therefore, enclosing $1.00 to be used in this great idea of yours. As you understand, this dollar is not to be credited to me, but to O. H. King, 1422 Hurt Bldg., Atlanta, Ga. I will continue to work for the EXPERIMENTER until I go to the Navy, which I am expecting to do in November."

"A. L. Terry,

"1422 Hurt Bldg., Atlanta, Ga."

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"I have long been a reader of the E. E. and have alway managed to maintain a state of mental equilibrium after perusing your sometimes far-fetched 'inventorials,' but I must admit that the September number contained a humdinger in the developments of the Gyro-Electric Destroyer. And in consequence thereof I feel privileged to rise up and say, 'Shake!' both to the originators of the idea and the editor who projected it. *Why not* a Gyro-Electric Destroyer? It is no more fantastical than the first airplane seemed to us, or the first tank, or the long rang 'Bertha' of the Hun. So, I say, boost for it, write some of those advertisements like you do up for the 'Maggie,' or like your August editorial, which, by the way, was a masterpiece! Keep it up for several months if necessary, appeal to the American idea of patriotism and also of taking a chance, and every man who sees it will send in his dollar. Then you have the winter to build it, and in the spring we will see, what we will see. Here's hoping for the success of the Gyro-Electric *'Teufel-wagen,'* and 'hoping' with a dollar bill.

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"Milton Ward,

"Ahron, Iowa."

"GIVE THEM HELL."

"I am enclosing one dollar as my part of the subscription for the building of a Gyro-Electric Destroyer. I am not a subscriber to the ELECTRICAL EXPERIMENTER, but I purchase my copy as soon as it appears on the newsstands and have read with interest your articles relating to this novel but promising idea. Surely subscribers to an 'Electrical Experimenter' organization should have confidence enough to finance one of its experiments, so build away and then roll 'Over the Top' with the best of luck and give them Hell.

"Karl F. Mayers,

"Littlestown, Pa."

(*Continued on page* 490)

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(*Continued from page* 488)

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EXPERIMENTAL CHEMISTRY.

(*Continued from page 478*)

violet vapors on the addition of sulfuric acid to some of the waste liquor. Davy and Gay-Lussac both investigated this new element a year or so later, and Gay-Lussac gave it the name *Iodin* from the violet color of its vapor.

Occurrence.

Iodin does not occur free. Its compounds are widely distributed but are not abundant, being found chiefly in combination with sodium, potassium, calcium, and magnesium, in certain salt springs, and in the sodium nitrat—Chile Saltpeter—deposits of Chile and Peru. Until a short time ago the main source of this element was seaweed, but now the nitrat deposits of Chile furnish by far the largest proportion.

Preparation.

The seaweeds are collected and burned, the ash forming what has been known for a long time, as *kelp*. These seaweeds are burned to a fused mass of carbon and as, this mass being then lixiviated with water, the solution evaporated to remove the excess of chlorides, sulfates and carbonates, and the concentrated mother liquor treated with sulfuric acid, which causes a separation of sulfur due to the sulfides and sulfites present. This sulfur and the crystals of sulfate formed are removed and the remaining acid liquor contained in an iron retort, is treated with manganese dioxid, which, with the free sulfuric acid previously added, liberates iodin according to the reaction:

$$2NaI + MnO_2 + 2H_2SO_4 = Na_2SO_4 + MnSO_4 + 2H_2O + I_2$$

The temperature is kept at 60 degrees, which causes the iodin to pass off in vapor and condense in a series of earthenware receivers adapted to the retort for that purpose. Fig. 137 depicts such vessels which are known as *Aludels*. Any excess of manganese is avoided in order to prevent bromin and chlorin, which are present in the liquor as salts, from passing over and combining with the iodin.

Preparation of BROMIN from Potassium Bromid, Manganese Dioxid, and Sulfuric Acid.

Experiment No. 147.

Pulverize in a mortar about 5 grams of Potassium bromid (KBr). Put on a paper 2 grams of powdered manganese dioxid, then pour over it the potassium bromid from the mortar, mix them thoroly together, and, creasing the paper, pour them into a flask of about 125 cc. capacity. Have a one-hole stopper for a thistle, which should extend close to the bottom of the flask. If there is no side neck to the flask, a two-holed stopper must be employed, containing the thistle tube and a delivery tube bent at right-angles. The delivery tube, either directly from the side neck of the flask, if one is used, or from

(*Continued on page 498*)

WHY IS A BLIMP?

(*Continued from page* 453)

end of the horizontal "worms". The fins and rudder lie flat against the sides of the balloon when it is not in the air. Upon ascent the wind blows into the rudder thru wind scoops, inflates it, and passing upward thru two small pipes, inflates the fins in turn. The time that it takes for this inflation depends entirely upon the strength of the wind.

There is an opening between the ballonet and the air-rudder, and consequently, when the wind blows into this rudder, it flows thru it and into the ballonet. This air not being able to escape, it is put under a pressure equivalent to the pressure of the wind that is forcing it into the ballonet, and which is directly governed by the wind velocity in miles per hour on the outside of the bag.

The pressure of this air in the ballonet causes it to expand upward, and this upward expansion in turn presses on the gas above until the internal pressure of the air strikes a state of equilibrium with that of the gas. Upon the occurrence of any atmospheric change, the ballonet action takes place as previously outlined, and causes the balloon proper to retain its original shape. This maintenance of shape is a very necessary element, for upon its remaining constant depends the ability of the balloon to fly accurately and safely.

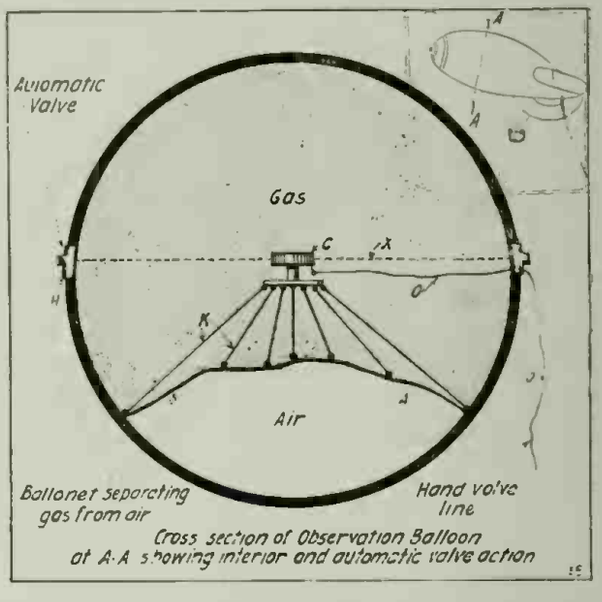
The basket is made of rattan that has been interwoven by following the over and underlapping method which insures rigidity and strength. Its capacity is two observers. One of these acts as a *pilot* and is responsible for the action of the balloon, while the other is known as the *observer*, and he is especially trained for this very important post. Instruments contained in the basket are of highest sensitivity for determining height, direction of wind, speed of wind in miles per hour, etc. A telescope is mounted on the cross-arm over the heads of the occupants, and due to its universally jointed swivel, it has a range of 360 degrees in any plane. Two parachutes also figure as part of the equipment, as also do a telephone, consisting of transmitter and receiving instrument, a camera, an additional pair of binoculars, and last, but not least, a means of protection against enemy air attack in the shape of a modern light-weight machine gun.

Of especial interest is the way in which the basket is attached to the balloon. This method of cross-lacing minimizes the swing of the basket to nil, and gives an increased stability, beside absolutely preventing rotary motion of any sort by the basket.

The "Blimp", in reality a dirigible balloon, navigating under its own power, is shown in cross-section for the benefit of the reader. By referring to the symbols in the picture, and then finding their corresponding definition in the caption below it, the writer hopes for a thoro understanding of the actions of the various means and methods employed to conquer the air in this particular type of machine.

The chances of enemy artillery making a direct hit and destroying one of these blimps or even observation balloons, is remote. One would casually think that hitting a balloon by shell fire would be the easiest thing in the world. Exactly the contrary is the case. The main difficulty is caused by the fact that there is nothing to judge the *bursts* of the shell by. From its position where the enemy artillery is firing, nothing can be judged except whether the shells are going straight toward the balloon or not, and nothing is known as to whether these shells burst in *front* or *behind* the balloon. Observation from the enemy's flank will tell this, but flank observation will not tell the truth about the accuracy of the line. Cross-observation is the only method by which it can be made an easy target, but as this type of artillery observing takes probably about twenty minutes, the balloon can be moved about by means of the automobile or locomotive on the ground below, and thereby causing the enemy to take another observation, and just about the time that they are ready to fire a shot at the balloon, it is again moved, and thus plays a game of hide and seek with the enemy artillerists.

The most dangerous position of the kite balloon, is at the period of time when it is just leaving the earth, and until it arrives at a height of about twenty-four hundred feet. After once attaining this altitude, it is comparatively safe from attack from any source upon the ground. But this immunity is not perfect once an enemy airplanes arrives upon the scene of action.



This View Shows a Cross-Section of an Observation Balloon, and the Arrangement of Air and Gas Chambers, with Automatic Valve Action Provided.

At the base where the cable and the wires from the balloon reach the ground, are stationed twelve men, constantly sweeping the sky with powerful glasses. Enemy airplanes are sighted, an alarm is immediately sounded, the automobile or locomotive winch begins to wind up the cable, which moors the balloon to the earth, and powerful anti-aircraft guns squirt out their fire at the Boches that are trying to swoop down upon their prey. The guns crash, nearer and nearer comes the balloon to the ground, the automobile or locomotive to which it is moored, starts to move, and gently draws the balloon to its nest, where it is concealed until another and better opportunity for ascending arrives.

The duty of the observers when they are up above the shell-torn lands "somewhere in France," along the American sectors, is to be ever watchful for unusual activities behind the enemy's lines, to take careful note of the positions of guns, trenches and men, likewise to carefully check up reports of cavalry reconnoissance, to be watchful for the bringing up of reserves, and spot field works.

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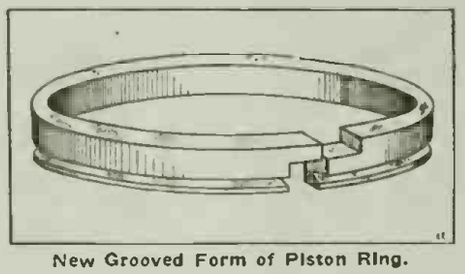

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WHY AIRPLANES DON'T FEAR ANTI-AIRCRAFT GUNS.

(*Continued from page* 447)

hundred meters. (A little over 4/10 mile.) This condition is clearly shown in the accompanying illustration.

Hence, the great problem of the anti-aircraft gunner is to accurately determine in advance the position in space where the enemy airplane and the projectile will meet, after both have followed their respective trajections for an equal period of time. This forms a problem which has been called by the British, "the problem of *prediction*." In general and considering that the target is an animated one, and having, as we might say, its own will-power, it is quite obvious that no absolute and definite solution can be applied to the problem unless we can refine our intellects to the the point of knowing what direction the enemy aviator is going to take each successive second! During twenty seconds, the average time period during which the anti-aircraft projectile is in the air, a flying machine has time to change its course in various sudden and unexpected ways, both as to altitude and as to direction. Colonel Reille outlines, however, a number of interesting methods of determining by certain laws, just where the target is *liable to be* after the lapse of such a period as this, and as he states, "The problem, altho appearing almost impossible of solution, nevertheless has a probable solution, and this belongs to the domain of mathematical extrapolation, based on the laws of continuity."

In general the solution of the problem of accurate anti-aircraft firing depends on the measurement either of the *angular velocity* of the target, i. e., the space in degrees that it covers in a certain period of time, or the measurement of the target's *linear velocity*, i. e., its speed in feet per second, etc. Now it was found that the angular velocity of a flying machine moving with a uniform linear velocity, changes value every minute in practically all cases. Supposing even that the angular velocity measured at the very moment of the shot could be applied to extrapolate for the point in the air which the projectile ought to reach, and this is questionable owing to the relatively long duration of the flight, any measurement taken at a moment somewhat prior to the firing of the shot is evidently *out of date* and has no value whatever regarding the extrapolation desired.

This is the reason why, after the trials made with instruments capable of giving from time to time discontinuous measurements of angular velocities, it has been felt necessary to substitute for them instruments capable of giving continuous measurements, and this instrument is illustrated herewith. It is called a *galvanometric cinemometer*.

The instrument works on an ingenious electrical principle as follows: A steel armature which turns inside of a magnetic solenoid (coil of wire) develops a current of induction, the intensity of which is a measure of the velocity of rotation. If the steel armature is secured on the axis of a sighting telescope pointed at the airplane, a galvanometer properly graduated will enable the range-finding officer to read constantly instead of periodically, the *angular velocity* of the moving target. As the illustration of the measuring instrument shows, there are two steel armatures and two solenoids provided; one measures the angular velocity when the telescope is moved across the horizon, the other solenoid and armature indicating the angular velocity when the telescope is moved up or down vertically. A mean value is obtained from both instruments when the telescope is moved diagonally or up and sidewise for instance. The problem of aiming and firing an anti-aircraft gun is thus a considerable one, and moreover highly scientific in its solution, for among other things, the officers having to do with the range-finding, have to determine the altitude or height of the enemy plane; its orientation, and its velocity, either angular or linear; the extrapolation or prediction of the point to be aimed at, wherefrom the knowledge of the azimuth* is determined. The altitude is measured by triangulation from a large observation base. In all these calculations and their various ramifications, both applied and suggested, the use of the well-known *plotting board*, familiar to all artillerists, is recommended.

In determining the azimuth when the angular velocity of the target is determined by the aid of the instrument here shown, the extrapolated azimuth is obtained by the plotting of the horizontal angular velocity and this in starting from the last azimuth in which the target has been observed, prior to the firing of the shot. In the same way the angle of sight is extrapolated or plotted from the angular velocity taken in the plane of sight where the target has been observed, prior to the firing of the shot.

Consider once more the fact, as aforementioned, that an enemy aircraft may traverse a distance of about seven hundred meters or .434 mile during the flight of the projectile thru the air. The shell proceeds on its way and clings helplessly to its trajectory, and will inevitably burst once the combustion of its fuse has come to an end. In the words of Colonel Reille—"During this period the race is surely most unequal, for the moving aërial target under the guidance of a quick-witted aviator, has maintained the full power of her free will,

*Azimuth: An arc of the horizon intercepted between the meridian of a place and the vertical circle passing through the center of a celestial body.

(*Continued on page* 496)

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WHY AIRPLANES DON'T FEAR ANTI-AIRCRAFT GUNS.

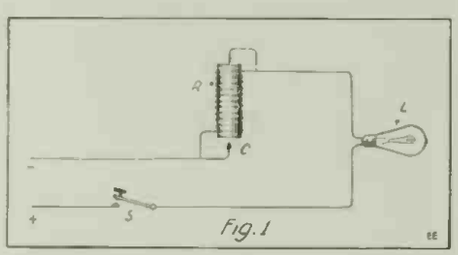
(*Continued from page* 494)

gle projectile from the ground burst anywhere near the 'plane, and at once she is in a position to thoroly baffle all the calculations that have been wasted on the aiming and firing of this projectile. Due to the foregoing facts, it is clearly evident that the systems of anti-aircraft firing based solely on *ranging* must be condemned as being ineffective and excessively expensive." "Also," as this authority, who is Chief of Artillery in the French Advisory Mission concludes—"are they not sufficient to show that, so long as we do not have a gun of a fantastic muzzle velocity, and capable of pouring into space projectiles of a speed infinitely superior to that of the flying machine, then the anti-aircraft gunner must concentrate all his attention and ingenuity in throwing skyward, sudden and dense *barrages* on the points in the air determined by extrapolation, silently calculated by measurements as accurate as possible."

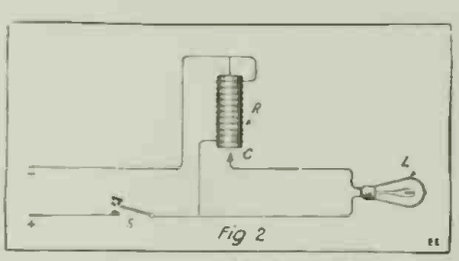
A THERMOSTATIC TIME SWITCH.

(*Continued from page* 475)

This device will afford considerable amousement and mystery to the unitiated who see the lights flash on apparently by themselves, as the operator has ample time to move away from the push-button before the lights light.



Principle of the Thermostatic Time Switch, In Which a Coil Heats a Rod R, Expanding It and Closing the Lamp Circuit.



Theoretically Workable Thermostat Switch for Controlling Lamp But Impractical for Obvious Reasons, Such as Heating and Deterioration of the Heating Coil.

MAGNETIC AND OTHER FOOL WAR DREAMS.

(*Continued from page* 451)

whale of an idea. I think I will take half a day off, inject a hypodermic syringe full of Prof. Kammerlingh Onnes' liquid helium, and try that stunt myself. It sounds *almost* good.

In another corner of the editor's desk, what did I pick up but another spasm from a fly-by-night inventor (mostly vent) residing in Ogosh, Minnehaha. Gaze on Fig. 3 of the accompanying illustration, and you will see one of the greatest pests of the Naval Ins—, excuse me, Consulting Board, viz: the *magnetic compass mine*. This disturber of the Patent Office peace gets my goat. "'ts easy," sez he, "just take a spark coil, some batteries and a compass needle,

and place them in the mine. In another compartment of the mine place a ton or so of gun-cotton or T. N. T." "Now," sez he, "when all is ready, and the compass needle duly fitted with an electrical contact, it will swing around and close the spark coil circuit, thus detonating the high explosive as soon as a steel ship draws near. Fine—but how in blazes am I going to tell enemy ships from my own?!*! I should worry!

GADZOOKS!!! Lads, but look at war dream No. 4! What do our eyes behold, my Lords? Nothing less than the evil eye and titanic grin of the terrible *Electro-magnetic torpedo.* "Why should so many torpedoes be wasted by missing the mark, when such an invisible and omnipotent force as that of magnetism is availble," writes this "also-ran" inventor. No sooner said than done, and down he sat and penned this drawing and specification. I would assure you friends that if I were as big as the biggest torpedo, with a girth of twenty feet and a length of ten yards, and just bubbling over with magnetic molecules, I would not be attracted by the biggest steel boat you ever saw at a distance exceeding a few inches at most. If you do not believe it, just go down to the nearest steel foundry where they have an electro-magnet capable of lifting several tons, and see for yourself how far my magnetic influence extends.

The "electrification" experts had been at it again when I ran across Phoney Patent No. 5. "Take some ten thousand of your electrical experts" sed this inventor in his spessyficcashion for a patent to *end the war* instanly, and addrest to no less a personage than General Pershing himself—"send them down to the sunny shores of the Mediterranean, and let them improve each shining hour by gathering thousands of No. 1 electric eels. Ship said eels to the Western Front in plate-glass trunks, so that they cannot shock anyone while in transit, and at the psychological moment, liberate fifty thousand for luck from airplanes flying along the Rhine into that German holy of holies, and the war will be ended. I commission that budding genius with the rank—I sure think it's rank!—Brigadier-General of the Electric Eel Division, and he can have full charge of that Department any time he wants it!

I momentarily lost my equilibrium and nearly forgot to hold my magnetic molecules in line, while old "H. P." nearly fainted, when my gaze fell on War Patent No. 6. CARAMBA!!! What do you think of this *magnetic* conceit? The chap that promulgated and otherwise foisted this brainy (?) idea on a long-suffering War Board was a Count—Count of No-account, I guess, for he wrote—"Why not build a VERY POWERFUL ELECTRO-MAGNET and submerge it in the shoal waters about the North Sea, so that the enemy battleships will be attracted from the deep channels into the shoals, where our sea forces can knock them to smithereens." Well, boys, I am glad I am here to speak for myself, and take a tip from father, that if that bird could build an iron core large enough for me to live in, and surround it with a coil of copper wire, big enough to use all the kilowatts developed in Europe, well even then I could not cause any of the mighty steel-plated dread-naughts of the German Navy to move one-thousandth of one millionth part of an inch from their chosen path. Of course, if a nosy submarine tried to pass me at a distance of a few feet, and provided I had several thousand kilowatts of magnetized molecules tuned up to a state of saturation, I *might* hold him a while. But none of that five-mile or ten-mile stuff, or quarter mile either.

I have often wondered how it would feel to have several million of my best trained molecules concentrated on the nose of a

fast-traveling bullet, so that when approaching the steel helmets of the Kaiser's *finest,* they would immediately yank the bullet out of its wonted course, and cause it to slam mightily against Fritz's steel sky-piece, and by this sudden concussion cause the bullet to explode with most disastrous results!

A budding genius from Whatsundermyhat, Nil, proposes that the Naval engineers shall equip all sea-going vessels with a series of (always) "large and powerful" magnet coils, placed in belt lines entirely around the hull of the ship, and excite my magnetizing coils with several hundred kilowatts of *alternating current.* Now, altho you might not know it, when an alternating current is past thru my magnetizing coil, I can repel certain bodies with extreme speed, but not for any great distance, usually not exceeding a few inches. You can imagine then what chance I would have repelling a modern automobile torpedo traveling at the rate of fifty miles an hour, and with a momentum of many thousand foot-pounds.

Boys, Howdy! Take off your hat to war spasm No. 9, specially invented to hasten peace, so its inventor states, and he makes my bones weary, for I'll be dinged if he doesn't pack up a bunch of my best trained Maxwellian molecules into an iron lifting magnet measuring ten feet in diameter, and whirl it along over the enemy positions suspended from an airplane. You ought to hear that boy rave. I can see the boche on a dead run for Berlin, can't you? Yes, you can't! No wonder the Sun wears such a pleasant smile in Fig. 9—it must be a warm day in Ju-ly—lie is right!

EXPERIMENTAL CHEMISTRY.

(*Continued from page* 491)

the right angle bend, is connected to a medium size test tube, which is immersed in a vessel filled with water. Pour in 5 or 10 cc. of sulfuric acid thru the thistle tube, and apply gentle heat after mixing the substances together by rotating the flask a moment. The apparatus depicted in figure 138 utilizing a retort may be used by those who prefer this mode of preparation. The apparatus depicted in Fig. 139 may also be used in place of either of the above.

Avoid getting the gas into the room by applying only gentle heat. As was the case of chlorin, the best antidote for an overdose of bromin is alcohol or ammonia, inhaled from a handkerchief. Collect 3 or 4 cc. of bromin then clean the apparatus with water, or if necessary, hydrochloric acid, and finally rinse with water.

Preparation of IODIN from Potassium Iodid, Manganese Dioxid, and Sulfuric Acid.

Experiment No. 148

Take a small glass retort or a tube and arrange it as in Figs. 138 or 139.

Grind up in a mortar 5 grams of potassium Iodid and mix with it on paper 2 grams of fine manganese dioxid; then transfer the mixture from the paper to the retort, exercising care not to get any into the neck of the retort.

Pour thru a funnel of 5 cc. of sulfuric acid. Mix the substances together by rotation, then put the retort in place and apply *gentle heat* only. Do not continue the process over five minutes! Then remove the stopper from the flask and thrust a cold stirring rod halfway down the bulb for two minutes while the contents cool.

How Can We Tell "Real" Death?

(*Continued from page* 457)

which is usually injected into the jugular vein in the neck after the blood is withdrawn, is composed of a certain chemical solution which tends to prevent rapid decay of the tissue. Once the body is embalmed, it is impossible for a person to come to life again (as, for instance, from a state of suspended animation). So it becomes all the more important to know an exact test for determining *when life absolutely ceases to exist,* even before embalming as becomes obvious.

USUAL TESTS FOR CESSATION OF LIFE

1. Pulse and Heart Beat: The pulse, as the end of life approaches, grows weaker and weaker, and this is felt by grasping the wrist so that the index and second finger bear against the radial artery. As life approaches the end, the heart beat frequently may drop to as low as 20 to 30 per minute. It is usual for the physician to listen to the heart beat with the stethoscope. There is also available what is known as the *microphone-stethoscope,* which is supposed to be extra sensitive, for the purpose of listening to the faintest heart beat. Some physicians, however, state that the most sensitive and reliable test for the heart beat is to rest the ear against the breast, upon which a piece of gauze has been placed for ethical reasons and which does not interfere with the transmission of sound from the heart cavity to the ear. The stethoscope in such cases is liable to amplify or localize other slight sounds occurring in the breast due to movements of air in the lungs, or due to congestion in the lung passages, especially where the patient has been afflicted with what is known as *death rattle.* If the heart has to all intents and purposes stopt, when listened to at the breast over a period of five minutes and then for another period of five minutes, it is safe to assume that the patient is actually dead, for in practically all ordinary cases where *syncope* or *suspended animation* has occurred, the persons so affected have come to life again in a period not exceeding three minutes. Finally the radial artery may be opened at the wrist. If *no blood appears,* it indicates that life has past from the body and that the heart is not functioning even in a slight manner, as is the case in *suspended animation.* It is the opinion among medical men that in the case of syncope *life does not entirely depart from the body,* and no authentic case is on record where such a condition has occurred, as Dr. John B. Huber has pointed out.

2. The Respiration Test: Respiration normally occurs at the rate of sixteen to eighteen per minute, but this may drop to as low as three or four per minute as life approaches its finality. An old fashioned test which is a fairly good one and extensively used at the present time is that of the cold mirror—the mirror being held over the mouth. In the case of syncope, any slight action of the lungs may cause the expulsion of breath, which forms a mist on the mirror. This test, however, will not indicate the condition of syncope. No ordinary test will indicate this condition, excepting that of cutting the radial artery at the wrist.

Even slight breathing can be heard by the ear applied to the breast, especially by the trained ear of an experienced physician. The *death rattle* is one phase of the respiration action which sometimes persists after life has ceased to exist, apparently.

3. Body Temperature: When life ceases to exist the temperature of the human body invariably drops rapidly, or at the rate of approximately 1.6 degrees Fahrenheit per hour. The living body has a temperature of 98.6 degrees, but a person may die with a fever and have a temperature as high as 106 to 108 degrees. The living body temperature, however, may fall below 95 degrees temporarily, in some serious cases of cholera or yellow fever. About 95 degrees is usually considered the minimum temperature at which life can exist. Sometimes the temperature will rise several degrees after death, but this is purely a chemical reaction in the different parts of the body. The body will become cold, and room temperature may follow in from three to twenty hours. In some cases a slight warmth of the body has been noted after a period of as long as twenty-four hours.

4. Color of Skin: To all intents and purposes, when the circulation of the blood has practically ceased, the skin of the body becomes ashy pale, and there is absence of the pink color when examined under a strong light, as from a reflector. The tissues of the body lose their elasticity, and irritants placed on the skin do not give any vital reaction.

Skin Signs: Scarification of the skin and use of a cupning glass fails to draw blood. Injection under the skin of a solution of ammonia is followed only in life by a port wine colored congestion. Reddish color of the finger tips when approximated toward a light if there is circulating blood.

(*Continued on page* 502)

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YOU have got to do your bit in the big task facing America. How will you do it? Will you be able to sell your services at big pay as a skilled worker, or will you have to put in your time in uncongenial work and get little for it BECAUSE YOU LACK TRAINING? America is faced with the problem of finding men who can think and act for themselves. It is a big problem. Trained men were never scarcer, and yet think what this scarcity will be like when America jumps into the work of reconstruction. Skilled workers in every trade and profession will be at a premium. There will be work for you, for every man, for years to come. The choice of what you do and how much you earn is up to you. What are you going to do?

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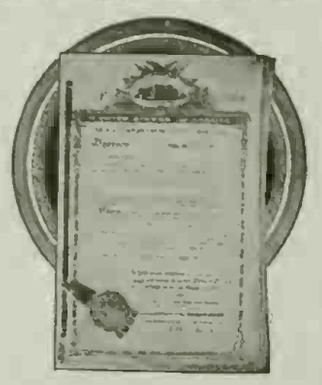


Edited by H. GERNSBACK

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries address 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 details, in order to protect the inventor as far as it is possible to do so.

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

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

Spring Handle.

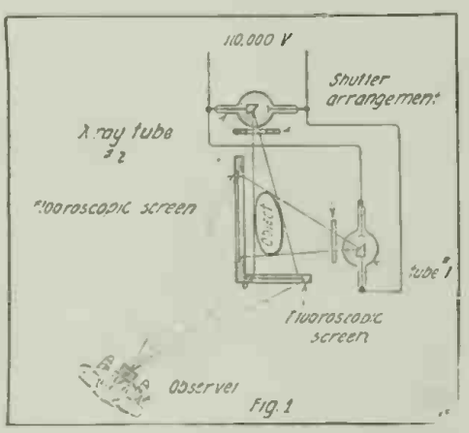
(270) Fred A. Shearer, Centralia, Wash., has an idea to prevent handles attached to tool chests, etc., from being broken in transit. They are often broken when thrown off trains. His idea is to place a small wire spring in the handle to keep it closed, thus preventing damage. Our advice is asked.

A. Spring handles are not new, and there have been a great many styles on the market. Any first class hardware store carries such handles.

Stereoscopic X-Ray.

(271) Robert J. McGill, Washington, D. C., submits a plan of X-ray work for quickly locating a foreign object in a human body by throwing two shadow images upon fluoroscopic screens which are at right angles to each other and at a stereoscopic angle to each other, so that the observer, (see illustration) can get an idea of the depth of the object as well as the location laterally. By using a stereoscope, the observer may combine the two views so as to give the appearance of solidity to the resulting image in the "mind's eye." This principle may be used for observation and diagnosis of cases other than those where foreign bodies are lodged in the patient's body. Our advice is asked.

A. This seems to be a particularly clever idea, and altho stereoscopic X-ray pictures have been taken before, we do not think that we have come across a scheme whereby the object can be seen stereoscopically *direct* by means of a fluoroscope. Heretofore pictures were taken on regular photographic plates, and these pictures were then in turn viewed by means of a steroscope. We think this idea is patentable but as a precautionary measure, we would ask our correspondent to get in touch with a patent attorney to have him make a search.



Stereoscopic X-Ray Scheme Involving the Use of Two X-Ray Bulbs.

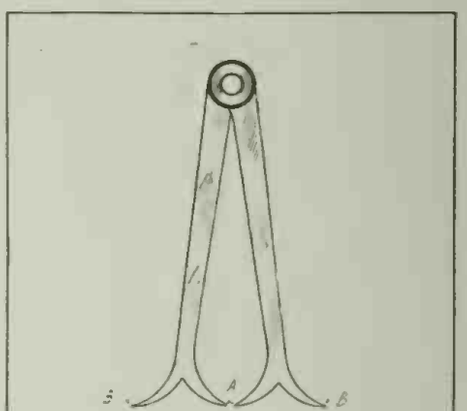
Sub-Aquatic Wireless.

(272) H. K. Skinner, Oxford, Ohio, wishes to know if he could get a patent on underground wireless by applying same to a submarine. Our advice is asked.

A. The sketch which our correspondent submits outlines the idea, but he evidently forgets that salt water being a fairly good conductor, prevents wireless waves from being propagated under water for any appreciable distance. For this reason the idea can hardly be called practical.

Double Caliper.

(273) Lawrence Byrne, La Salle, Ill., submits a double caliper as shown by attached diagram. As



A Caliper Which Measures Inside or Outside Diameters.

will be noted points A A are used for calipering the outside, and points B B are used for measuring the inside of the work. Our advice is asked.

A. This is a particularly clever idea, and we are quite certain that a patent can be obtained upon it. We do not think a caliper of this sort exists at the present time. We advise our correspondent to get in touch with a patent attorney.

Miscellaneous Patent Questions.

(274) M. A. Levins, Pueblo, Colo., submits several ideas. We answer them as follows:

1. The use of selenium in connection with measuring the candle power of various light courses is not new, having been often described in text books.

2. The idea of having a speech record on a moving picture film, so as to make so-called *speaking pictures* is not new. This idea was described a long while back by us and is the so-called Hartmann process. It is patented.

3. The use of selenium as resistance in connection with moving pictures is not practical as outlined by our correspondent.

Aerial Torpedo.

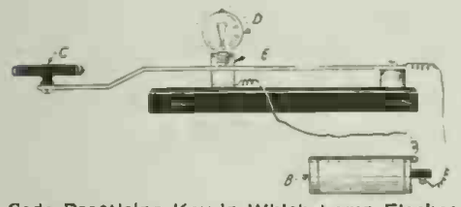
(275) H. Reinhart, Edmonton, Alta., Can., has invented an aerial torpedo propelled by the escaping gases, on the principle of the sky-rocket, with a small explosive charge in the war head. The torpedo is supposed to be used from aeroplanes

only, and weighs a few pounds, but is destructive enough to damage an enemy plane or dirigible balloon. The torpedo could be started from a sort of small cannon which would ignite the powder and propel it until it was traveling under its own power. Tho the distance it would travel would not be far and a steep angle for firing would be necessary, it probably would have a destructive effect.

A. An idea of this kind, while it is good and while it might work in practise has the great drawback that, like all other devices to combat aeroplanes, it will be ineffective, for the reason that aeroplanes travel too fast, and even if it were possible to make the flying torpedo self-propelling and self-steering, how could it overtake an aeroplane manned with a thinking pilot who changes his course at will. A mechanical device, of course, could do nothing of the sort, as you could not make it follow an aeroplane. Mechanisms of this kind, while interesting, are not very practical, even if, they should be controlled by wireless.

CODE PRACTISE INSTRUMENT

(276) A. E. Kopp, New Middletown, Ind., sends in a drawing and description of a code prac-



Code Practising Key In Which Lamp Flashes Signals.

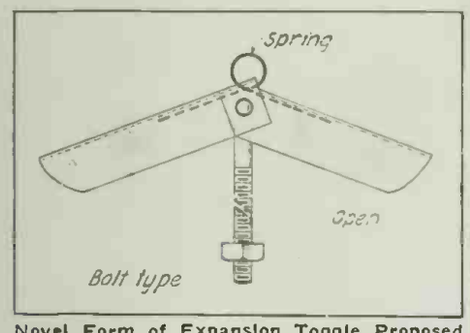
tise set, and the illustration which we reproduce herewith is practically self-explanatory. As will be noted the bulb D is mounted on the cross piece, while the key C makes contact with the bottom of the bulb thru battery B. It will, therefore, flash every time the current is "made."

A. This is a very clever idea, but there is one thing we do not like about it, and that is the current is broken on the downward stroke. As a rule such outfits are not liked very much, and if our correspondent can devise an instrument whereby the current is made on the *downward* stroke, we believe he would have a much better apparatus. However, even in the illustrated state we believe a patent can be obtained.

Expansion Toggle.

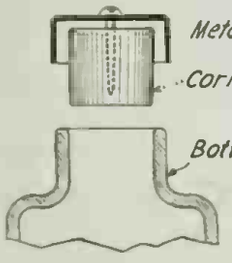
(277) D. W. Booth, Montreal, Que., Can., submits an idea on an expansion toggle which we illustrate. Our advice is asked as to patentability and practicability.

A. This seems to be a good idea which seems patentable, altho we would not vouch for it without making a search in the patent office. Off hand it seems that a toggle of this kind would be more expensive to manufacture than the old style.



Novel Form of Expansion Toggle Proposed By Inventor.

(278) Paul B. Kingsley, Cheyenne Wells, Colo., submits the following: "Just recently I purchased a bottle of Le Pages' glue. After removing the metal screw cap I found a cork. I was immediately confronted with the problem: How shall I remove the cork without a corkscrew? I finally succeeded in prying the cork out with a knife, and sat down and thought. An idea came to me. I secured a screw of the rounded-headed variety, and



Improved Cork and Cap Idea for Glue Bottles.

after punching a hole thru the metal cap I thrust it thru and turned it into the cork. Then I could remove the cork easily with the metal cap, and replace the two with one operation. See illustration. Why not make corks along similar lines, to be used on such bottles with a labor saving view? Various modifications of this idea may be made from a manufacturing standpoint. Particularly to keep the screw (or swivel pin) from pulling out of the cork. Would like your opinion on the subject."

A. While the idea is clever and no doubt patentable, we are of the opinion that glue bottles—once opened—need no cork. When in use they are at best a nuisance because they stick to the bottle, and for that reason the metal cap as a rule is used, which presenting little surface does not stick as strongly as the large surface cork would. Our opinion is that from a practical standpoint, an invention of this kind would not be very satisfactory.

THE DUNWOODY INSTITUTE.

The William Hood Dunwoody Industrial Institute, a school with an endowment of five and one-half million dollars "for training in industrial and mechanical arts," is now training a large number of men under contract with the Government for both Army and Navy. One of the interesting departments in connection with this training is the Radio Department, in which at the present time there are under training over 200 Navy Radio students and fifty Army Radio students.

The men enlisted in the Navy or inducted into the Army or Navy are sent to the Institute for an eight to ten weeks' course of instruction in both operating and theory. The Institute is now considering a material increase in the quota of Radio students under training for the Government and needs additional instructors both for class theory and laboratory as well as operating. Any men having proper qualifications, if interested, should write to The Dunwoody Institute, Minneapolis, Minn., for further particulars.

HOW CAN WE TELL "REAL" DEATH?

(*Continued from page* 498)

Muscle Signs: In death the muscles show an ACID in lieu of an ALKALIN reaction during life. Needles thrust into living muscles become oxidized. A living muscle responds by contraction when a faradic current is applied to it. The response diminishes after death and is lost in 3 hours. If 20 minutes have elapsed after presumable death and the muscular contractility is unaltered—the subject is NOT dead. By this method (electro-bioscopy) a woman who lay for 32 hours deprived of apparent vitality was saved from burial.

Icards' Fluorescein Sign: This is probably one of the BEST signs of death. It is simple, reliable and the drug is innocuous. A solution of 15 grains of fluorescein, 15 grains of carbonat of soda and 120 grains of water is injected under the skin. As long as the circulation has not ceased, the injected fluid spreads rapidly, and in this case the body acquires a greenish-yellow coloration within 2 or 3 minutes. The eyes simultaneously become emerald green. With a slow circulation the phenomenon may be delayed 20 minutes. NO COLORATION shows that life is extinct.

5. Eyeball Test: In death the patient's eyes are invariably open, but they may appear to be closed for the reason that the upper and lower lids both droop, the upper lid drooping about half way over the eyeball and covering the pupil; the sinking of the lower lid causing the white of the eye to be noticed, and hence it is generally thought that the eyeballs are pointed upward, but they invariably point straight ahead. The eyes are closed by skillful manipulation on the part of the undertaker. In real death the eyeballs lose their extreme tenseness which invariably occurs in cases of syncope or suspended animation. A flashlight thrown in the eye causes no reaction, this test being known as the *light test*.

The *corneal test* is made by scratching the cornea of the eyeball with the finger nail—in *real death* no movement of the eyeball or reflex should occur. With regard to the face, the mouth invariably drops open when life ceases, and this must be closed by the undertaker, preferably before the body has become cold and the muscles set.

6. Rigidity of Body: The rigidity of the limbs and the rest of the body does not always indicate real death, for it has been found that this conditinn can also occur in cases of syncope or suspended animation; hypnotic subjects can also simulate a cataleptic or rigid state.

NEW AND PROPOSED TESTS FOR CESSATION OF LIFE

1. The Litmus Paper Test: As is well known, litmus paper is used to determine whether a solution or secretion is alkaline or acid, the paper changing color accordingly. In applying this test for the purpose in question, a small piece of paper is employed, one end of which is placed

on the eyeball or on the under side of the lid, and if it does not change color it may indicate a syncope condition. This is the reason: In *life* the skin and flesh exudations are alkaline, while when death occurs bodily decomposition and its various chemical recations set in; therefore these exudations become acid. Hence we obtain the acid reaction on the litmus paper in this test, if the person *is really dead*. This is one of the best and newest tests available, says Dr. Sinclair Tousey. A similar test is one employing a solution (ether or chloroform), a few drops of which are placed on the eyeball, and the solution, due to the actions just mentioned, will cause the eyeball to turn red and slightly swell, *if life still exists* in the body, even tho all other tests indicate differently. If no coloration or enlargement of the eyeball occurs, then death can be considered to have taken place, says Dr. Albert Abrams.

2. The Electro-cardiograph Test (proposed by the writer): From the fact that the very minute electric currents produced by the pulsations of the human heart, as explained in an article on the Electro-cardiograph which appeared in the May, 1917, issue of this Journal, it would seem that by applying the extremely sensitive Einthoven string galvanometer or an equally sensitive instrument to the body, then the slightest action of the heart would produce a measureable electric current, which would register on the photographic recorder of the apparatus. It would also seem possible for every physician to be equipt with a special portable instrument of this type for the purpose in question.

3. X-Ray Test (proposed by Mr. H. Gernsback): Suggested on the strength of the fact that with the improved high-power X-ray apparatus available today various diseased conditions of the lungs can be established with the aid of the X-ray photograph, including tuberculosis of the lungs, which, owing to the absence of air in the diseased lung, photographs black in the skiagraph.

4. Abrams' Test: This is based on the fact that a beating heart has a specific radio-activity and yields a characteristic reflex. As long as the heart beats, this reflex can be elicited. A detailed description of this reflex is too technical for the average layman.

5. Weighing the "Soul": This is probably a rather far-fetched and mythical proposition, but according to reports current some time ago, it was claimed that tests were made with a specially sensitive bed-scale, on which a patient was placed and later died. The physicians claim that after making every conceivable and known allowance for bodily decomposition, both organic and gaseous, there was still a discrepancy of about four and one-half ounces which the medical savants could in no way account for, and they attributed it to the *soul* departing from the body.

(We print this statement for what it is worth.—Editor.)

Conclusion: "The danger of premature burial has no doubt been exaggerated, but the diagnosis of death by a competent physician should be made obligatory by law," says Dr. Albert Abrams, the well-known medical authority. "A period that must elapse before burial should be fixt by law. In France, it is 24 hours; in Germany, 48 hours, and in England, it is customary to await putrefaction, thus emulating the traditions of Greece and Rome, where 6 to 11 days were allowed between death and the funeral."

WESTINGHOUSE ENGINEERS GET NEW RESEARCH LABORATORY.

(*Continued from page* 459)

materials laboratory, the ceramic laboratory and the research laboratory. The latter is housed in what is commonly known as the "new research building." The growing demands for more fundamental work made it desirable to provide a special building where advanced and new research problems could be better separated from the more insistent works problems. A location about a mile distant from the works was selected, partly on account of the crowded condition in the vicinity of the works, but more especially to secure a site relatively free from vibration, dirt and noise and which would afford a certain amount of isolation.

The power house contains motor-generator sets for supplying single-phase, two-phase and three-phase current at 220 volts, and direct current at 250 volts (three-wire circuit). A motor-driven air compressor supplies comprest air at 125 lb. pressure, and a large motor-driven vacuum pump supplies the necessary house vacuum. A liquid air machine capable of supplying 1½ to 2 liters of liquid air per hour is also installed in the main power house. The storage battery is in a separate room in the basement of the power house and consists of a total of 218 cells, so divided that various groupings and combinations may be obtained.

A GYRO ELECTRIC "MOVIE" CAMERA FOR THE BATTLEFIELD.

(*Continued from page* 460.)

projector would be hopelessly out of place amongst the efficiency of the war camps, not from any detrimental standpoint as to the quality of the projector, but that where everything must be as compact as possible it became necessary to evolve one that would occupy but little space, be easy to operate and still fill the bill in all particulars.

Apparently all these requirements have been fulfilled in a new portable projector evolved by a Chicago concern. It will project a 12-foot picture at any distance from 50 feet to 80 feet, according to the focal length of lens.

A 4-inch lens, which is the standard equipment on all projectors, will give any size picture up to 12 feet in diameter, and throw up to 50 feet. Proportionately smaller size pictures at throws less than 50 feet.

A 6-inch lens will give any size picture up to 12 feet at any throw up to 80 feet. Proportionately smaller size pictures at throws less than 80 feet. This does not prevent the use of the projector in a small room where there is but a 6 or 8-foot throw for a 2 to 4-foot picture can be obtained, according to whether a 6-inch or 4-inch lens is used.

A WATER-JET BLAST APPARATUS.

(*Continued from page* 476)

the water outlet, it should be stopt by tightening the water outlet pinch-cock. By regulating both pinch cocks a place is reached where the water remains at a constant level, all air going out to the air delivery tube, and all water going out the water outlet tube.

An apparatus such as just described was made by the writer and has been in constant use in his laboratory. It supplies sufficient air for two blast lamps, and will give at least *five pounds* of air pressure for injection purposes, etc. If more air is needed then *three* injectors may be used, or if not as much is required, only one injector is necessary.

If a combination blast and vacuum apparatus is wanted then one, or both of the injectors may be made into a water-jet vacuum pump by the addition of a "T" fused on to the air inlet hole. If both are thus equipt, a blast and suction cannot be obtained at the same time unless one air-opening is left free. One injector may be left open for the air supply and the other used for suction. But in doing this the supply of air is cut in half. Usually therefore it is better to leave both air inlets open and make a vacuum pump separately, then both may be used at the same time without loss of air.

In this way, and with a minimum of expense, and with a very little knowledge of glass blowing, an efficient suction and air-blast apparatus run by water pressure may be constructed so that they will be in every way as satisfactory as the factory-made product.

ELECTRICITY AIDS HUN "MOVIE" SPIES.

(*Continued from page* 455)

The final episode of this series is brought to a dramatic climax by showing the final efforts of the Kaiser's spies to wreak their hatred on America up to the very moment war was declared.

Harrison Grant and Dixie Mason know that Ambassador von Bernstorff will not leave the country without making a supreme effort to cause damage to American resources. Ceaseless vigilance directs their

attention to one of the greatest railroads in the country, and they discover that two German spies employed as dispatchers have planned to wreck the whole system by mixing the train dispatch orders. (See Fig. 3.)

The episode abounds with dramatic and patriotic thrills. Mrs. Blank Blank has the satisfaction of telling von Bernstorff what a dupe he has been in her hands, and how he has betrayed to the Secret Service, thru her, many of the plots of the Imperial German Government.

Heinric von Lertz at last meets justice. He is locked in the hold of a vessel by accident, in which he has opened the sea-cocks to sink it for the purpose of keeping it from falling into the hands of the Americans. He is drowned like a "rat in a trap" as the crime of his own doing is accomplisht.

TALKING THRU LAND AND WATER.

(*Continued from page* 450)

in Fig. 1. As the operator speaks, changes in the microphone resistance will occur, corresponding to the fluctuations of the voice, and these resistance variations will cause differing strengths of battery current to reach the electro-magnetic oscillator, which in turn will radiate powerful sonorous vibrations or sound waves corresponding to the spoken voice. These telephonic sound waves transmitted thru the earth or water, are picked up by a microphone (or by an oscillator) and caused to affect the telephone receiver in the same way as the telegraphic dot-and-dash signals do. Telegraphic signals have been transmitted to a distance of twenty miles by this method, and telephonic speech has been transmitted and received over distances exceeding twelve miles.

One of the most interesting phases of this recently patented invention (U. S. Patent 1,270,398) is that by means of a compound microphone arrangement (mounted in one of these liquid tanks or ground pits so as to be revolved thru any desired angle) it becomes possible to very accurately determine to the fraction of a degree, *from just what direction a sound wave is propagated!* A practical application of this remarkable principle involved in the new Fessenden sound-transmitting and receiving apparatus, is shown in Fig. 3, where, by means of two observation points fitted with the special "sound direction detecting apparatus," it is possible to quickly and accurately locate any activities on the part of enemy "sappers," who may be engaged in digging a mine.

The principal feature of the whole arrangement here outlined, is that the signal-producing or receiving instrument is not in direct contact with the earth, and does not vibrate with the same phase or amplitude as the earth itself at the transmitting or receiving point, thereby avoiding losses from refraction, bending, or irregular travel of the sound waves, and enabling the true direction of the sound to be rapidly ascertained, and permitting amplification by mechanical resonance, et cetera; as will become evident.

Referring to Fig. 3 and the detail illustration at the right showing a close-up view of one of these "sound direction" detectors, we see that a large pail-shaped tank of water is sunk in the ground to start with. *The ground around the pail is preferably wetted* so as to make good physical contact between the pail and the ground. A three-legged metal spider rests at the bottom of the pail, and this is surmounted by a sound-insulating pedestal made of lead. In this sound-insulator is placed a vertical and revolvable metal rod which carries a pivoted cross-arm supporting a sensitive microphone

(*Continued on page* 507)

TALKING THRU LAND AND WATER.

(*Continued from page* 505)

at either end. The two microphones face each other and are connected in series-parallel with a battery and a differentially wound telephone receiver. Suitable angle index dials are fitted to the apparatus, which instantly indicate the angle, both vertical and horizontal, at which the instrument happens to rest when a certain measurement is being taken.

Considering that the two differential windings of the telephone receiver are connected so as to oppose each other, any sound waves traveling thru the ground and reaching both microphones exactly at the same instant, will cause a total cessation of sound in the receiver, when the bar carrying the two microphones is exactly at *right-angles* to the direction from which the sound proceeds. The position in which the microphone bar indicator points toward the enemy's trench will be the one to be attacked, either by counter-mining or by a direct raid on the enemy trenches. This measurement gives the horizontal direction or angle from which the sound is emanating.

To determine the vertical angle or the dip of the direction from which the sound waves emanate, the central vertical rod is rotated thru 90 degrees of the pivoted microphone bar, and is tilted until the sound is minimized again, at which point the angle or dip is indicated on the vertical index dial of the instrument. By taking another observation at a point thirty to forty feet down the trench, the location from which the sound proceeds may be determined in the same manner, and its point of origin will be that point at which the two lines of direction, so determined, meet, and its distance can then be instantly calculated (or computed on a slide rule) by trigonometrical means, with which all military men are thoroly familiar.

POPULAR ASTRONOMY.

(*Continued from page* 463)

globular cluster is composed of thousands if not hundreds of thousands of individual suns surpassing our own sun in size and brilliancy. They appear to be systems that have reached the height of development in which a comparatively settled and stable condition of affairs has been attained. They resemble the spirals in having exceptionally high velocities of translation thru space, but they are comparatively few in number, about seventy being catalogued up to the present time as against thousands of the spiral nebulae. Now these globular systems show a symmetrical distribution with reference to the plane of the Milky Way which appears to form an equatorial belt that the globular clusters and the spiral nebulae avoid. The width of this equatorial belt wherein lie the vast majority of all the stars, including our own sun, and the great irregular gaseous nebulae is about ten thousand light years, while its diameter appears to be fully three hundred thousand light years. Symmetrically distributed above and below this belt in spheroidal form lie the globular star clusters. The fact that these clusters are distributed symmetrically with reference to this belt seems to be evidence that they are units in one great universe in which the Milky Way occupies the equatorial position. This has a direct bearing on the *island universe* theory of the spiral nebulae. The spirals as well as the globular star clusters lie at great distances outside the equatorial belt but they show signs, as we said before, of being affected by it since they tend to cluster in greatest profusion in the vicinity of its poles as if avoiding the strong gravitational attractions existing in the equatorial region.

It would appear then that the spiral nebulae are not "island universes" in the sense that they are Galaxies similar to and independent of our own Galaxy, but are rather secondary formations in a universe in which the Milky Way occupies the position of an equatorial belt. The spiral nebulae are possibly conglomerations of stars and nebulae that have at some time broken away from or past thru the equatorial region of dense star clouds and gaseous nebulae and are moving rapidly away from the central plane since the antapex of their radial velocities is the center of the equatorial region.

According to Dr. Shapley of the Mt. Wilson Observatory, who has recently made extended investigations of the globular star clusters, computations based on the radial velocities and distances of these objects from the central plane show that within one hundred and twenty-five million years, if the velocities remain unaccelerated, more than half of the globular clusters will have penetrated this equatorial region occupied by our Galaxy while the Great Cluster in Hercules, one of the nearest, will reach the plane in less than thirty million years. These intervals of time are very short in the history of a sidereal universe and he concludes that the central region has been penetrated by the globular star clusters many times in the past and that the moving star groups that are found within this equatorial region such as the Hyades and the Ursa Major star group may be remnants of clusters that attempted to cross the plane of the Milky Way.

The most acceptable theory advanced up to the present time in explanation of the spiral nebulae therefore assumes that they are not "island universes" that resemble our Galaxy in size and extent but rather subordinate units in one vast universe in which the Milky Way, the majority of all the stars, the planetary nebulae, and the great irregular nebulae from which the stars are formed, occupy the central belt. At great distances beyond this region lie the globular star clusters and the spiral nebulae.

Tho the origin of the spiral nebulae and the cause of their peculiar structure is still unexplained they are generally believed to be enormous conglomerations of stars and nebulosities having a motion of rotation as well as a velocity of translation thru space that is tremendously high.

(*Next installment will appear in November issue*)

THE HOW AND WHY OF RADIO APPARATUS.

(*Continued from page* 472)

metal cover on the transmitter, and placing the wireless receiver diafram (with its cap removed, of course) up against the "Detectiphone" transmitter diafram. In fact the two may be glued together so as to have a practically single period of vibration, similar to the method utilized in building telephone relays. After doing this, and taking care not to spill the carbon granules out of the microphone, the receiver and transmitter should be bound together firmly with tape. The same directions hold, of course, for the second receiver and transmitter, stage D. At Fig. 4 there is shown a simple method of supporting the sound-proof wooden boxes, containing units C and D; by suspending them on ¼ inch rubber bands from an arm. This prevents extraneous vibrations from affecting the ultra-sensitive

transmitters. This system has been applied commercially, and an amplication value of 15 times the initial received strength of signal has been obtained.

The "Helmholtz" acoustic resonator has been successfully used to boost the strength of signals as heard in the radio receiver, the glass bell of the resonator being placed close up to the receiver opening as shown in Fig. 5-A. It is particularly suited to use on regenerative valve sets, where a variable capacity is employed to vary the number of *beats*. The receiver used is preferably a standard 1,000 or 1,500 ohm type. The large opening of the resonator should fit over the opening in the telephone receiver cap. This type of pure acoustic resonator responds only to a certain frequency for each size of bulb; therefore the resonator used should approximate the beat frequency used. Also the variable capacity in the audion circuit should be varied until the beat frequency created permits the Helmholtz resonator to be in resonance with the receiver. On spark signals and a crystal detector a resonator corresponding to the pitch of the incoming signals should be selected in each case.

Fig. 5-B illustrates an adjustable resonance amplifier which has been used with beneficial results, it is said. The resonance tube comprises two tight-fitting brass tubes, one sliding within the other, and the complete tube member joining a microphone and receiver, for example. The resonant frequency to which the tube will respond may be changed by sliding the inner tube in or out. The law of frequency for these tubes can be found in any good text-book on physics. Various sizes of tubes should be tried.

The "comprest air" amplifier. A new and extremely simple form of intensifier for telephonic, telegraphic and phonographic signals or sounds in the *Parsons comprest air* valve, shown in Fig. 6. A radio or telephone receiver, R, is conected by a rod, as seen, to an air piston or other form of valve. Whenever the receiver diafram moves, or signals are being received, it actuates or moves the air valve controlling the flow of comprest air to a loud talking diafram chamber, L, connected to a suitably large horn. This is only a general description of this most interesting amplifier, and further information can be gained from the phonograph companies using it, also by consulting the records of the Patent Office or back files of the ELECTRICAL EXPERIMENTER (October, 1915, issue, page 265).

The "Lowenstein" Electro-magnetic Amplifier. This apparatus as designed by Fritz Lowenstein, of New York, will operate on any receiving detector and is recognized as the most sensitive detecting device for electric current of this particular type ever constructed for commercial use, as it will be deflected by a current of 1 microampere (1 millionth of an ampere).

This super-sensitive relay is illustrated in Fig. 7. The moving element C is wound with a coil of extremely fine wire and carries a contact D which makes connection with a small pool of mercury E, when the armature is deflected. The moving part is supported on two jewel bearings to eliminate friction and the connections to the moving coil consist of two very fine helical copper springs suspended at both ends. Two small discs, F, F, are provided to regulate the swing of the coil, which is mounted between two pole-pieces, BB, that are energized by the massive coils shown at A, A, A, A. The coils are so connected that the two pole-pieces will have different polarites, thus forming a N. and S. pole. The current for these magnets is obtained from a 110 volt direct current supply and is led in thru the wires G.

The operation of this remarkably sensitive relay is as follows: The powerful electro-magnets are first excited and the moving coil is conected to the receiving outfit in place of the regular 'phones thru terminals H, and a calling device, such as a bell, at the terminals I. When the coil C is excited by the feeble current produced by the detector, which, of course, is received by the other instruments from the radio transmitting station, it will turn, and its lever D will make contact with the pool of mercury E, thereby completing the circuit which causes the calling device to operate. The bell can be replaced with a tape register by which messages can be readily copied. This, of course, must be operated at a slow speed, as the moving coil has an oscillation period of .1 of a second. The oscillating frequency period can be changed by varying the distance of the levers F, F, and the coil. The ivory or bone cup in which the mercury is kept can be moved either forward or backward by operating a small thumb screw located at the end of the container.

The complete relay is supported on a table that can be rotated to offset any detrimental effects of the earth's magnetic field. A suitable cover with a glass top is placed over the instrument to prevent any dust settling on the delicate moving parts. This device is capable of withstanding shocks and will work even when slightly tilted, for it has been tested on moving vessels and the results were entirely satisfactory.

Altho the relay is adopted for radio work, it will be very useful in a laboratory where it is necessary to detect very minute or feeble currents. By mounting a sensitive microphone to make connection with the winding on the moving element this apparatus might then be used as a telephone relay, second only to the Audion in sensitivity.

The "Selenium" Relay. Until recently the most sensitive relay was the Siemens polarized relay, which would close its contacts with about 0.00005 ampere.

The new selenium relay invented by Mr. G. Allstrom is said to respond to less than 0.00000000001 (one hundred billionth) ampere. See Fig. 8. This would make it even more sensitive than a telephone receiver, and experiments have shown that for wireless work it is well adapted for signalings and calling purposes, etc. The instrument has been used in connection with electrolytic detectors, which were always thought successful only in connection with telephone receivers. Loud, audible signals were never obtained so far with such detectors, but the Allstrom selenium relay makes it possible to use a sounder or tape register with any kind of detector, no mater how sensitive.

An extremely light piece of sheet iron, A, is hung between two platinum wires of the minute diameter of 0.0001 inch, etc. In the center of the iron sheet a small, very light mirror is cemented. An electro-magnet, M, which may have a resistance as high as 10,000 ohms, is placed immediately behind the iron foil, so that the magnet core almost touches the iron.

Some distance away a sensitive selenium cell, S, is stationed. The cell itself is enclosed in a box, which at the front has a narrow slot. A source of light, O, is placed behind and directly over the selenium cell, and the room must, of course, be dark. By means of a parabolic mirror a beam of light, R, is thrown upon the small suspended mirror on A.

This beam is reflected towards S, but as long as the foil A, is motionless, the beam of light does not fall thru the slot of S.

However, a minute current—such as a wireless wave—passing thru the windings of M, will magnetize its core sufficiently to turn the very light mirror on A, and the

ray can now fall thru the slot of S, which reduces the resistance of the selenium cell. This is sufficient to operate relay R, which in turn will actuate the signal bell.

With suitable means the oscillations of A can be dampened so that it will return in its original position immediately after the current had past thru M.

In further detail it may be said that a magnet coil having 7,000 to 8,000 ohms resistance will be sufficient for the etheric wave relay coil M. Such a coil may have a very soft iron core about ⅝ inch in diameter and 5 inches long. Two fiber or hard rubber end discs are mounted at either end, whose diameter is roughly 2¼ by ¼ inch thick. The iron core is insulated with a couple of layers of heavy waxed paper. The coil can then receive about 11 ounces of No. 36 B. & S. gage enameled copper magnet wire. This gives approximately 7,284 ohms resistance for the magnet M, which adapts it nicely to the minute radio currents.

Further, the damping of the iron vane A, can be magnetic in character, so as to leave the vane free of an unbalanced weight. A permanent steel magnet, placed several inches from the iron vane, will have the desired effect in causing the moving member to come to rest quickly. Other methods are also applicable.

The "Audion" Amplifier. The vacuum valve or Audion amplifier is one of the best known and most widely used at this time. Fig. 9 shows the circuits for a cascade arrangement of three oscillation valves. The current fluctuations in the detector circuit are progressively imprest upon the grids of a second and third valve, and these valves, by virtue of their relaying action, result in a progressive amplification being attained. The loose coupler, LC, transfers the aerial circuit oscillations to the first oscillation valve, No. 1; the plate of this first valve is connected up with the usual high voltage battery and the primary, P, of a one-to-one iron wire core transformer. This transformer may be an auto-transformer, the winding having about 9,000 ohms resistance. A spark coil secondary is often used for the purpose, placing a soft iron wire core thru the center of the winding. The secondary winding is connected to the grid and filament of the second valve. Three to four valves are usually all that can well be employed in a cascade amplifier, as the oscillations in the third or fourth stage become so strong as to paralyze the valve. A high resistance (half a million to one and one-half million ohms) is best connected across the grid and filament at R, to prevent excessive potentials accumulating on the grids of the second and third valves. The plate circuit of audion No. 3 is connected to a loud-speaking receiver, which may be fitted with a horn. Coupling transformer T_2, is of the same dimensions as transformer T_1. Bulbs Nos. 2 and 3 should be larger than bulb No. 1. According to Eccles, the three stage cascade amplifier, using ordinary sized bulbs, will yield an amplification of about 120 times; the third Audion will operate a sensitive magnetic type relay connected to a tape register.

The "Lieben-Reisz" Gas Relay. The newer gas or ionic stream relay, designed by Lieben and Reisz, the German investigators, is similar to the Audion, but possesses distinctive features of its own which render it particularly efficient as an amplifier for weak radio currents, which vary from 1 to 50 micro-amperes usually for fair signals. Their gas relay is shown diagrammatically in Fig. 10. Here a regular radio receiving circuit is represented with aerial A, ground G, coupling transformer L C, detector D of the mineral type, variable condenser V C, and a special transformer T_1. The primary

of transformer T_1 takes the place of the telephone receivers usually employed. The secondary of the transformer acts on the valve tube shown at A H K.

The glass tube is exhausted of air and filled with attenuated vapor of mercury at a pressure of 0.001 mm. (20°C.), and this vapor rises from a small portion of mercury amalgam placed at the bottom of the tube. The cathode electrode at K is a platinum strip 1 mm. wide, 0.5 mm. thick and 1 meter long wound on a glass supporting stem, zigzag fashion. This strip is coated also with a thin layer of barium and calcium oxides. The anode electrode A consists of an aluminum wire spiral, while the auxiliary electrode H is made of a thin aluminum plate extending across the tube inside, between anode and cathode. It is punctured thru with many holes about 3½ mm. in diameter.

Also, in general, the cathode K is brought to a bright red heat by an electric current from the potentiometer R, attached to a 30-volt battery. Across the cathode and anode is imprest 220 volts D. C. from a dynamo, etc. The voltages must be kept quite steady. A high resistance W, shunted by a condenser C, is in series with the anode, as also the primary coil of a transformer (step-up) T_2. The secondary S connects with telephone receivers P.

It was discovered by Wehnelt that heated metallic oxids emit electrons; so in the Lieben-Reisz relay the heated cathode K gives off a stream of cathode rays or electrons (cathions), which pass thru the holes in the grid H connected to the radio circuit thru transformer T_1. The strength of the cathion discharge thru H will depend on the potential of H. Hence it will be seen that varying grid H potentials are constantly produced by the received Hertzian wave signals acting thru the circuit and transformer T_1. As the cathode stream is varied, so will the 220-volt current vary in proportion, and these variations will be heard as strong signals in 'phones P.

This valve tube acts therefore as a true relay, and it is said that one tube, as here shown, boosts the received currents to 33 times their original amplitude. Of course two or more tubes can be conected in cascade to give any amplification desired. This gas relay was supposed to be much superior to the Fleming valve and de Forest Audion in sensitivity, but as Eccles points out the de Forest patents cover similar devices of equal sensitivity, size for size. Reisz claims that with four of these relays connected in cascade it has been possible to attain a magnification of 20,000.

The "Pliotron" Amplifier. This is a form of vacuum valve devised by Irving Langmuir of the General Electric Company research laboratory, and is claimed to differ from the Fleming valve and the Audion in that the instrument depends for its action on a pure electron discharge. In a pure electron discharge, as the temperature is raised, a point is always reached where the current becomes limited by the space charge between the electrodes. When this stage occurs but a small fraction of the electrons escaping from the cathode manage to reach the anode, whereas the majority of them are repelled by the electrons in the space and, therefore, return to and are absorbed by the cathode. Hence, if a negatively charged body is brought into the space between the anode and cathode, the number of electrons which then return to the cathode will increase, so that the current to the anode will decrease. If a positively charged body is brought near the cathode, either inside or outside the tube, it will largely neutralize the electrons in the space, and will, therefore, allow a larger current to flow from the cathode. By thus placing a variable potential electrode between the anode and cathode the current

Not Enough Men for These $5,000 Positions

An Important Letter

From the President of the American Commerce Association

I am writing this letter as a last resort to see if we cannot secure more men willing to qualify for traffic positions paying $2,500 to $10,000 a year.

How important is the trained traffic man's work can be seen by these few cases out of thousands which occur every day. A concern in South Chicago had been shipping about 200 cars of coke from Connellsville to their smelters. Some time ago a traffic expert succeeded in getting a rate adjustment which resulted in a saving of about $5.00 on each car. Thus on this one item alone a saving of over $360,000 a year was effected.

In St. Louis, through misrouting of freight, errors in reconsigning cars and undercharges on shipments, a railroad lost over $27,000.

A traffic expert discovered that freight rates paid by the Meeker Coal Co. were legal, but exorbitant. A ruling secured from the Interstate Commission resulted in a refund of $120,000.

There are about 50,000 large business corporations and about 400,000 small shippers which must be protected by competent traffic men. These concerns have freight expenses running from a few thousand dollars to many thousands of dollars monthly. Yet in the entire country there are only a few hundred men actually competent to save the money now being wasted through lack of efficiency in applying the Government Freight Rate System.

Realizing the crying demand for trained traffic experts, and seeking relief, the American Commerce Association—a national organization OF traffic men, FOR traffic men, BY traffic men—offers to give men the training required to make them competent to handle the problems of most economical distribution. This instruction is given by mail and can be studied in spare time at home. The most complete and thorough training is given, and, through the Association, costs but a few cents a day.

Through its Advisory Council, every member of the American Commerce Association receives the help of the most prominent traffic men in America.

It is impossible to go into details in this letter, but the Association has published a remarkable book for free distribution which explains everything in detail and tells how any one may quickly learn the new profession of traffic management. If you are at all interested in getting into this highly profitable field, paying salaries of $2,500 to $10,000 and more, write for the remarkable free book. Please state whether you are a beginner or whether you have had previous traffic experience, and give your present age and occupation, also your telephone number. Address American Commerce Association, Dept. 5011, 206 S. Wabash Avenue, Chicago, Ill. (American Commerce Bldg.)

flowing between the anode and cathode may be controlled. This controlling member is usually in the form of a fine wire mesh or grid, as Fig. 11 shows.

The illustration, Fig. 11, shows the construction of the pliotron. A glass frame is used on which to wind the fine wire grid. In the figure the filament is mounted in the center of a glass rod frame, on which the fine grid wire is wound by means of a lathe; the grid often consisting of tungsten wires as small as .01 mm., spaced as close as 100 turns to the centimeter. The operating characteristics of the "pliotron" depend upon the length of filament used, the distance between filament and grid, the spacing between grid wires, the diameter of the grid wires, the distance between grid and anode, and the size and shape of the anode. A circuit for using the "pliotron" as an amplifier is given in Fig. 11, in which case the high frequency currents received from the grid may be amplified one hundred to six hundred-fold. Here it is the radio and not the audio frequency that is amplified; thus the detector circuit can be tuned to the same frequency as the amplifier circuit, with marked advantages in the matter of selectivity.

The "Alexanderson" magnetic amplifier. Referring to the accompanying diagrams, Fig. 12, we have two magnetic windings, A and B, related to one another magnetically and grouped on a laminated core structure in the peculiar fashion shown, there being a slot left in the central leg of the iron core. It is apparent that there can be no direct transformation of energy from one winding to the other for the reason that each turn in the exciting winding B, includes both the positive and the negative branches of the flux produced by the alternating current winding A, which is connected in series (or parallel) with the high frequency alternator or other source of oscillating current. Hence there is no voltage induced in the winding B. However, the current in either of the windings A or B influences the permeability of the common iron core, and therefore changes the inductance value of the other winding. Should the current flow in either winding be sufficient to saturate the iron core, it is therefore rendered practically non-magnetic and the inductance of the second winding is reduced to the value it would have, if the coil included only air. When, however, a current flows in the other winding which gives a magneto-motive force equal and opposite to the first, the iron core is rendered magnetic again. As the two divisions of the A winding are wound relatively opposite to the B winding, the one branch will oppose the ampere turns of B on one-half cycle and the other branch during the successive one-half cycle.

The opposing ampere turns must be at least equal to the ampere turns in the winding B in order to have any flux variation in winding A.

The relations of currents in these windings is substantially the same as between the primary and secondary current in a transformer, altho in this case one is an alternating and the other a direct current, or a current of a different frequenecy. It is thus obvious how the current flow in winding A can be regulated in proportion to the controlling current in winding B.

Short-circuited condensers are connected to each of the radio frequency coils. A shunt condenser, C_4, across both coils and their short-circuiting condensers, C_2 and C_3, increase the sensitiveness. Another condenser, C_1, inserted in series with the entire amplifier is employed to obtain linear proportionality of amplification and increased sensitiveness. The ratio of amplification is found to be proportional to the ratio of

the frequency of the radio current to that of the controlling current. For telephone control the amplification ratio varies from 100 to 1 up to 350 to 1. It has been successfully used to control the out-put of a 75 kilowatt radio frequency alternator. With this amplifier it has been possible to effect a variation in the antenna energy from 5.8 to 42.7 kilowatts with a variation of control current of but 0.2 ampere. Think of effecting such a control—namely 37 kilowatts variation—by means of a telephone transmitter.

This covers the important types of radio amplifiers. Radio investigators and experimenters generally will, however, undoubtedly find of interest the following articles which have appeared in this journal. If you cannot obtain a copy of the desired issues from the publishers you can see them at your local library in most cases.

Comprest air amplifier applied to phonograph. Oct., 1915, issue.

Vibrating Reed Amplifier. By Samuel Cohen. Dec., 1915, issue.

Amplifying telephone receivers, Baldwin patent. Jan., 1916, issue.

Radium intensifies radio signals. Oct., 1916.

A new Magnetic Radio Relay—How to build one. It closes a local circuit for tape recorder or other apparatus. By Henri Mea. March, 1914, issue. page 162. (Note:—The magnet coil dimensions given are in error; instead of one ounce each magnet coil contains 11 ounces of No. 36 B. & S. gage enameled copper magnet wire, giving a resistance of 7,650 ohms for the two spools in series.)

Selenium, Relay. See present number of ELECTRICAL EXPERIMENTER, page 471.

Audion Amplifier Action—Exhaustive discussion of electronic movements, etc. Most complete article on this phase of the vacuum valve available. August, 1916, issue.

U. S. Navy Amplifone. See July, 1915, issue.

THE PHENOMENA OF ELECTRICAL CONDUCTION IN GASES.

(*Continued from page* 466)

graphic paths it can be seen that they have encountered no force strong enough nor any mass great enough to turn them aside in their passage thru many thousand molecules until the particle had slowed down a great deal. Another interesting point is evident here in the fact which can be obtained from the photographic path that the slower the ion is traveling the more ions it will produce, and the faster it travels the more likely it is to pass completely thru a molecule without hitting anything. The way in which an electron may pass thru a molecule has been illustrated in a previous paper by the way in which a pebble may be thrown thru the circle described by a rapidly revolving ball on a string without either touching the ball or the string. Similarly two molecules consisting, as in Fig. 5, of electrons rotating about nuclei, may pass thru each other without either of the two nuclei or the two electrons colliding, and the faster they are moving in the directions of the arrows the less likely it is that the rotating particles will collide.

The fact that the paths of the ions in Fig. 4 is quite different from the others shows that ionization may be of several different kinds, and in no way is this shown and explained more than by these photographic paths. This brings up the question as to just what the mechanism of ionization is. There is little doubt but that the beta particle produces ions in passing through molecules of air by *ejecting* an electron from each molecule, either by *collision* or by the *force of its field.* As the electron remains inert along the path of the ionizing particle it seems to have been suddenly loosed rather than forcibly ejected as by collision. The action of the

(*Continued on Page* 515)

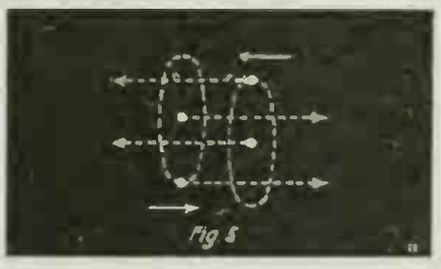
THE PHENOMENA OF ELECTRICAL CONDUCTION IN GASES.

(*Continued from page* 513)

alpha particle is quite similar, and it also seems that an electron is loosed from each molecule thru which the alpha particle travels, and in some cases several may be loosed, which might be expected from the greater size of the alpha particle.

In the case of short ether waves, say X-rays, the electrons seemed to be very forcibly ejected, for they branch off from the main path and every branch indicates the point where a collision took place and a new ion was produced. Hence the path of a ray of X-rays thru air is an intricate network. Just why ether waves produce this violent ejection in contrast to the passive ionization left in the path of alpha or beta particles remains a mystery.

In connection with the older molecular theory molecules were considered to be perfectly elastic so that on colliding with each other they bounced back with exactly as much energy as before. This assumption was necessary because if it were not true the molecules of any gas would slowly lose their energy and would fall to the bottom of their containing vessel as inert particles. In other words at each collision energy would be lost and the pressure would gradually decrease to zero. If we investigate the conditions of collisions it is apparent that reflections do



Showing How Two Molecules, Consisting of Electrons Rotating About Nuclei, May Pass Thru Each Other Without Either of the Two Nuclei or the Two Electrons Colliding, The Faster They Move the Less Chance of Collision of the Rotating Particles.

not always occur. The molecules might pass thru each other under proper conditions, or they might meet each other so that all the energy of one is used up in producing ionization and that one becomes inert, or they might be reflected. If they are reflected it may be from one or both of two causes:—The electric fields of the particles within the atom may oppose and repel each other, or some impenetrable centers more solid and material than electricity, if there be such, may collide and rebound. The fact bears repeating that an alpha particle may pass thru half a million molecules before experiencing such a force or such a material center. The faster the molecule travels of course the more chance it has of going completely thru another molecule. Ordinary gas molecules move at such relatively low speeds that practically all collisions produce *reflection*. The fact that the collision seems perfectly elastic is still difficult to explain unless as explained above, the reflection is due to the *repulsion of electric fields;* then the only loss of energy would be due to the *ether* and the ether is considered *frictionless*.

The field of the ionization of gases is one of the most promising in all science. In these papers the most important phenomena have been considered relative to electricity in gases and besides adding to our practical scientific knowledge and intellectual resources the light which it throws on the real electrical nature of matter and electricity is invaluable.

(*Conclusion.*)

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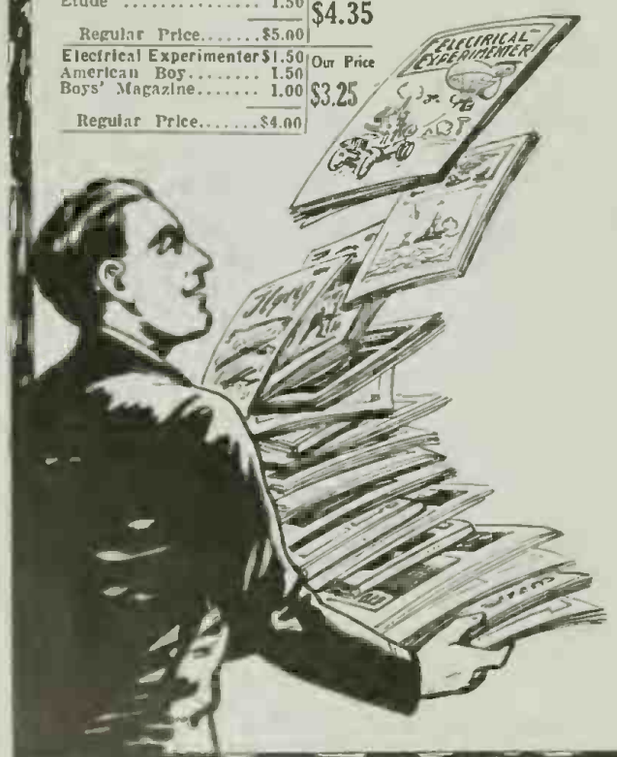

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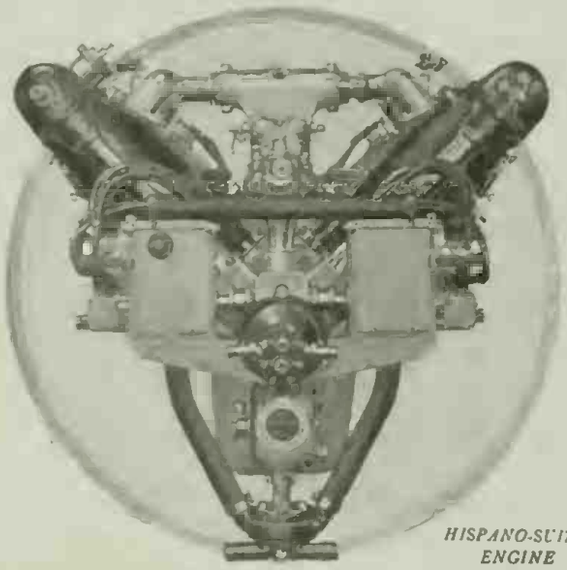

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