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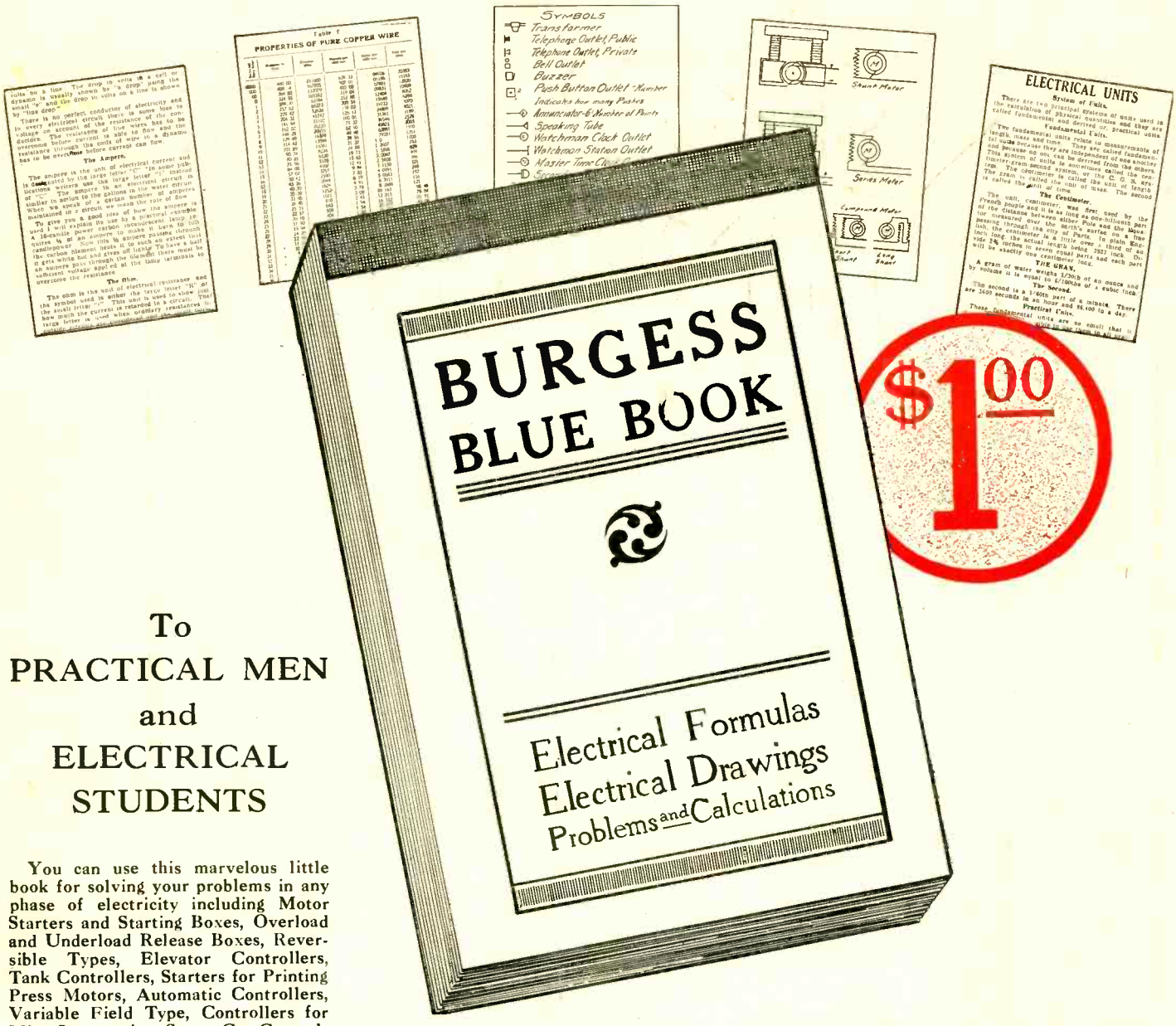

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Vol. XIV.
Whole No. 158

Science and Invention

FORMERLY
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June, 1926
No. 2

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IN OUR NEXT ISSUE

Lights Change Stage Settings!

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Contents for June

HOW TO SUBSCRIBE FOR "SCIENCE AND INVENTION." Send your name, address and remittance to Experimenter Publishing Co., 53 Park Place, New York City. Checks and money orders should be made payable to Experimenter Publishing Co., Inc. Mention the name of the magazine you are ordering inasmuch as we also publish RADIO NEWS, RADIO INTERNACIONAL, RADIO REVIEW and AMAZING STORIES. Subscriptions may be made in combination with the other publications just mentioned at special reduced club rates. Send postal for club rate card. Subscriptions start with the current issue unless otherwise ordered.
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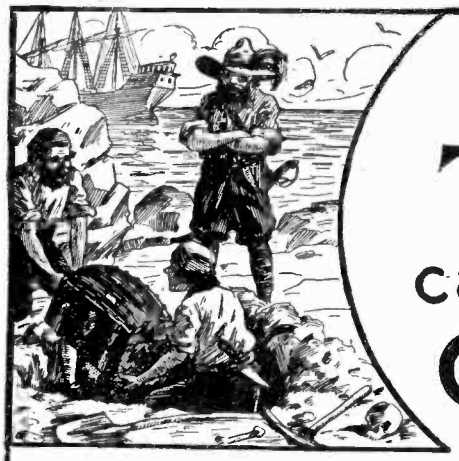

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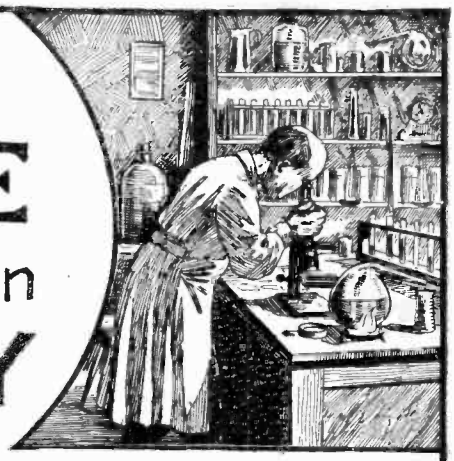


Good Chemists Command High Salaries

and you can make yourself independent for life by unearthing one of chemistry's yet undiscovered secrets.

T. O'CONOR SLOANE, A.B., A.M., LL.D., Ph.D.
Noted Instructor, Lecturer and Author. Formerly Treasurer American Chemical Society and a practical chemist with many well known achievements to his credit. Not only has Dr. Sloane taught chemistry for years but he was for many years engaged in commercial chemistry work.

Do you remember how the tales of pirate gold used to fire your imagination and make you want to sail the uncharted seas in search of treasure and adventure? And then you would regret that such things were no longer done. But that is a mistake. They *are* done—today and everyday—not on desert islands, but in the chemical laboratories throughout your own country. Quietly, systematically, the chemist works. His work is difficult, but more adventurous than the blood-curdling deeds of the Spanish Main. Instead of meeting an early and violent death on some forgotten shore, he gathers wealth and honor through his invaluable contributions to humanity. Alfred Nobel, the Swedish chemist who invented dynamite, made so many millions that the income alone from his bequests provides five $40,000 prizes every year for the advancement of science and peace. C. M. Hall, the chemist who discovered how to manufacture aluminum made millions through this discovery. F. G. Cottrell, who devised a valuable process for recovering the waste from flue gases, James Gayley, who showed how to save enormous losses in steel manufacture, L. H. Baekeland, who invented Bakelite—these are only a few of the men to whom fortunes have come through their chemical achievements.

What Some of Our Students Say of This Course:

I have not written since I received the big set. I can still say that it far exceeded my anticipations. Since I have been studying with your school I have been appointed chemist for the Scranton Coal Co. testing all the coal and ash by proximate analysis. The lessons are helping me wonderfully, and the interesting way in which they are written makes me wait patiently for each lesson.—MORLAIS COUZENS.

I wish to express my appreciation of your prompt reply to my letter and to the recommendation to the General Electric Co. I intend to start the student engineering course at the works. This is somewhat along electrical lines, but the fact that I had a recommendation from a reliable school no doubt had considerable influence in helping me to secure the job.—H. VAN BENTHUYSEN.

So far I've been more than pleased with your course and am still doing nicely. I hope to be your honor graduate this year.—J. M. NORKUS, JR.

I find your course excellent and your instruction, truthfully, the clearest and best assembled I have ever taken, and yours is the fifth one I've studied.—JAMES J. KELLY.

From the time I was having Chemistry it has never been thus explained to me as it is now. I am recommending you highly to my friends, and urging them to become members of such an organization.—CHARLES BENJAMIN.

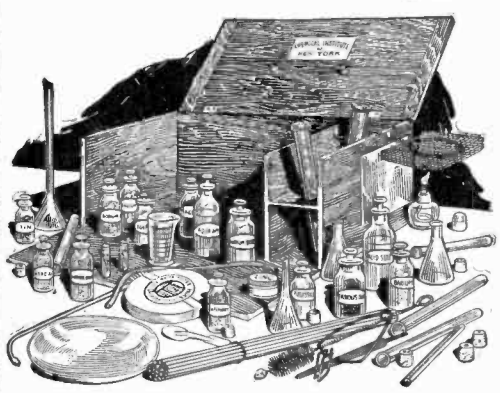
I shall always recommend your school to my friends and let them know how simple your lessons are.—C. J. AMDAHL.

I am more than pleased. You dig right in from the start. I am going to get somewhere with this course. I am so glad that I found you.—A. A. CAMERON.

I use your lessons constantly as I find it more thorough than most text books I can secure.—WM. H. TIBBS.

Thanking you for your lessons, which I find not only clear and concise, but wonderfully interesting. I am—ROBT. H. TRAYLOR.

I received employment in the Consolidated Gas. Co. I appreciate very much the good service of the school when a recommendation was asked for.—JOS. DECKER.



Now Is the Time to Study Chemistry

Not only are there boundless opportunities for amassing wealth in Chemistry, but the profession affords congenial employment at good salaries to hundreds of thousands who merely follow out its present applications. These applications are innumerable, touching intimately every business and every product in the world. The work of the chemist can hardly be called work at all. It is the keenest and most enjoyable kind of pleasure. The days in a chemical laboratory are filled with thrilling and delightful experimentation, with the alluring prospect of a discovery that may spell Fortune always at hand to spur your enthusiasm.

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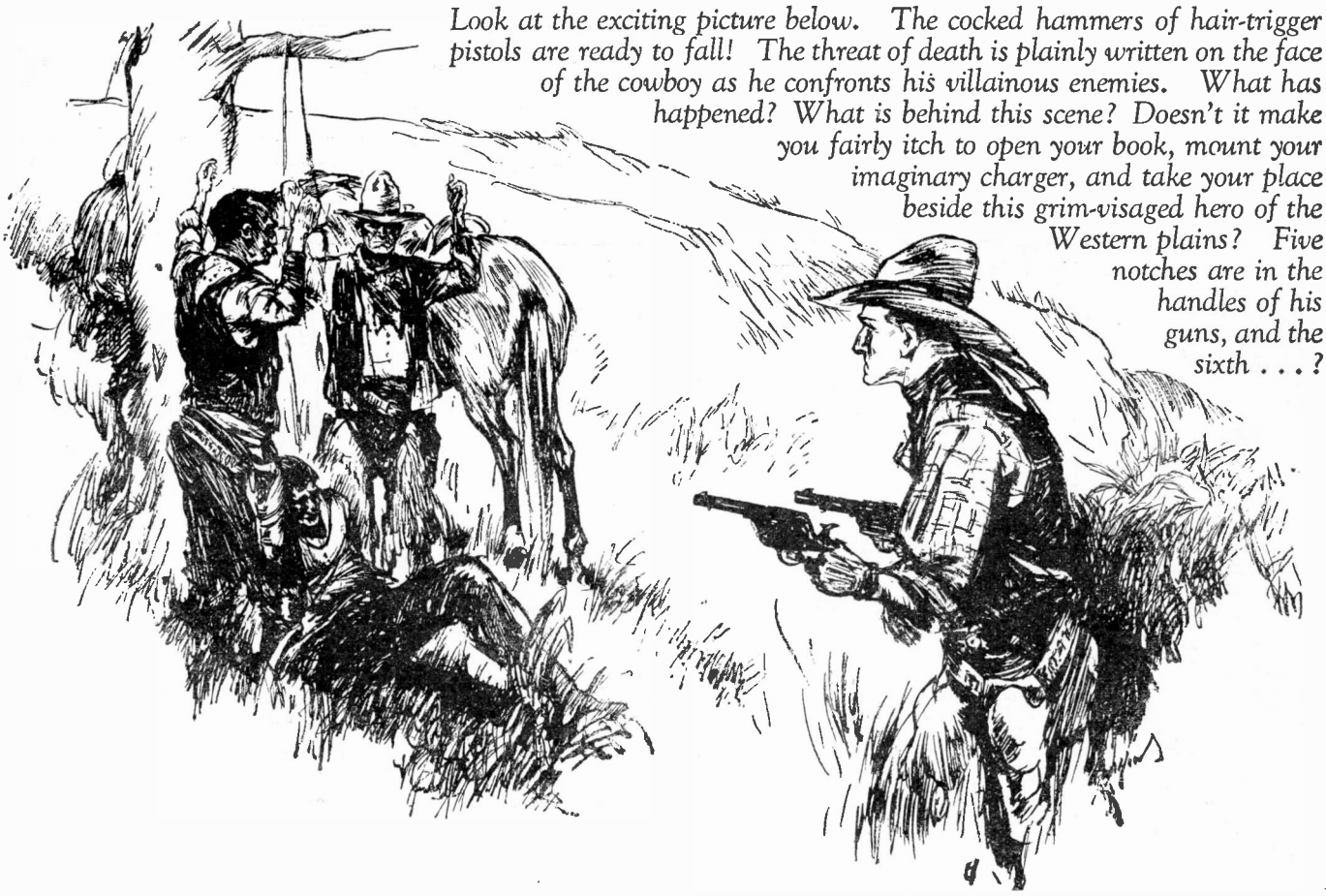

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Whole No. 158

Science and Invention

June, 1926
No. 2

HUGO GERNSBACK, F.R.S., *Editor-in-Chief*
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DR. T. O'CONOR, SLOANE, Ph.D., LL.D., *Associate Editor*
Editorial and General Offices, - - - 53 Park Place, New York

"Those Who Refuse to Go Beyond Fact Rarely Get As Far As Fact" - - - HUXLEY

WHAT AM I FITTED FOR?

By HUGO GERNSBACK, F. R. S.

ONE of our readers in Los Angeles, Mr. Francis Bingham, asks us, "How can a young man find himself, or discover his natural ability? Is there any scientific method of judging a man's vocational abilities? I am a young man starting out in life, and you know that one of the most important things in a man's life is the road he takes. The world is full of misfits. There are thousands of young men all over the country just like me, who need general and helpful advice on the subject. What are your thoughts in the matter?"

The question is not a difficult one to answer, but although a ton of advice can be given, it is doubtful whether it will or can always be taken. Under our complex method of living it is not always possible for a young man to take the road he likes best, as economical conditions often prevent him from doing what he likes best.

Parental influence is very often the most important factor in deciding a career. Father may have a store and it is natural for him to desire that his son should follow in his footsteps. So, early in life, the son often is trained for the vocation, and not knowing better, or perhaps not having a choice in the matter, he sooner or later becomes a storekeeper like his father. In Europe, and particularly in France, this sort of thing is very much more the vogue than in this country. In France it is not unusual to find the great-grandson in the same business as his great-grandfather, all descendants having followed in the footsteps of their fathers.

It may be reasoned that in such a case a high standard is set, as the experience gained from generation to generation certainly must be worth something, particularly in the fine arts; but it does not always follow that this must be so. Most of our self-made men in this country, Edison, Ford, and many others did not follow parental experience, and most of the self-made men of this type, have made huge successes. How can the two be rhymed together? The answer here is simple. A man can always be taught to do a certain thing, and whether that man is the son of another man in the same business makes very little difference. The question is, "Could not the son be much better at something else?" And here the answer is "Yes."

As a matter of fact, in most cases investigated, it is found that if the young man is allowed to follow his own inclination, the chances are that he will be vastly more successful than if he takes up something in which he is not primarily interested, but does so only from a sense of duty.

The world today is full of misfits and we find them in all walks of life. We find a famous lawyer whose hobby is model building. In this case he became a famous lawyer in spite of the handicap but the chances are that in some mechanical line he would have fared much better and moreover it can also be demonstrated that the outstanding successes of our country are those men who followed their own inclinations, their own hobbies, and did what they were best fitted for.

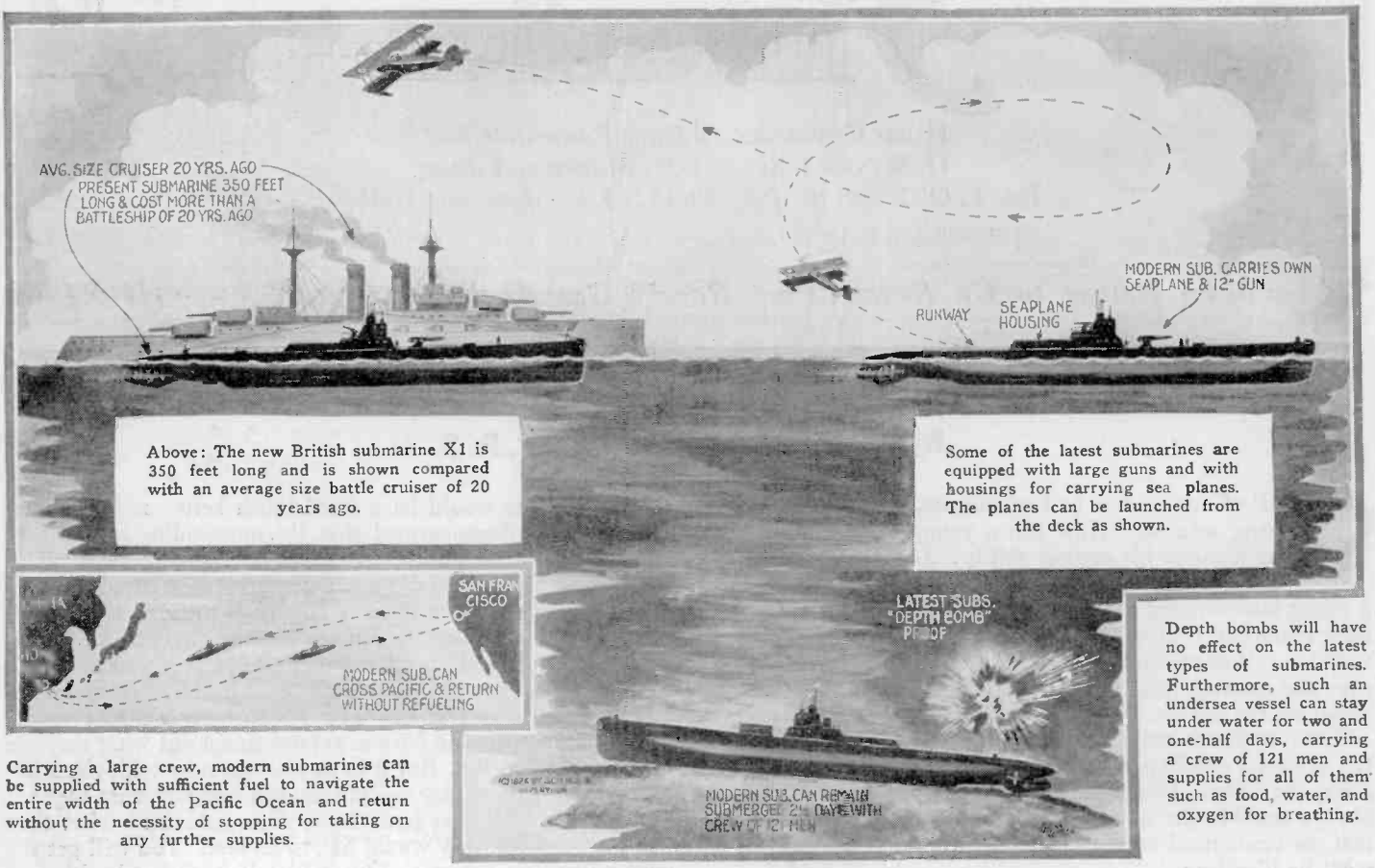
In talking to young men, it has often puzzled me to find that they do not seem to have a definite inclination, and it does not seem to make much difference to them if they are asked to study for law, to go into the wholesale business, or to become interested in some factory. The reason here is that they are still too immature, and have as yet not found out what they are really best fitted for. But it is surprising, even with these immature young men, how quickly you can find out what they are adapted for. All that is necessary is to ask them what they like best, or what they would like to do best. You will get the most surprising answers. One will tell you that he likes to write stories, the next one has a flair for toy airplanes. Another one has a hankering to take machinery apart and put it together again. Still another one wants to roam the seas, and so on. From such answers the careful vocational expert, and even a father with intelligence, should have little trouble in finding out what the subject is best fitted for.

The simple question asked of a young man, "What would you like to do best?", will probably bring out a hidden clue that will show the father how the wind blows. I personally believe that a young man, when he reaches the age of 16, in many cases, should know in his own mind what he is best fitted for. And no matter how strange the liking the young man may have, he should by all means be allowed to follow his real calling, because there is nothing more tragic and more useless than fitting a young man into a position which he detests. Under such conditions it will never be quite possible for him to give his best, and in most cases he will make a failure of it, only to turn to his real calling sooner or later. In such cases, I am sorry to say, it is usually too late, as the man has often advanced so much in age that he can not fit himself into new conditions as readily as he could when he was twenty-one.

There are, as a rule, roughly speaking, two classes of boys or youths, the one class being the studious, (mental) type, the other the manual, (mechanical) type, that is, the type that loves to fashion things by hand. The studious-mental type, as a rule, develops into the business (clerical) type, the lawyer, or professional, whereas the other type is usually best fitted for mechanical, electrical, and machinery work. There are, of course, exceptions to all of these. The mental type may sometimes revert to the other type, and *vice versa*, but it would in all cases perhaps be best to let each type follow its own inclinations, without curbing it too much. "Follow your calling."

Mr. Hugo Gernsback speaks every Monday at 9 P. M. from Station WRNY on various scientific and radio subjects.

New Submarine Has Startling Features



Above: The new British submarine X1 is 350 feet long and is shown compared with an average size battle cruiser of 20 years ago.

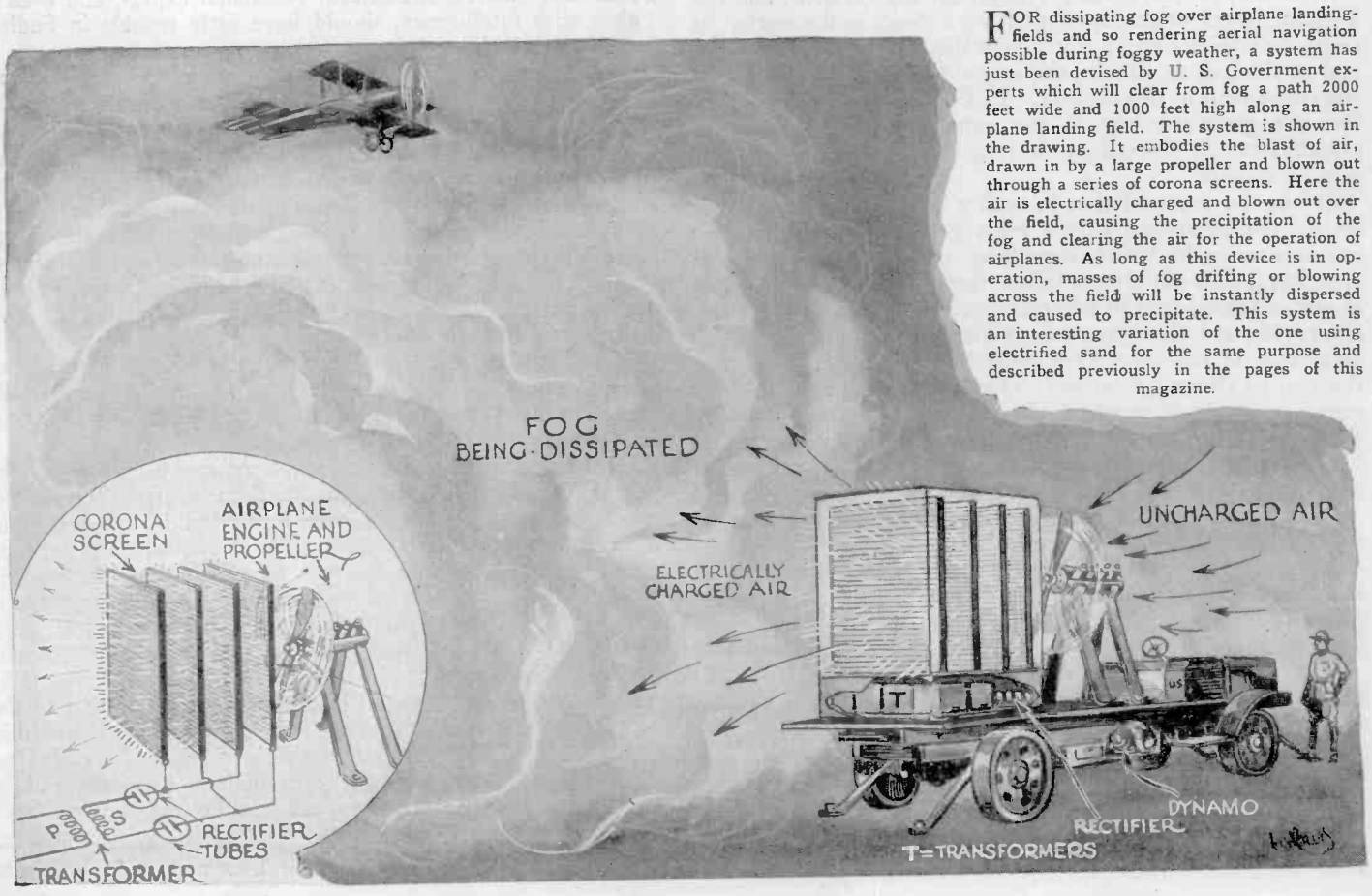
Some of the latest submarines are equipped with large guns and with housings for carrying sea planes. The planes can be launched from the deck as shown.

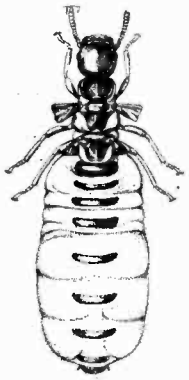
Carrying a large crew, modern submarines can be supplied with sufficient fuel to navigate the entire width of the Pacific Ocean and return without the necessity of stopping for taking on any further supplies.

Depth bombs will have no effect on the latest types of submarines. Furthermore, such an undersea vessel can stay under water for two and one-half days, carrying a crew of 121 men and supplies for all of them such as food, water, and oxygen for breathing.

Electrified Air Disperses Fog

FOR dissipating fog over airplane landing-fields and so rendering aerial navigation possible during foggy weather, a system has just been devised by U. S. Government experts which will clear from fog a path 2000 feet wide and 1000 feet high along an airplane landing field. The system is shown in the drawing. It embodies the blast of air, drawn in by a large propeller and blown out through a series of corona screens. Here the air is electrically charged and blown out over the field, causing the precipitation of the fog and clearing the air for the operation of airplanes. As long as this device is in operation, masses of fog drifting or blowing across the field will be instantly dispersed and caused to precipitate. This system is an interesting variation of the one using electrified sand for the same purpose and described previously in the pages of this magazine.



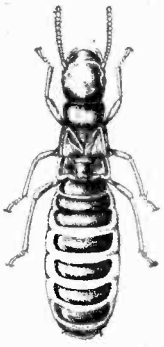


White Ants Destroy Buildings

By HELEN HOFFMAN

Scientific men of all other countries have failed to combat the white ant, but the U. S. Government hopes to do so by present plans, Part of this nation-wide program includes the erection of an ant-proof building in the Panama Canal Zone

Left: Showing the appearance of a white ant.



Right: Another view of this destructive insect.

UNDER the direction of T. E. Snyder, an authority on the subject of the termite, the name applied by biologists to the *white ant*, the government is erecting, at Ancon, in the Canal Zone, what it hopes may prove to be an ant-proof building. This is intended to serve as a model of construction to the unhappy Panamanians. Unable to cope with the pest, residents of the Panama Canal Zone, who have suffered damage to home and other property, have appealed to the government.

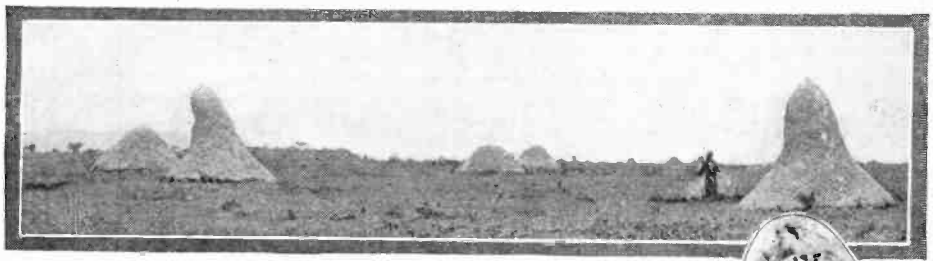
In the erection of this building the Bureau of Entomology has taken into consideration the well known habits and appetites of this wood eating insect. It believes the only effective permanent preventive remedy lies in proper building construction, and the tested specific that is most certain to eliminate them. This specific is "insulation" of all untreated woodwork from contact with the ground; it can be accomplished by the use of stone or concrete for foundations and for the lower flooring or the use of foundation timbers impregnated with coal-tar creosote. It points out to the afflicted ones that "practically all the termites which damage buildings in the United States are of subterranean habit; "if they can be kept from reaching woodwork from the ground they cannot survive in the building. Also, if present in a building, after all untreated wood, such as joists, wooden floors, sills, etc., has been removed from contact with the ground, they will die out, *i.e.*, dry up, even if the termites have penetrated to the height of several stories in the building. They have been cut off from their moisture supply in the ground which is necessary for their life.

The general belief that the termite is a product and habitant of the tropics scientists say is untrue. Proof that they infest the states to a great extent is shown by the records of the Bureau of Agriculture. For example, complaints of their destructive work in almost every state in the Union have come to the attention of the Bureau.

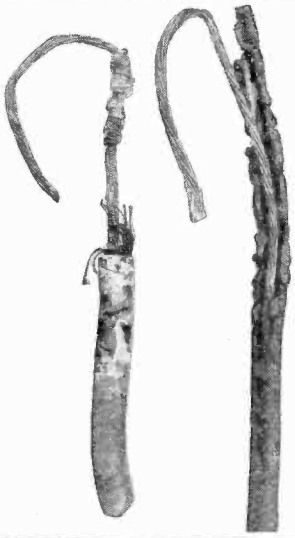
A year ago more than eighty complaints were received from the city of Burlington, Iowa. Complaints of destruction to crops and homes continue to register from many Southern districts and even as far north as the New England states.

In Washington recently the attention of the Bureau was called to the discovery of the white ant's work, practically at its own doorstep. If there is anything the termite enjoys more than wood it is paper. An army

(*Continued on page* 166)

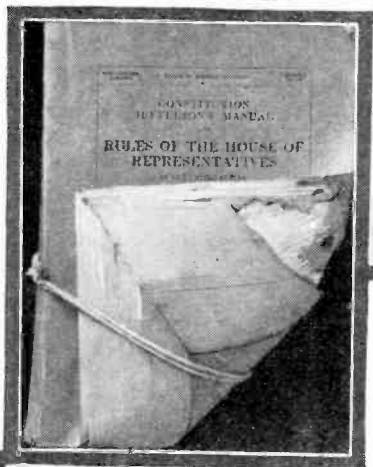


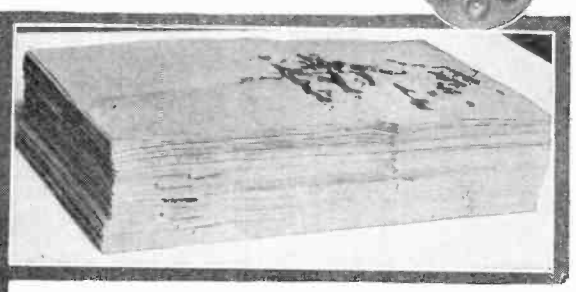
Above: This illustration shows the tremendous size that termite mound nests often reach. Sometimes a whole prairie is dotted with the homes of these pests. They often reach a height of 15 to 18 feet. Note the relative height of the man in the above illustration.



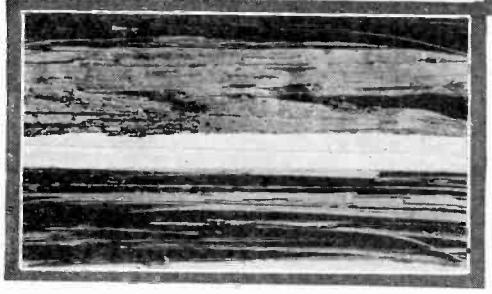
Left: Two views of lead sheathed and rubber insulated cables that have been stripped of their coverings by termites. These are examples of the destructive work of these little creatures such as is so often in evidence. These cables were located in the Panama Canal Zone.

Right: The sole of a new shoe has been attacked by white ants or termites and the resulting destruction of the leather is graphically shown. The insects have succeeded in boring numerous holes directly through the material and have completely ruined it for its proper purpose.

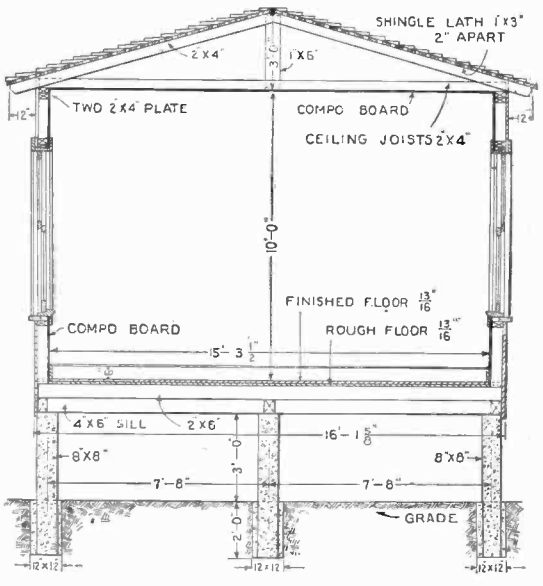




Improper flooring allowed the entrance of termites to some of the government buildings in Washington, D. C., and the result was many destroyed pamphlets and documents as shown in the two photos above.

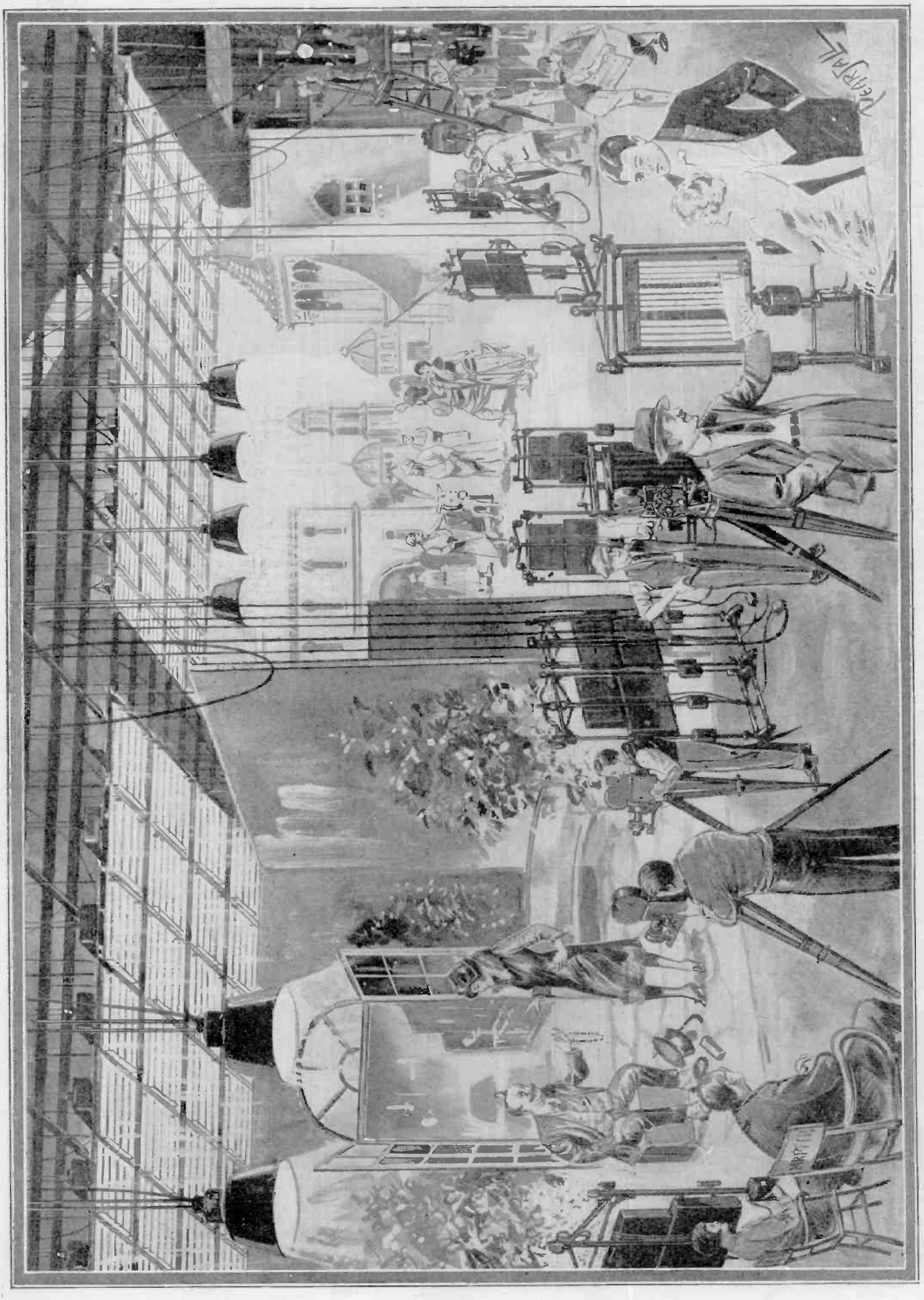


Left: An example of a piece of wood that was completely destroyed by the action of white ants.



Right: Government specifications that have been evolved for the construction of buildings in termite infested territory. Note the concrete foundations which raise all wooden parts from contact with the ground. To protect timbers from termites, coal tar creosote is most effective.

The Interior of a Motion Picture Studio



Although seeming chaos reigns in the interior of a movie studio, still everything goes forward in the speediest possible manner. Our illustration here shows two large settings, one of which, when shown on the screen, will appear to have been taken out of doors. Note the multitude of lights, some hanging from the ceiling, some standing on movable pedestals at convenient points. They are all necessary for the effects.

A Visit to a Movie Studio

By A. P. PECK and M. ESSMAN

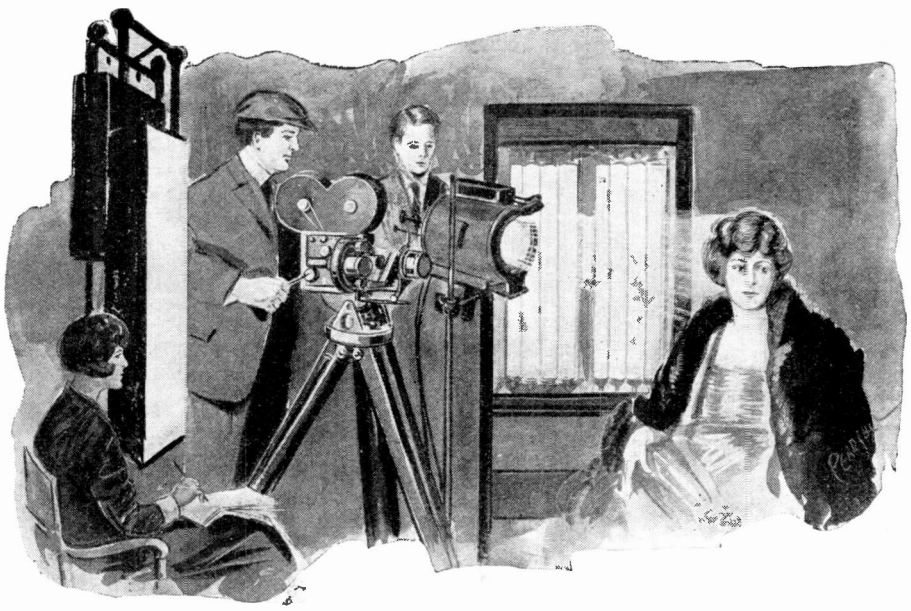
Some of the Mysteries of Moviedom Which Make Great Pictures Possible Are Brought to Light in This Article

IN the past few years we have published a good many articles in this magazine dealing with various phases of trick motion-picture photography and hundreds of our readers have written us expressing their appreciation of these articles. Furthermore, they have asked queries regarding various phases of motion-picture work and in response to these, we recently made a personal visit to the studios of Famous Players-Lasky at Long Island City. Reaching there we were welcomed and shown through the great studios occupied by the Eastern branch of this large producing company. There were a good many interesting things to see there and there were some sets erected that showed graphically how it was possible to take scenes, which on the screen appear to have been taken out of doors in the great "wide open spaces."

The first thing that caught our attention even before we entered the building was a crew of cameramen, directors and assistants grouped around the outside of one of the studio buildings. Naturally we lingered a while to see what was going on. The taxi in which we arrived was brusquely ordered away as it was in the way of the scene that was just about to be taken. Standing in the offing, we watched the cameramen focus on one of the studio doors. Then up the street came a lumbering ice wagon. Driving the horse was someone who seemed to be vaguely familiar but whose plebian clothes for a few minutes concealed his identity. The "iceman" turned out to be none other than Richard Dix. Driving up to the main entrance of the studio, with the cameras industriously grinding away, he jumped from the driver's seat, ran around to the back of the wagon, clamped a piece of ice securely in the tongs and toted it off on his back. Returning to the wagon, he was met by another man, well dressed and with an air of prosperity. A short discussion followed and then the action stopped. All this time the cameras had been working. Also, even though the day was comparatively bright, there were two great electric spotlights directed on the scene so as to assist old Sol in his work. This just gives an example of how scenes are taken at places where you would least expect to find a part of a motion picture being filmed.

We then proceeded into the studio, met one of the publicity directors, who, by the way, is a very charming young lady, and were conducted to the upper stage. Here everything seemed to be in a confusion. Electricians were running to and fro carrying rolls of cables and pushing spotlights equipped with roller bases. Off in one corner was a complete theatre-setting incorporating a full sized stage with its various drops and footlights. A little further on was a street scene complete to the very minutest detail. Show windows and plate glass were there, decorated in the usual manner and even the window spaces were trimmed just the same as you might see them in any store on the street. This entire scene at the time of our arrival was completely illuminated with a radiance equal to that of a bright, sunshiny day. This light was furnished by a series of mercury arcs and carbon arc spotlights that were judiciously placed so as to avoid any glare and reflection.

Off on another side of the studio was what appeared to be half of the library of a millionaire's home. Luxurious draperies covered one of the walls and the others were lined with huge bookcases filled with rare volumes. Directly in back of this library and reached, oddly enough, by passing through the library door was the setting of a tiny restaurant of the lower class equipped with bare wooden tables and a bar. Further back on this same stage, the floor space being several hundred feet long, was a setting for an outdoor scene. Rocks and trees were there and every one of them looked just as real as could possibly be. Closer investigation disclosed that the rocks were made of painted canvas and that the trees were artificial. Still when you see this scene in the movies you will swear that the film was taken in the outdoors with nature as a background.



Above: Taking a close-up "shot" in the studio, using tubular mercury arc lights for general illumination and an electric spotlight for bringing out the features of the actress in sharp detail. Note the scene-clerk in the left foreground. Her work is most important and is mentioned in the accompanying text.

All of this goes to show just what a variety of scenes can be laid in one comparatively small studio. Another feature of the upper stage was the so-called gridiron which comprises a sort of sub-ceiling. This is a network of iron bars from which lights can be hung on their cords and moved from place to place, according to the position in which it is desired to locate them.

Just as we were leaving the upper stage, we noticed a peculiar sort of carriage arrangement equipped with large rubber tires. It was a platform about 6 feet square. Asking what this was for we were informed that it was the platform that made it possible for the camera to follow a person when walking. The camera is to be placed on the platform and focused upon the person who is in action. Then, as the person moves around, this small platform can be made to follow him and keep the camera at the same distance at all times.

We then were conducted to what is known as the lower stage, more or less a duplicate of the upper one and upon which there were still more large sets. One of them in particular attracted our attention. It was another outdoor scene made up of painted canvas and artificial trees but it did not seem to be complete. However, further investigation showed that this scene was to be filmed from a distance of about 60 feet and interposed between the camera and the large set was a miniature set that was so perfectly constructed and so accurately aligned with the large set that when the camera took the picture, the miniature would blend into the large scene and give the appearance of a complete setting. By doing this, the expense of constructing a complete large scene is avoided as the miniature is very much easier to make and complete quickly and at less expense than if the entire large scene were to be built.

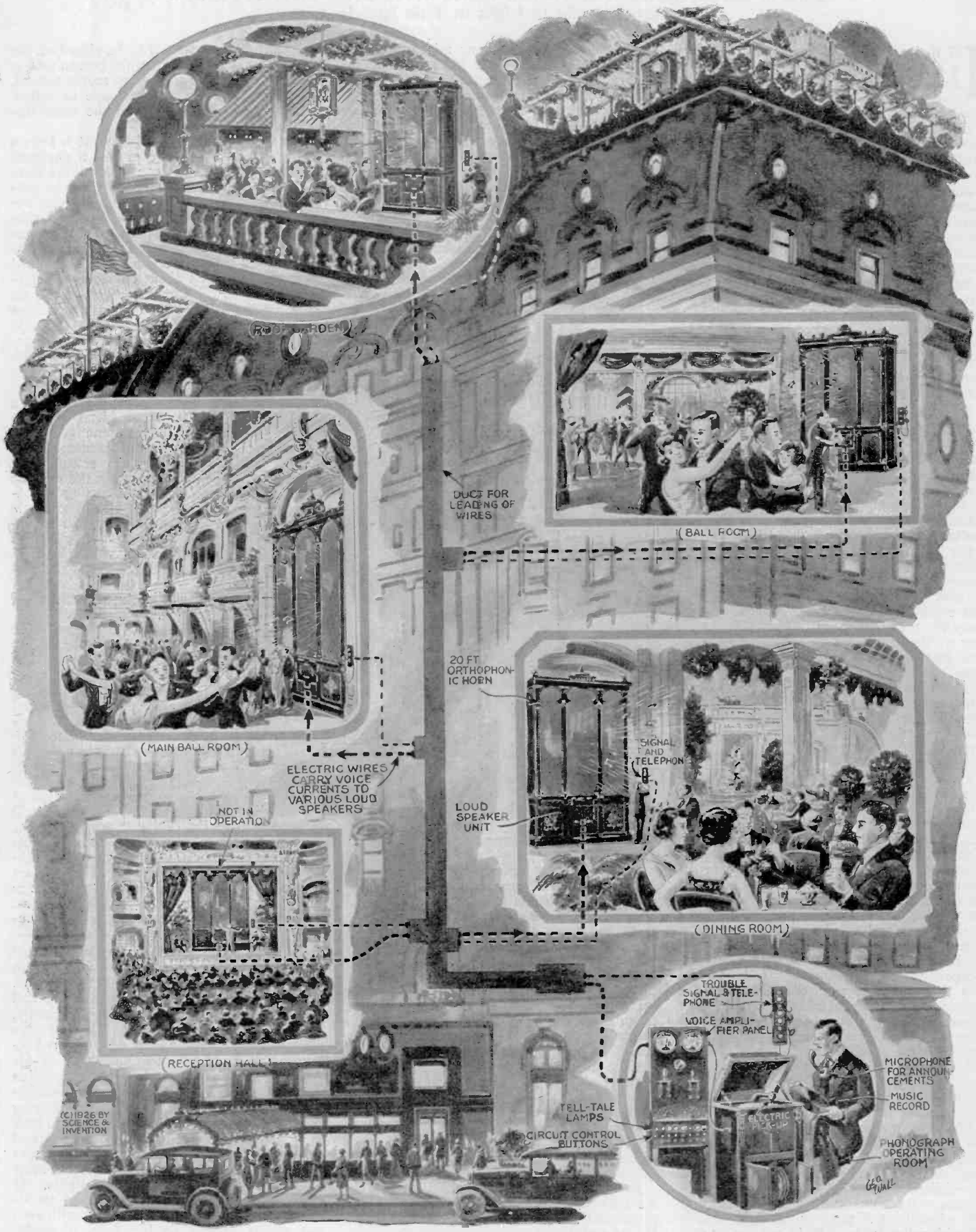
If anything, the lower stage seemed to be more cluttered up with "props" and other paraphernalia than the upper stage. "Props" is the word that is used to designate various standard materials that can be used in different scenes. Included among the props of any movie studio are hundreds of household articles such as chairs and tables of various sizes and descriptions, vases, electric lighting fixtures, artificial flowers, curtains, draperies, and other like materials. The business of taking care of these props is a science in itself and the property man is a busy one, particularly when several sets are being constructed at the same time.

Over in one corner of the lower stage there seemed to be some activity and so naturally we drifted over in that direction. The camera, however, was unattended and there was no director present, so obviously, no action was being "shot." This set was disclosed as the stage door of a cheap burlesque house and sitting around, waiting for the director to return and to start the action were several actors and actresses completely made up. Under the glare of the lighting illustrated, they were almost hideous to look at. Various colored grease paints and powders are used by motion picture actors and actresses in order to offset the color effects obtained by the powerful lights. If a motion picture were to be made of an actress made up in the usual manner with reds and shades of red on her face, it would, if photographed under the lights of a studio, appear most unnatural. These reds would

(*Continued on page* 181)

Possibilities of New Phonograph

(How It Would Appear Installed in Hotel Astor, New York City)



A new electrically operated phonograph that has recently been developed to a practical point can be employed for providing entertainment over vast areas. Our artist's illustration above shows the use of this new phonograph in a hotel for providing entertainment to all of the various ballrooms, dining rooms and reception hall. By means of control-boards located at each of these points, the music furnished by the phonograph at some remote point can be controlled as to volume and also can be shut off or turned on at any time desired. Furthermore, the operator can be instructed from various points.

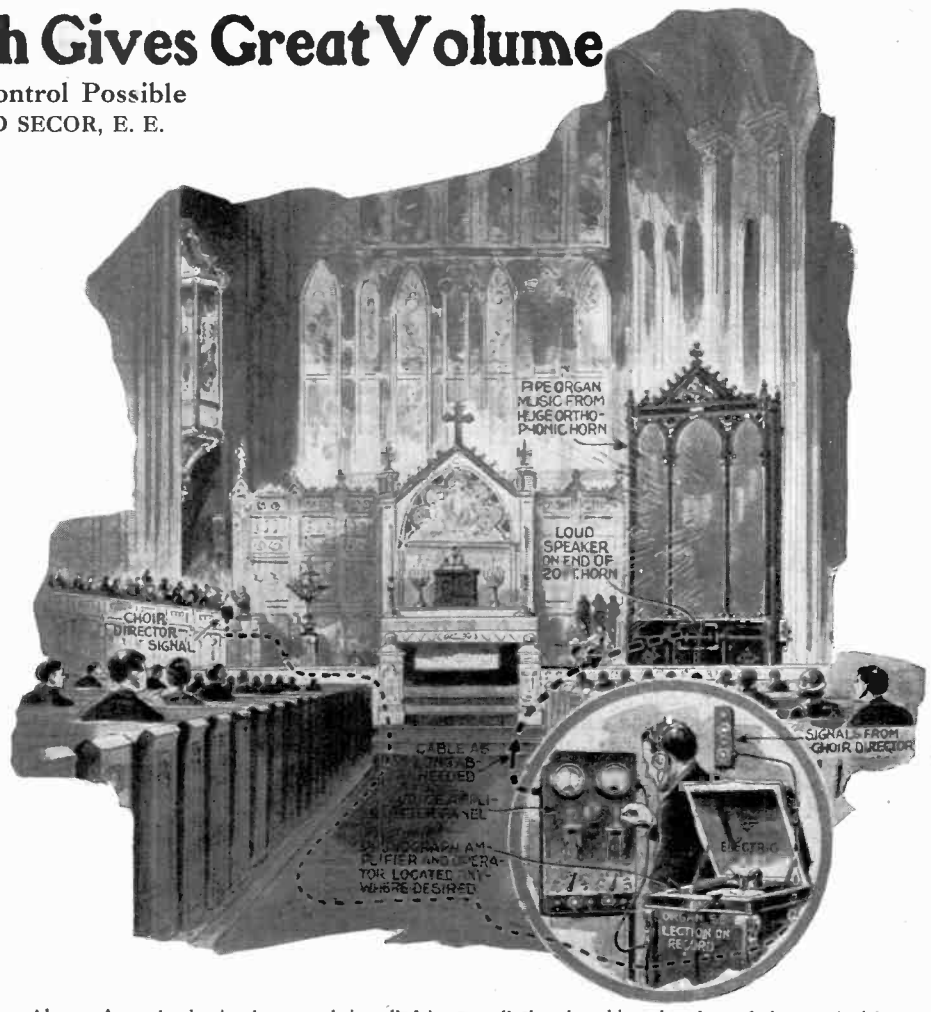
Super-Phonograph Gives Great Volume

Perfect Tone Control Possible

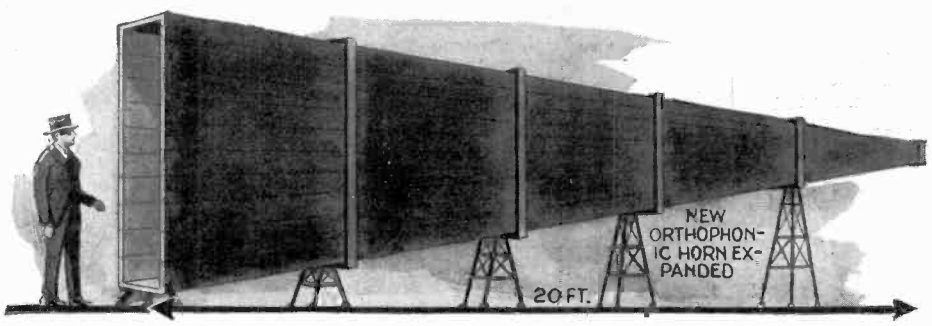
By H. WINFIELD SECOR, E. E.

UP to the present time the great difficulties with phonographs have been the inability of the operator to control the volume properly, the fact that the entire tone range cannot be satisfactorily covered and the lack of adequate volume for use in large auditoriums and other places where the volume of produced sound is desired to be as great as that of the original orchestra or other recording medium. In the new orthophonic phonograph developed by the Bell Laboratories of the American Telegraph and Telephone Co., the Western Electric Co. and the Victor Talking Machine Co., all of these troubles have been overcome.

The new machine uses a horn 242 inches long with an opening 80 inches high and 91 inches wide. It uses standard records of the type with which we are all familiar yet by means of an electrical pick-up, the sounds can be amplified to any desired degree so that the volume and quality of orchestral tones can be faithfully reproduced. The frequency range has been greatly increased with this new type of talking machine. With the former ones, the range was from 250 cycles to 4,000 cycles. All of the drums, the real beauty of the bass notes of practically all instruments and the true quality of the lower register of the bass voice, being in the region below 250 cycles were entirely lost in the early type of machine. At the other end of the scale, the high notes suffered due to distortion and blasting and often were lost. Although authorities vary somewhat, it is safe to say, that about the lowest note which the human voice is capable of producing is one of 64 cycles. The tuba produces a 40-cycle note, while the pipe organ goes as low as 16, which is little more than an air vibration that is felt rather than heard. With the new orthophonic phonograph, practically all of these low notes can be faithfully reproduced. Furthermore, the highest notes of the piccolo in the neighborhood of 4,600 cycles can be as distinctly heard when reproduced by the orthophonic instrument as if the auditor were listening to the piccolo itself.



Above: An orthophonic phonograph installed in a small church, taking the place of the usual pipe organ and rendering excellent results. Note the signalling system.



If the folded horn used in the new orthophonic phonograph were to be extended, it would assume the size and comparative bulk shown in the illustration at left.

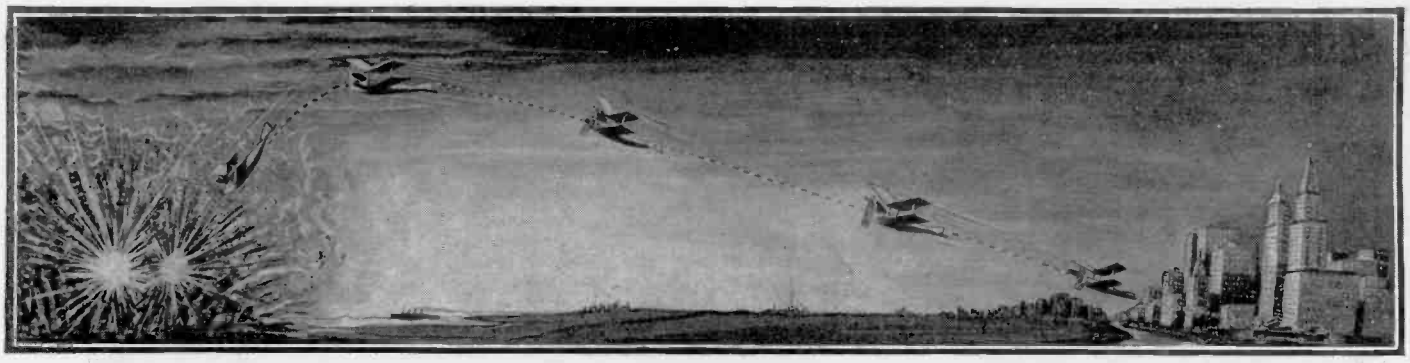
Above: The orthophonic phonograph complete with electrical pick-up and large horn.

In regard to the reproduction of piano music, it may be said that the former talking machine could not reproduce fundamental notes below middle C. However, the human ear has the capacity to "manufacture" the lower notes from such overtones of notes below middle C as were reproduced and it was only this faculty that made former types of talking machines agreeable to listen to.

The new orthophonic talking machine in its present form was only produced after a good many years of research. It has been known for some time that phonograph records have much more engraved upon their surfaces than the old type of reproducing instruments could get out of them. Work was then started on methods for reproducing these heretofore unobtainable sounds and improved pick-up devices, sound boxes and horns were tested and experimented with to a very great extent. The horns were found to have a great effect on tone quality and volume and eventually the horn 242 inches long was decided upon as being the most practical.

A short consideration of the subject will show that this newly developed electrically operated phonograph will have many applications. For instance, as pictured on the opposite page, all of the ballrooms and other points of entertainment of a large hotel could be provided with music at all times from a single phonograph located at some convenient point. Thus, the employment of several orchestras could be done away with and ordinary phonograph records could replace them with just as artistic an effect. Then again, the pipe organ of a church could be replaced by one of the new electric phonographs with its accompanying control board and enormous loud speaker horn. The ability of the instrument to reproduce faithfully all of the organ tones would make this entirely possible and in fact very practical particularly in small churches where the installation of a large organ is impossible due to its great cost.

Other applications of this very flexible and adaptable phonograph will immediately suggest themselves. For the rendition of orchestral pieces on any occasion, the phonograph will be useful.



In the above drawing, it is shown how these new aerial torpedoes can be employed for attacking costal cities by enemy landing parties. The torpedoes are launched from any one of several types of platforms and are so set that they will fall and detonate at a predetermined point. Surprising accuracy can be obtained by careful setting of the comparatively simple mechanism that controls them as the article discloses.

Aerial Torpedo Latest Terror

Crew-less Aerial Torpedo Controlled by Gyrosopes and Carrying 250 Pounds of TNT Flies 200 Miles at a Speed of 100 Miles Per Hour

By F. E. LOUDY, Aeronautical Engineer

IMAGINE, if you can, the demoralizing effect upon a body of troops of seeing a small airplane emerge from the smoke of battle and, uncannily directed by machinery, approach their territory at a speed of 100 miles an hour, suddenly drop at a strategic point and wreak havoc. Such a scene would have been a common one during the late World War if hostilities had continued for a year or so longer. A new aerial torpedo of great destructive powers had been designed by government officials and, if the war had continued, would have speedily been placed in service. Information has just been released relative to this engine of war and the illustrations on the proceeding page show many of the details.

The pertinent details of this automatically directed torpedo are as follows. The cost of it, exclusive of the explosive used is only $350, whereas the well known Whitehead torpedo for use by submarines and other vessels costs $13,000. Furthermore, the Whitehead torpedo had an effective range of only 20 miles, whereas this new aerial torpedo will travel a distance of 200 miles at an average speed of 100 miles per hour. It carries 250 pounds of TNT and can be started from a small special carriage at any desirable or available point.

Aerial torpedoes can be released from dirigibles hovering over hostile cities when far out of reach of anti-aircraft guns. Tremendous destruction is thus realized.

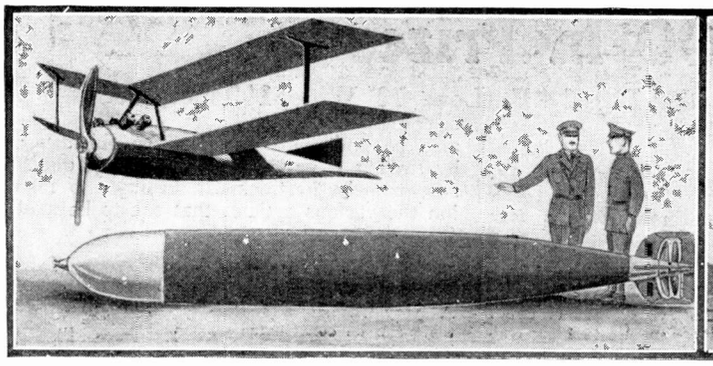
The motive power that actuates the propeller of this torpedo is of a four cylinder V-block type of gasoline engine. It is supplied with ignition current by a storage battery which in turn is controlled by a mileage counter that short circuits the engine ignition when a certain predetermined distance has been covered by the torpedo.

The direction and tilt of the small airplane, the body of which carries the explosive is controlled by means of two gyroscopes. The elevator and rudder controls which operate to keep the machine on a true course are actuated by means of a vacuum system provided with its operating supply by the engine. Altitude and distance of operation are controlled through solenoids supplied with current by a generator attached to the rear end of the engine-crankshaft.

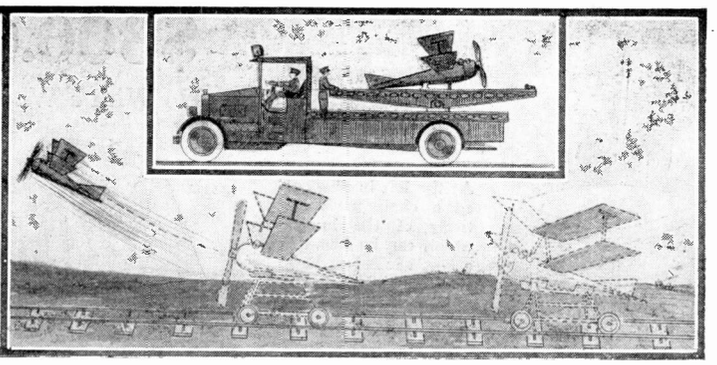
These aerial torpedoes are easily transported from place to place and take up very little room. They can be launched from a very small platform that can be quickly set up or if necessity so demands, they can take off from a reasonably level field. All of the mechanism that controls the flight of the plane is set before the torpedo starts on its flight. The controlling gyroscope has to run at a speed of 18,000 R.P.M. and of course it takes several minutes to attain this speed. It will furthermore run for a period of 30 minutes after the ignition current to the engine is cut off and therefore, the gyroscopic control is active long enough to guide the torpedo safely to the ground at the desired landing point.

The uses of such a torpedo in future warfare can at the present time only be imagined. While the cruising radius of the torpedo in its present form is rated at 200 miles, further refinements and improvements

The utilization of aerial torpedoes in connection with coast-guard guns of large calibre and with scouting airplanes is graphically depicted here. Specially designed projection platforms can be employed for starting these engines of destruction on their journey of death. The man-carrying airplanes can be used for reconnoissance duty for directing the torpedoes.

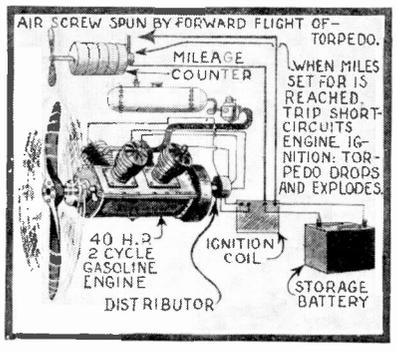


The new aerial torpedo compared as to size with the Whitehead submarine torpedo. In many ways, the aerial torpedo is preferable to the Whitehead. It is cheaper to construct, has a greater range and is far more versatile in its war time uses.

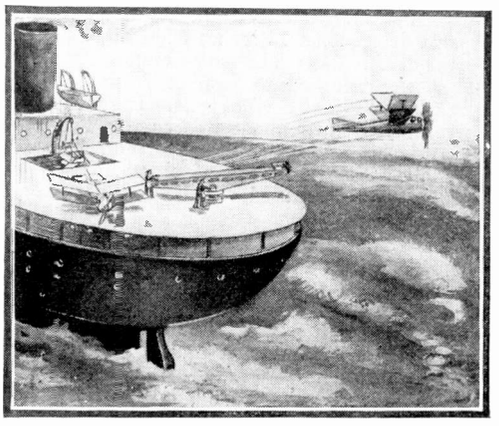


The insert above shows a special launching platform for this aerial torpedo mounted on the rear of a motor truck. The other part of the drawing shows a torpedo being launched from a railroad track. It is carried on a small truck which it leaves upon attaining speed.

in design may increase this radius considerably and so add to the ultimate destructive effect. It is quite possible that the torpedoes may be constructed in larger sizes so as to increase their effectiveness, but even in its present comparatively small size, several can be released at about the same time and thus obtain the effect of one or two very much larger torpedoes. At the present stage of development, the exact direction which the torpedo is to pursue must be determined beforehand and the control so set. If, however, radio control is incorporated, it will be entirely possible to direct the torpedo towards a rapidly moving object and score a great majority of effetive hits. The high speed at which this torpedo can travel will make it a potential weapon for combating enemy aircraft. If its speed can be increased, and there is no reason why this should not be done, and radio control is employed, the fighting flyer of the future may find himself relentlessly pursued by a mechanical demon that cannot be shaken off. The surface of the subject of aerial torpedoes has only been scratched.



The drawing above shows the mechanical details of the engine, the ignition circuit and the mileage counter of this new aerial torpedo.



The launching of an aerial torpedo from the deck of a vessel is illustrated above. The special projection platform is of quite small size.

How to Know the Value of Patents

By LEO T. PARKER

PATENTS are property. That has been decided on numerous occasions by the U. S. Courts. The value of a patent, however, is another matter. It is true some patents are worth many thousands of dollars and that other patents are not worth a single dime. Now the important thing is to know how to logically determine whether a patent is worth anything and if so how much.

The value of a patent depends upon several things. These things are not so difficult to correctly judge when once an individual understands the simple methods of arriving at a conclusion. First and most important is the length of the unexpired term of the patent. For instance, the term of a U. S. patent is 17 years, and if seven years have passed since it was issued, then the remaining term is ten years. The reason why it is stated that the unexpired term of a patent is most important is that if it is almost expired, the patent's value probably may not justify the trouble, time and expense of investigating its validity with intentions of purchase or of acceptance as security for a loan. If the length of the unexpired term justifies further investigations then it is advisable to request from the patentee or owner of the patent, a complete statement relative to whether or not the patent is already adjudicated in the Courts of the United States. Adjudication means that the patent has passed through one or more courts in infringement proceedings and that its validity has been passed upon.

As a matter of fact the value of a patent is considerably increased, or rather established, if it is adjudged valid in the court proceedings.

While many persons are of the opinion that a patent automatically becomes valid when issued by the Patent Office nevertheless the Patent Office assumes no responsibility and gives any assurance that an issued patent is valid. During the prosecution of an application for a patent, the Patent Office makes as thorough search of the Patent records as is practical, to determine whether or not other patents on similar inventions have previously been issued in this or other countries. If other similar inventions are found, the claims of the patent being prosecuted are required to be limited by the inventor in accordance with the prior patent. Quite naturally the Examiners in the Patent Office are not immune to mistakes and therefore patents are occasionally issued with stronger or broader claims than are justifiable.

Right at this point it perhaps is advisable to explain, for the benefit of those who are unfamiliar with patents, that although the specification or descriptive matter of a patent may thoroughly and completely explain an invention and the drawings may disclose a very complex and unique device, the invention actually patented *is defined in the claims*, which may limit it to only a small part of what is shown and described in the specification. A patent may be granted on minute and unimportant details. When reading the claims of a patent it is well to remember the following simple and certain method or rule of determining whether a claim is effectively broad. If any important element can be eliminated from a claim the remainder of the parts may be built without infringing *that particular claim*. That is the reason a strong claim, usually, is short and brief in its language and contains few elements.

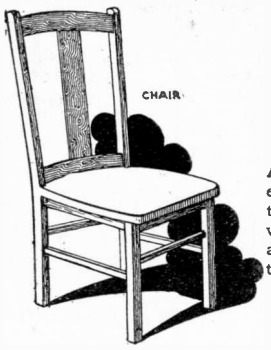
Now to get back to adjudication of a patent. As was previously explained the Patent Office in issuing a patent is not concerned in the matter whether or not other previously issued patents may have claims sufficiently broad to cover the later patents. Moreover, there is no doubt but many patents are issued on similar devices that are mere improvements of the basic patent. And although these many improvement patents may be issued, none of their inventors are privileged to manufacture the improvements without paying a license to the patentee or assignee of the original or basic patent. Of course, the patentee of the basic patent is not privileged to make and sell the improvements which are patented by other persons, but the patentees of the improvement patents are at the mercy of the basic patentee until his patent is expired.

Now when a suit for infringement of a patent is filed against an individual or firm who is believed to be making, using or selling an infringing device or product, there are only two important things for the sued party to do to avoid losing the suit. One is to prove that the claims of the patent do not cover the article he is making, and the other is to invalidate the patent by showing that other devices or articles were in public use or described in a printed publication, etc., before the party bringing the suit actually invented or discovered the device which he patented. In this country no person can obtain or possess a valid patent unless he actually is the first inventor or discoverer of it. Just what the word "inventor" really means re-

(*Continued on page* 179)

$300.00 In Prizes

What Can You Do With a Wooden Board 4 Ft. Long, 12" Wide, 1" Thick ?

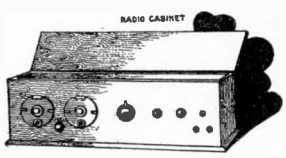


At the left is illustrated a chair made entirely of the lumber which can be found in a board four feet long, twelve inches wide and one inch thick.

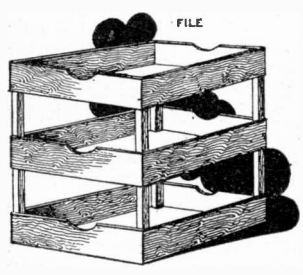
HERE is a brand new prize contest for those who like to build things in their spare time. It is a contest for those handy with tools, and for those who wish to build useful things that can be used about the house, in the office, in the factory, and so on.

The editors have selected a wood board or plank, 4 feet long, 12 inches wide, and one inch thick, and the readers of SCIENCE AND INVENTION are asked to fashion from this single board "USEFUL" objects. It should be remembered throughout this contest that the word "useful" is most important, because only articles that are of practical use and can be actually used will be considered in this contest.

Why not build a radio cabinet of this same piece of lumber, stain it and polish it to suit?



We have shown on this page a few samples of articles fashioned from the board, which, of course, does not by any means exhaust the list, as there must be hundreds and thousands of useful articles that can thus be fashioned. We have selected the 4-foot size of board because it is easily obtainable in any carpenter shop and is of standard width and thickness. The board can be obtained at a cost of about $1.00 at almost any such place.



A file for letters can be constructed of but very little lumber, and inasmuch as the conditions in this contest do not specify the particular kind of lumber you must employ, you can make a letter file of oak or mahogany to match your desk.

It is suggested that the board used be of good hard white wood. The board used by us was White Pine. To be sure, any other wood can be used, such as Oak or Mahogany, but for most purposes, the wood mentioned above will prove satisfactory, because it can be easily worked with ordinary tools, cuts easily, can be sandpapered nicely, and will take almost any finish.

In the shoe blacking stand illustrated at the left the footrest is arranged on a hinge and rises into position as soon as the lid is raised. The stand is made of wood and holds brushes, shoe paste, and any other accessories desired.

In this prize contest it should be remembered that the board can be cut up into any desired shape, not only cut sideways and lengthwise, but, if necessary, the board can also be split into quarter inch thicknesses by sawing it parallel to its smallest dimension, namely, its thickness, in order to fashion the various articles that are to be made from the board.

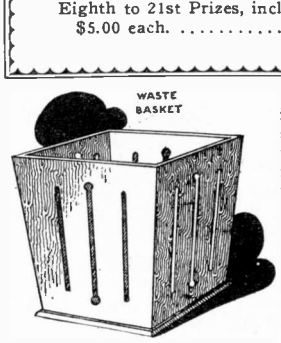
A small utility ladder is made of a piece of this four foot board. Such a utility ladder will find its way into the homes of everyone who needs to climb around to hang curtains, arrange pictures, etc.

$300.00 IN PRIZES
Conditions and Rules of the Board Contest

1. This contest is freely open to all, whether subscribers or not. From the contest are excluded employees of the Experimenter Publishing Company and their families.
2. Models of the prize entries are not to be sent in unless the contestant is requested to do so by the editors, in writing.
3. An entry consists of three photographs, not smaller than 5 by 7 inches, printed on glossy paper, one complete pen-and-ink drawing, giving full dimensions of the article, and a description of the article in 500 words or less.
4. Photographs, drawings, and manuscripts must all be sent in flat. Rolled entries will be rejected.
5. Penciled matter can not be considered. Use ink or typewriter.
6. As many entries as desired can be sent in to the contest. There is no limit to the number of entries accepted from each contestant.
7. From this contest are excluded mere ideas and designs only, for the reason that this contest was inaugurated to stimulate the building of the actual models. Entries without photographs of the constructed articles are, therefore, not eligible.
8. The prizes will go to those who submit the most practical and useful ideas of how to build various "useful" articles from the wooden board. The editors reserve the right to send for any one of the entries by paying transportation charges both ways.
9. This contest closes at noon, July 10th, 1926, at which time all entries must be in the hands of the judges in order to qualify.
10. Should two or more contestants submit the same prize-winning idea, a prize identical to that offered will be given to each of those contestants so tying.
11. Address all entries to Editor, WOODEN BOARD CONTEST, c/o SCIENCE AND INVENTION, 53 Park Place, New York City.

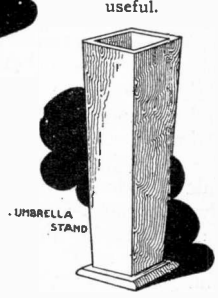
$300.00 IN PRIZES

First Prize	$75.00
Second Prize	50.00
Third Prize	35.00
Fourth Prize	25.00
Fifth Prize	20.00
Sixth Prize	15.00
Seventh Prize	10.00
Eighth to 21st Prizes, inclusive $5.00 each.	70.00
	$300.00

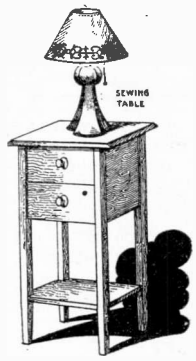


If the four foot plank is sawed up and assembled in the manner illustrated above, it will form a very useful waste basket. The idea uppermost in this contest is to produce something useful.

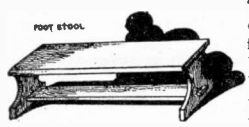
Who would not find an umbrella stand a serviceable addition to any home? The bottom of the umbrella stand can be made to a size to accomodate a milk bottle or a can, so that the drippings from the wet umbrellas need not wet the floor.



A very ingenious sewing table can be constructed as illustrated in the drawing at the right. This provides a space for two drawers in which the various paraphernalia necessary for sewing and darning can be put. The bottom of the table is provided with a shelf on which magazines may be kept. The table lamp could also be made of the same piece of board.



It is most important to note that not more wood than that contained in the 4 ft. board may be used; that is, two or more boards can not be used, ONLY A SINGLE BOARD. The board can be used in conjunction with anything else, such as hardware, other metal pieces, etc., but at least 80 per cent. of the material in the final article should be the board itself.

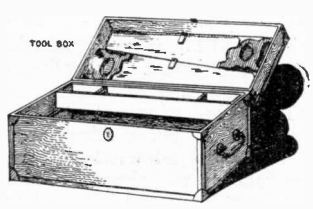


To the left is illustrated a very serviceable footstool which may be covered with needlepoint to harmonize with the other furnishings in the room.

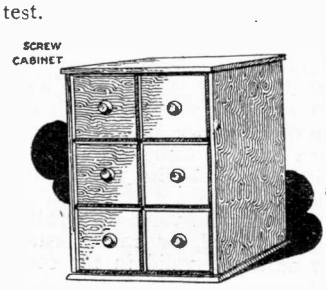
Nor is it necessary to use all of the wood. For instance, it you use only two feet of the board, this will still make you eligible for a prize, but if you can use up all of the wood, so much the better.

Note particularly, and we repeat it once more, that the judges will award prizes only for USEFUL articles that can be used by everybody or that are put to everyday use. Novelties that are of little use in our everyday lives, will not be entitled to a prize.

And what would be more appropriate than to construct a tool box of the four foot piece of wood?



It is not necessary to send models to the editors, or to the judges in connection with this prize contest. What is wanted is good photographs showing at least three views of the article, which means three separate photographs. In addition to this, a pen-and-ink drawing, skeleton fashion, giving the dimensions of the article, must be submitted. These photographs and drawing as well as a description in not more than 500 words, constitute a complete entry for this prize contest.

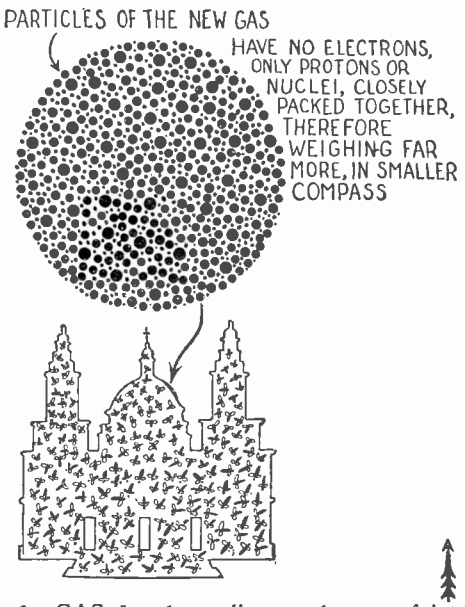


A useful commodity is the screw cabinet illustrated at the left. Such a cabinet can also be made to contain herbs and cereals for kitchen use.

Quart of New Gas Weighs 22 Tons

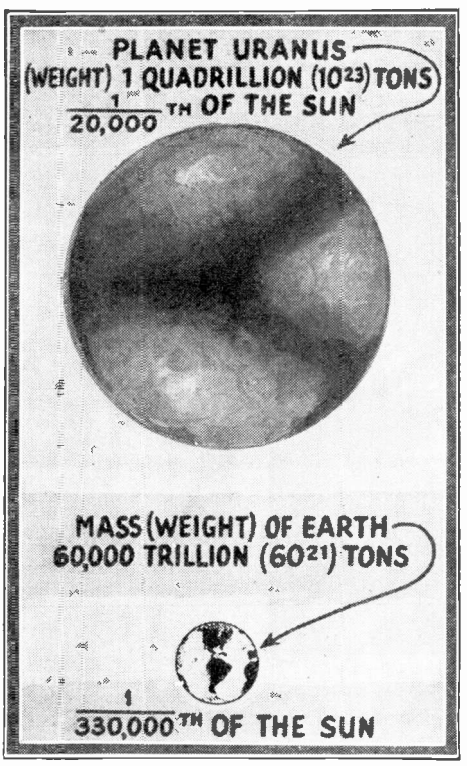
A Gas Recently Discovered on a New Star Exhibits Unusual Properties

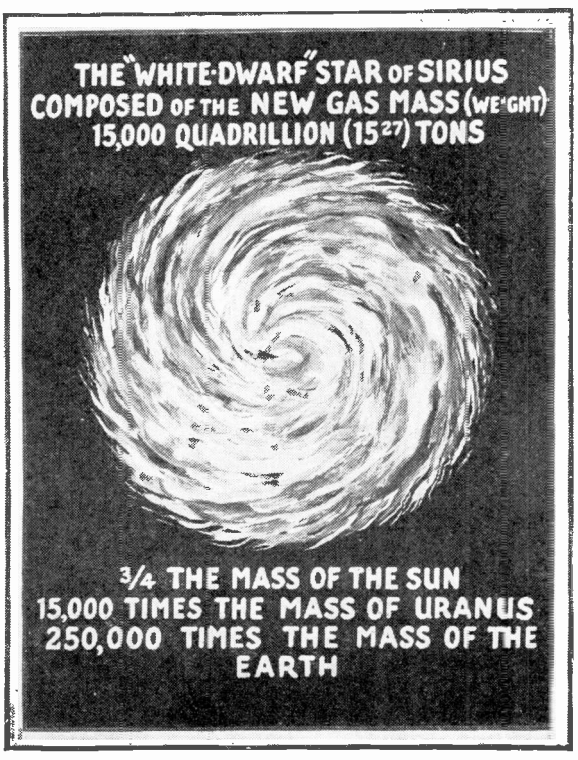
By ERNEST BRENNECKE



A GAS has been discovered on a faint star, known as a "white dwarf" that has been found revolving around Sirius. This gas, contrary to most matter, is composed of atoms that have no electrons but consist only of protons or nuclei. The result of this is that the gas is extraordinarily heavy and one quart of it weighs 22 tons. Let us liken one atom of a gas to a large cathedral populated by bees. In this new gas, the effect would be to have the cathedral closely packed with these small insects.

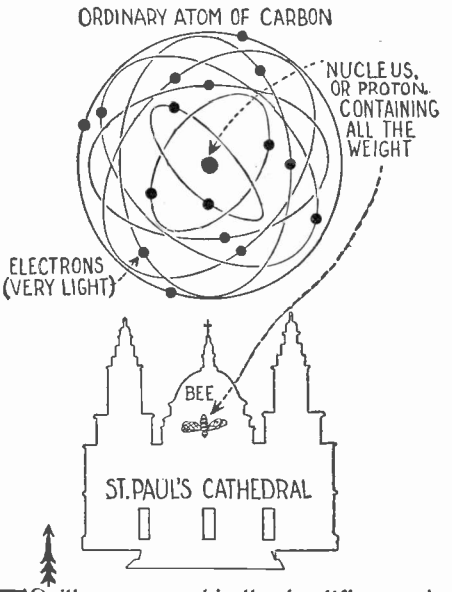
THE newly discovered "white dwarf" star is about the size of the planet Uranus which weighs one quadrillion tons or about one twenty-thousandth as much as the sun. The "white dwarf" star, however, composed of an extraordinarily heavy gas, weighs a total of about 15,000 quadrillion tons or about three-quarters as much as the sun. From these figures and knowing that the sun is about 15,000 times as large in volume as Uranus, we find that the glowing gas of the "white dwarf" star weighs 21,600 times as much as water. Suppose that a cupful of this gas was available. If dropped from only a few feet above the surface of the earth it would plunge deep into the ground.



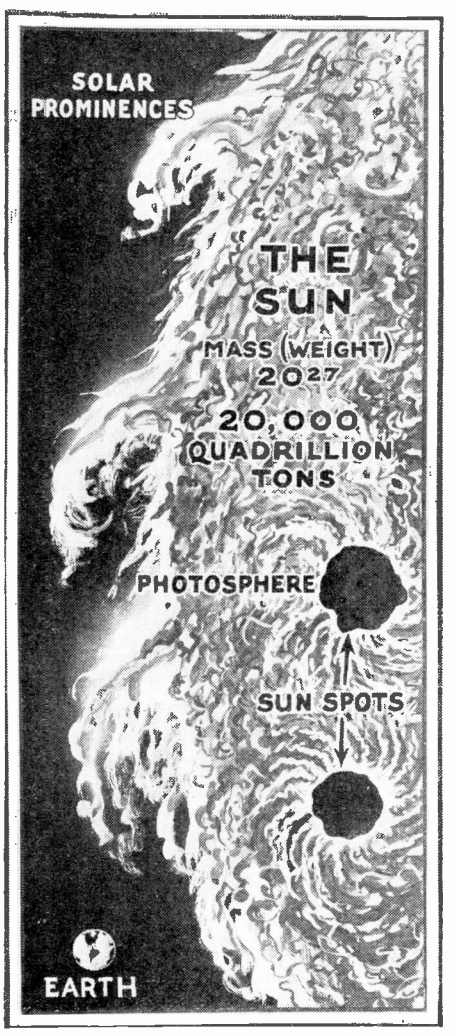


The "white dwarf" companion star of Sirius, revolving around that heavenly body is made up of a whirling mass of intensely hot gas, which gas exhibits the most peculiar properties of weight that are described on this page. The illustration at the immediate left gives all of the data on this newly discovered inhabitant of our solar system. Imagine the terrific force of gravity that would be present on a body such as this. If, for instance, the earth were made up of the same material as the "white dwarf," the force of gravity would give an ordinary man a weight of approximately 500 tons. With the muscular structure of the ordinary human being, he would be unable to lift himself or stand upright. Lying flat on his back, he could not even lift a finger for each finger would weigh about 1,600 pounds.

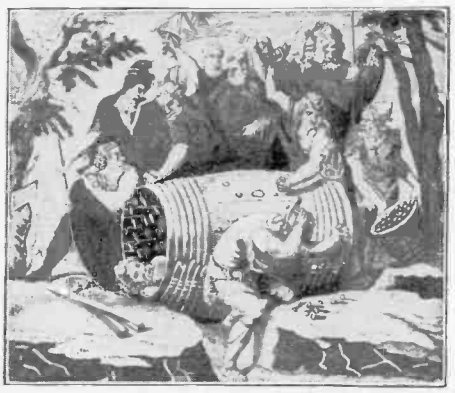
At the right is shown the sun, with its physical properties of weight indicated. The comparative size of the earth is also shown and by comparing the figures given with those quoted in relation to the "white dwarf," the wonders of this newly found heavenly body can be readily seen.



TO illustrate graphically the difference in the construction of the atoms of this newly discovered gas and that of ordinary substances, we show the above diagram. Again assuming an atom to be the size of St. Paul's Cathedral, we find that the nucleus or proton, containing all the weight of the atoms is about the size, relatively speaking, of a bee as compared to the cathedral. This shows how much heavier the newly discovered gas must be when we consider that it has thousands of nuclei or protons packed into the same space that is usually occupied by one entire atom with its many revolving electrons and one tiny nucleus that makes up practically its entire weight. In this new star, the atoms of the gas composing it have lost their revolving electrons.

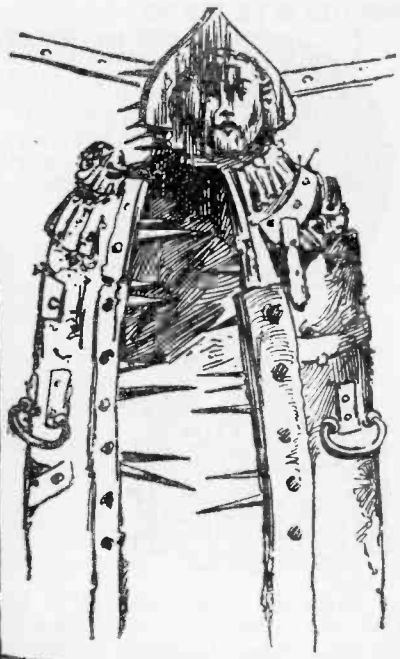


How ANCIENTS Gave "THIRD DEGREE"



The picture shows a rather famous punishment to which we often see allusions in literature. It is even found in classical traditions of olden times. The victim is put into a barrel lined with spikes, and when the barrel is headed up, it is rolled about, the unhappy victim suffering indescribable agony until death relieves him. imagine the barrel rolled down along a declivity as it has been sometimes described.

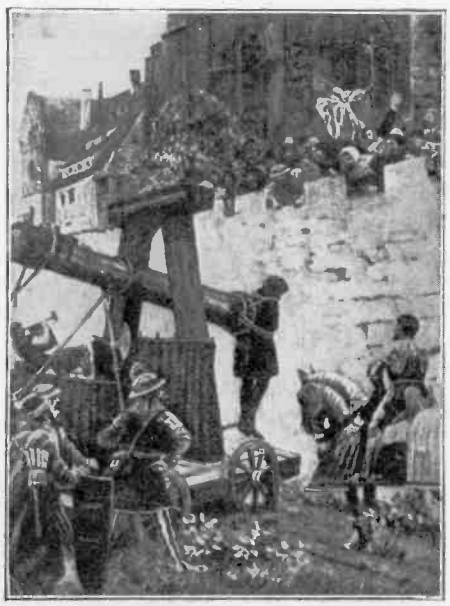
This picture represents the famous iron virgin. There were hinges towards the back, so that it opened like two doors, and from its interior a multitude of spikes projected. The victim was stood up within it and the case was closed on him, we may suppose with no gentle hand, the spikes mercilessly entering his body. This is a restoration by the artist. The original is somewhat ruined, and is in Nuremberg.



This shows the ruined instrument as now in the Nuremberg Museum, suggestive even in its present state of dreadful possibilities for the infliction of torture.

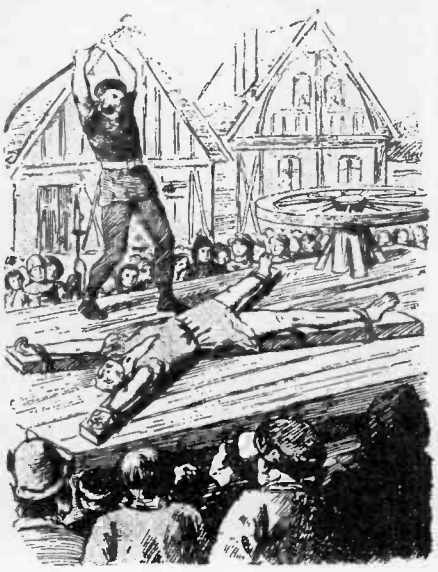
Above are shown how criminals were drowned by immersing them in a barrel of water, or it is said sometimes of wine. On the floor they are placing a victim in a sack, so that he can do little to resist them.

On the right is seen an attack on a town. The battering ram is mounted to attack the wall and make a breach therein to admit the attackers, but they have made a prisoner and threaten the townspeople with the first blow upon the wall to annihilate the victim. This was in hopes that the threat would make the townspeople throw open the gates.



There is a satisfaction in seeing the infamous Titus Oates exposed in the pillory. In the court of the equally infamous Judge Jeffreys his false testimony had sent many innocent victims to death. As a part of his punishment he was flogged through the streets of London, receiving thousands of stripes.

Imagine two women who have been fighting, yoked together as shown above, their rage and anger futile and the pair an object of utmost derision to the public at large.



On the right is seen the victim stretched on a St. Andrew's cross, while his bones are methodically broken one by one. One of the bars with which the breaking was done is preserved in Nuremberg. In the background is seen a wheel. Sometimes the victim was fastened on such a wheel for the process and was said to be "broken on the wheel."

Ancient Torture Methods

By PROF. T. O'CONOR SLOANE, Ph.D., LL.D.

IN the daily papers in the month of Jan. 1926, we are told that in one of the southern states, seventeen masked women went to a house, took a woman out, carried her off to a distance of about three miles, beat her with rods cut from the trees, and went away leaving her there senseless. During the last decade it is not too much to say that scores of people have been burned alive by lynch law in this country.

The history of the murderers, Leopold and Loeb, as it came out in the Chicago court, falls into line with what was stated above, showing how ready or even anxious human beings are to persecute and all this is in the twentieth century, and in America, often called "God's Country," we fear without entire correctness. The desire which seems inherent in the human organization to torture other people, receives almost daily illustrations. Our papers supply the literature of the twentieth century torturing and murdering.

Today, many prominent lawyers, and laymen too, are fighting capital punishment. To them it seems inhumane and entirely out of keeping with our present civilization to employ electrocution, or even hanging—both instruments of speedy death and almost without pain. And these measures are taken only after the criminal is legally tried in a court of Justice and convicted by a jury which has heard all the evidence pro and con. A distinction can be drawn between the ways of a thousand years ago and the present time. In olden times, a certain amount of ingenuity was lavished on instruments and processes of torture, while now, murder, burning alive, and flogging are about all that are used. After the middle of the 19th century, the administration of torture for the purpose of extracting confessions from suspected criminals and witnesses was abandoned, if not in actual application, then at least in form.

Torture even in the dark ages, was not administered entirely without a decided feeling of righteousness, though that may sound contradictory. We find that while there seemed no vestige of conscience or mercy in the infliction of torture for confession or punishment, the judges appeared to have, nevertheless, a profound conscientious scruple or definite legal provision that no one be executed—or sentenced—until he had been proved guilty. And the only conclusive evidence was a confession from the lips of the suspected criminal himself. Practically this confession was considered essential, and torture was applied to obtain it.

The practice of torture dates back to ancient times, and the literature on this subject is surprisingly extensive. We find that for many centuries this practice was regulated by exact statutes of law, varying in the different countries. Several hundred years ago, it was treated by law students in their theses and was generally accepted as the best method to insure a just punishment for the alleged criminal. For the old law designated specifically that no one could be executed without absolute proof of guilt. A confession was conclusive evidence and it was reasoned that the rack, or some other form of torture, had therefore to be applied.

It is interesting to follow the history of "Torture." About the oldest reference is found in the Old Testament, wherein is described flagellation—or beating—punishment by stripes. As it originated, it was merciful, in a degree, for it is definitely stipulated that no more than 40 stripes shall be administered to any one person.

The whip adapted by the Jews consisted of three lashes—one long and two short. In a curious old Latin book is given this description of the whip: the two shorter lashes were made of calf-skin and the long one out of asses' hide, and in the Scriptures, the ass and the ox are both referred to as examples of intelligence. It is said that the double length whip was used in order that the long lash might encircle the body and so inflict its blow on the front, while the shorter lashes strike the back. Every blow was counted as three stripes; thirteen blows therefore resulted in 39 stripes. Since it was strictly against the code to exceed the stipulated 40 stripes, 39 remained the number to be administered. To insure the proper number of blows being given, a certain verse from the Psalm was read. This contained 13 words in the Hebrew, and for each word one blow was given.

And the curious fact about this law is that it was carried out and adhered to for many generations, wherever and whenever flagellation was resorted to. Even in modern times, we read about the American sea captains beating unhappy sailors on board his ship with the stipulated 39 lashes. On merchant ships and whalers his method otherwise was far less merciful than the original. He not only beat his sailors, but tied their hands, extended upwards, to the shroud of the vessel and beat them until they were insensible from agony, without counting the blows.

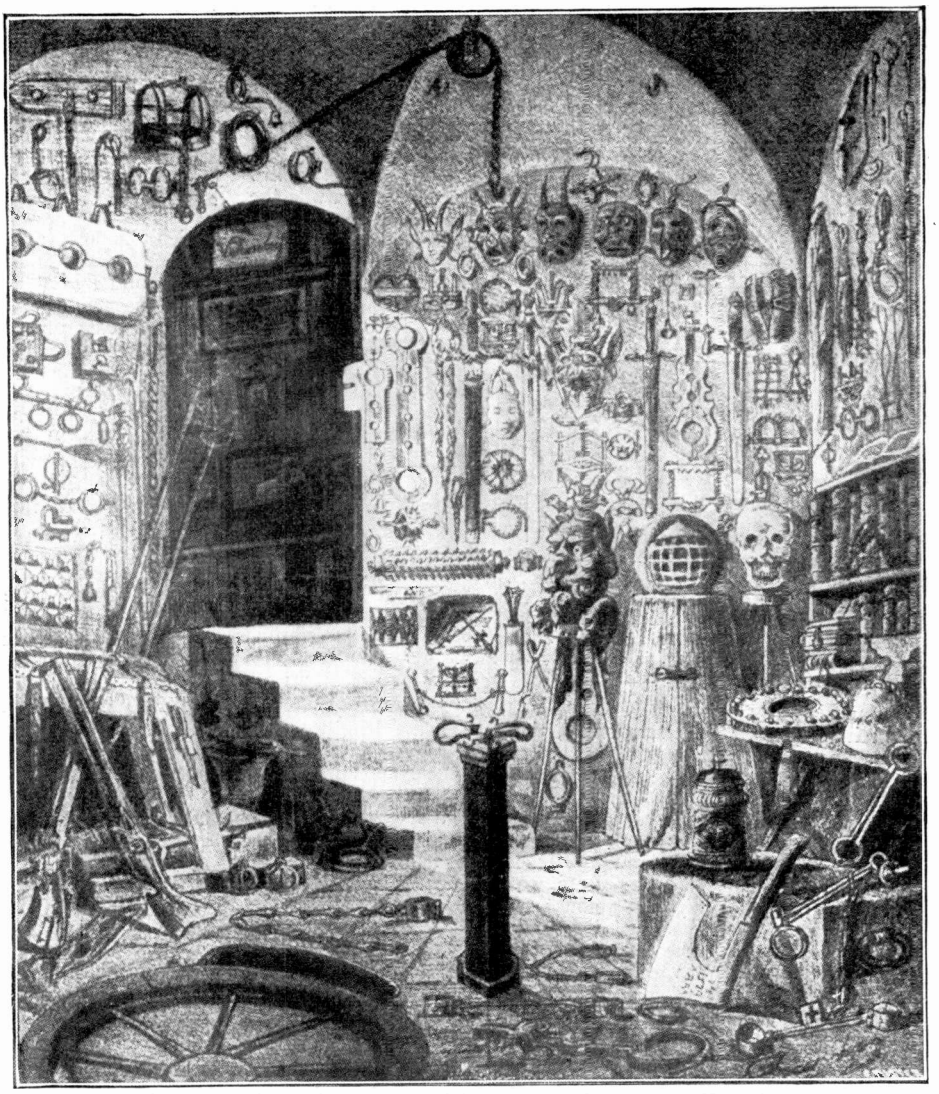
Flagellation was not the only form of torture used by the ancient Jews. When death was desired, Lapidation was employed. Lapidation — or the killing by throwing stones—was also exactly regulated. The first stone was thrown by a witness and was to strike the victim below the waist. If this proved ineffective, another witness threw a stone, aiming to strike above the waist. If this did not prove fatal either, a community stone-throwing contest ensued, in which the general throng gathered there for such amusement partook. This was kept up until the victim was overcome and died.

"Burning," another system of torture was used somewhat later. Here the victim is choked until he gasped for breath, when molten lead was poured into the unfortunate man's mouth.

In Roman days, torture, which was provided for by law, was supposed to have been restricted to slaves. Theirs was a very extensive system of slavery. Many of these were highly educated, doing secretarial and other high-grade work, but so long as they were of the slave class, they were subject to the tortures inflicted under the Roman administration.

The distinction between punitive torture and torture applied for the purpose of eliciting testimony or confession is quite clear, and

(*Continued on page* 177)



The above illustration shows the Museum of instruments of torture at Nuremberg, Germany. The reader can spend some time studying over the exhibits. To the right in the back of the room is seen the Virgin, a case lined with great spikes which was opened, the victim placed within it, and then closed upon him, the spikes piercing the body in many places. In the foreground a wheel is lying on the floor. On this a victim was sometimes stretched while his limbs were broken one by one by a heavy iron mace or club. The axe for beheading the victim is seen in the right foreground. It is a dreary exhibit of what the poet called, "man's inhumanity to man."

The Origin of the Moon

By DONALD H. MENZEL, Ph.D., Ohio State University

WHENCE came our moon? Was it born from the virgin fire, did it grow by degrees or did it spring suddenly into existence full-grown, like Minerva from the head of Jove?

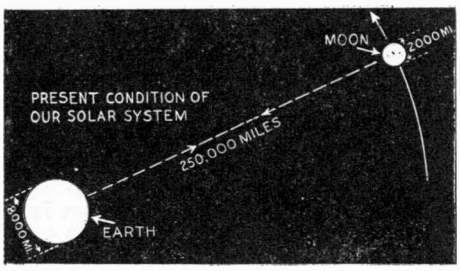


Fig. 1. The relative positions and sizes of the earth and moon are shown in the above illustration.

That the moon is ancient, no one will deny and it is no small tribute to the genius of man that he is able, with the help of mathematics, to bridge over the gap in time and decide the question. For the present condition of the moon forms one term in a gigantic equation which represents the life history of the moon. Our only assumption, and entirely a legitimate one, both practically and philosophically, is that the science of mathematics is eternal and unalterable in its nature.

The first of the three theories mentioned above is easily dismissed along with the entire nebular hypothesis, for the moon never could have originated in that manner. As for the second, it is a part of the Chamberlain and Moulton planetesimal hypothesis—that the earth and planets were all built up from fragmentary matter—planetesimals—and that the moon, along with these, grew by accretion. Owing to the doubt recently cast upon some of the main features of this theory, however, it does not appear as advantageous as that put forth many years ago by Darwin—not the Darwin associated immortally with organic evolution.

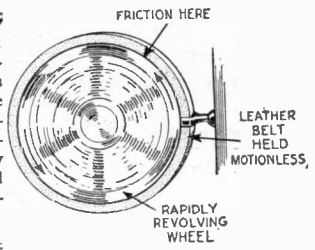


Fig. 3. Right: The friction between the earth's surface and the water is analogous to that between a rapidly revolving wheel and a loose leather belt.

This Darwin began by examining the present condition of the Earth-moon system: the Earth, rotating in 24 hours, and 8000 miles in diameter, and the moon, a quarter of a million miles distant, a fourth the earth's diameter, and its rotation time equal to 27 days, exactly the time it takes for it to revolve about the earth. This last is certainly no mere chance and Darwin examined the possible causes for its occurrence.

In the first place, the immediate consequence of the moon's presence is felt in the tides, for as shown in Fig. 2, there is one bulge pointing toward the moon where it pulls the water away from the earth and a corresponding bulge on the opposite side where it pulls the earth away from the water. As a result of the tides and the rotation of the earth, there is ever a tendency to cause a friction between the water and the solid earth just as there is friction between a wheel and a leather belt (Fig. 3). The result is that the earth's rotation is slowing down ever so gradually. The effect of the tidal friction is shown better in Fig. 4 than in Fig. 2. Due to the friction between the water and the earth, there is a tendency of the tidal bulge to move ahead of the moon. The attraction of the moon on bulge, A, will be in an opposite direction to the earth's rotation and tend to slow it down, while the attraction on bulge, B, will be in the opposite direction and tend to counterbalance the effect. The moon is, however, nearer to A than to B, and the slowing-down force would predominate. At the present time the rate is very small, the day having lengthened by a second in the last 120,000 years.

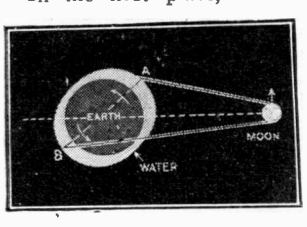


Fig. 4. Left: Friction between the earth and the waters of the earth is more plainly illustrated by this drawing.

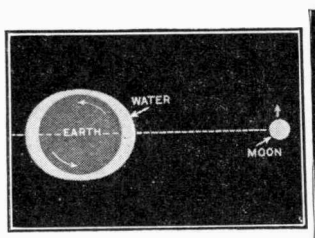


Fig. 2 One of the effects of the moon on the earth is the raising of tides and this, illustrated in the above drawing, is referred to in detail in this article.

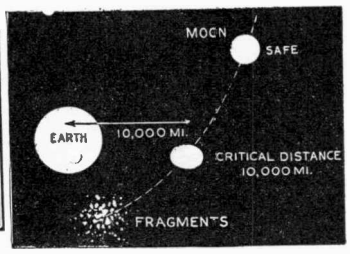


Fig. 6. It must be taken into consideration, when discussing the origin of the moon, that gravity would break up that body if it approached too close to the earth.

If tidal effects take place upon the earth, they would also occur upon the moon and of greater magnitude, for the earth has about 80 times the gravitational attraction of its companion. It is not necessary that the moon possess water, for there would be a certain amount of plasticity even in the solid parts of the moon and earth, accomplishing the same result. Thus the moon has been slowed down by tidal friction to that point where it keeps the same face toward the earth and it is obvious that eventually the same condition will prevail for the earth.

Whence goes this energy of rotation? Common sense tells us that it cannot be destroyed, owing to the well-known law of its conservation. As is evident from general principles, the moon will absorb the energy into its orbit; as a result it will move further and further away from the earth, spiraling outward as shown in Fig. 5 which is, of course, greatly exaggerated. The heavy line indicates the present tendency of the moon's motion and, extending the same backwards along the dotted line, it is probable that some 4,000,000,000 years ago or less the earth and moon were nearly in contact, the earth rotating in about four hours instead of twenty-four. The question naturally is asked whether or not the two objects ever were a part of each other. Roche proved about 1850 that the moon could not have existed in its present form at any distance less than ten thousand miles from the earth's center. If it approached any nearer the gravitational attraction of the earth for the one side of the moon would be so many times greater than for the other that the moon would break in pieces as shown in Fig. 6.

Any theory of the moon's origin must take the above into account. In the Jeans-Jeffries theory of the origin of the earth, discussed in detail in the May number of SCIENCE AND INVENTION, it was shown how the near approach of the sun to a star caused the ejection of a filament of matter from the sun, which filament finally condensed into the planets. Since the earth would have become solid within 15,000 years after its ejection, the moon probably would have been cast off from it before that time.

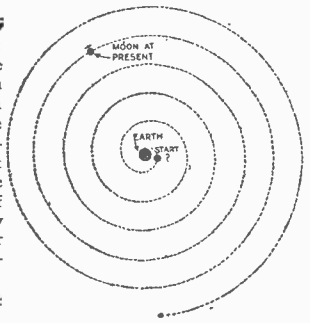


Fig. 5. Right: The spiral course that the moon must have taken after leaving the earth and traveling to its present position. The drawing is of course greatly exaggerated for the sake of clarity.

To return to Darwin's theory; he examined the various possible causes which might pull the moon away from the earth which, at that time, would have rotated in four hours as shown before. The tides of the sun would tend to do this, but of themselves would be as insufficient as they are today. Small forces, however, under favorable circumstances, can be made to perform large amounts of work.

To illustrate, (Fig. 7) a swing has a natural period of vibration. A man giving it a single push cannot push it very far, but by repeating the applied force at intervals exactly in tune with the natural period the amplitude of the swing can be almost indefinitely increased.

The tendency of the fluid earth would have been to contract to a spherical shape or rather a spheroidal shape due to the rapid rotation. Any force applied to it would distort it and on the release of the force, the earth would oscillate about the mean position. Now the period of vibration of the fluid earth has been computed to be about two hours—just half of the time of one revolution on its axis. As a result, while any given solar tide is insufficient to produce a large distortion, the force would be so applied at regular intervals that an increasingly large protuberance would be formed

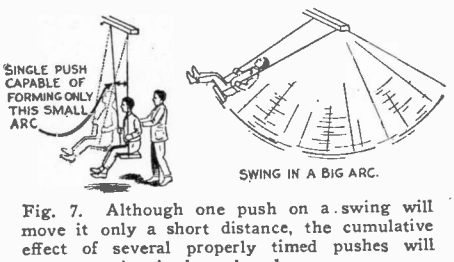


Fig. 7. Although one push on a swing will move it only a short distance, the cumulative effect of several properly timed pushes will swing it through a large arc.

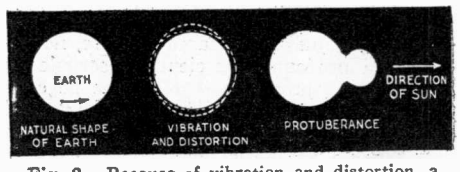


Fig. 8. Because of vibration and distortion, a protuberance may have formed.

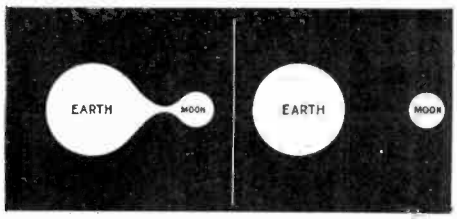


Fig. 9. The protuberance illustrated in Fig. 8 may have broken off as shown above.

(Fig. 8) stretched out until it reached beyond Roche's limit, finally breaking off and forming the moon. (Fig. 9.)

The suggestion of William H. Pickering is not without interest. He suggested that the disruption took place when the earth was in a semi-plastic condition, perhaps just after the formation of some of the crust. It is possible that the Pacific Ocean is the cavity from which the moon was torn. There is also the chance that the resulting disturbance of equilibrium caused a huge crack to form in the midst of the remaining portion, part sliding one way and part the other, thus forming the Eastern and Western continents. (Fig. 10.) This view is somewhat strengthened by the similarity of the Eastern coast of the Americas and the Western coast of the old world. They appear to fit into each other nearly like a jig-saw puzzle. There are, however, some objections to this theory.

Fig. 11. The Pickering theory, discussed in the text, places the formation of continents as being due to the cracking of the earth's surface.

Thus we have tracked the moon back to its starting point. How about the future? It is obvious that the moon will continue to slow up the earth and to spiral outward until the length of the day and the month are equal and each of value 47 days. So slowly will this occur that only until some 50 billions of years have passed will we find the state mentioned where the earth and the moon keep the same face toward each other, instead of only the moon doing it, as at present.

Even this will not be an end of affairs, for solar tides will gradually cause the earth to start rotating again in the opposite direction. The sun will rise in the west instead of in the east and the resulting lunar tides will now tend to accelerate the earth's rotation. Thus the moon will begin to spiral inwards until it reaches Roche's limit when it will break into fragments. (Fig. 6.) These fragments will continue to encircle the earth in the form of a ring, such as that of Saturn, only more massive and more extended. The length of the terrestrial day at that time will be, as in the beginning, about four hours.

And so it can be seen that those of us who are alive today need not fear any sudden change in the earth or in its relative position in regard to the moon during our periods of existence. Changes in the solar system do not happen suddenly, measuring

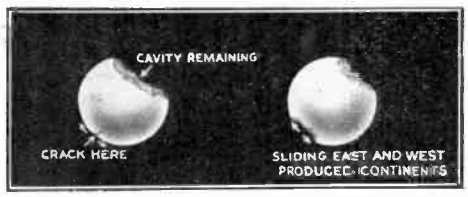


Fig. 10. According to one theory, after the portion that was to become the moon broke away from the earth, the resulting stresses cracked the opposite side, sliding took place, and continents formed.

time according to our standards, but take place over long periods of thousands or millions of years. As mentioned above, many billions of years will pass before the rotation of the earth has decreased to a point where it will always present the same face to the moon.

Just how many years later it will be after the above mentioned event takes place and until the moon spirals inwardly toward the earth and reaches Roche's limit and breaks up to form a ring around the earth is entirely problematical. Probably by the time this event takes place, the inhabitants of this earth will be in an entirely different form than they are today.

If the moon should approach the earth as in Fig. 6, the fragments might form a ring similar to Saturn's. Fig. 12.

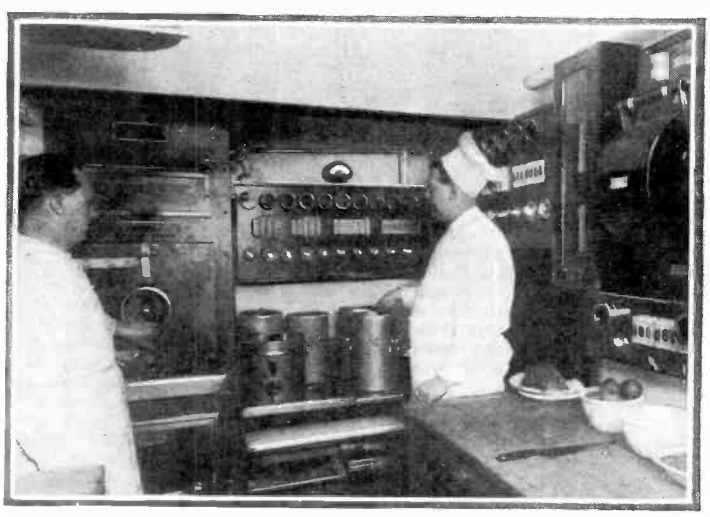
Travelling Electric Kitchen

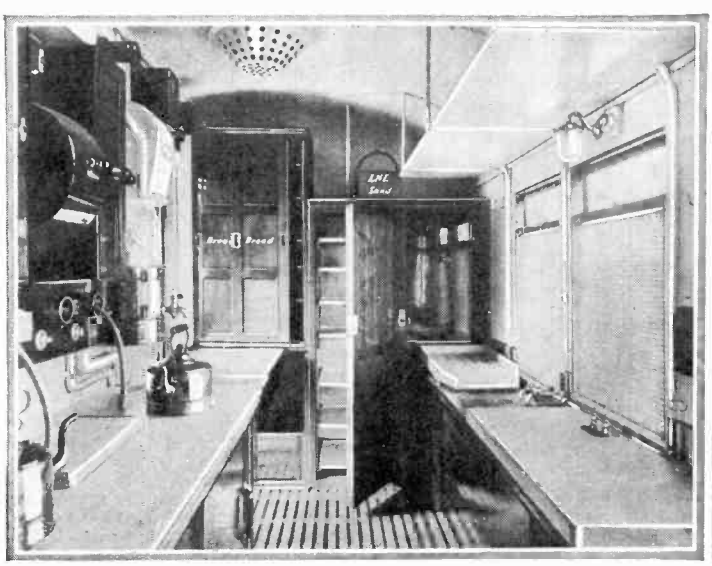
THE London and Northeastern Railway, England, operates a train called the "Flying Scotsman" between London and Scotland. We illustrate views from photographs of its electrically-equipped kitchen.

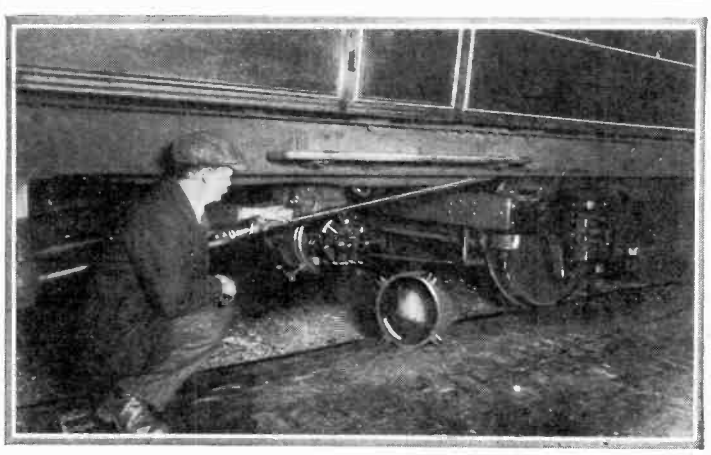
There is a complete cooking apparatus for supplying the restaurant on the train, and the photographs show how complete the installation is and suggests, also, at least the idea of great cleanliness.

The current is produced by one or more generators mounted under the car. From the standpoint of safety, it is incomparably superior to the ordinary kitchen operated with kerosene or other fuel, and certainly shows that our British cousins are well up to date.

Two views are given of an electric kitchen upon the famous Flying Scotsman train on the London and N.E. Railroad. Below to the right is shown the dynamo which supplies the current.







Cooking by electricity is not only for the house and boat, for our English railroad friends have here shown us how to fry steaks and boil eggs on railroads. The current is developed from a dynamo driven by a belt passing over a pulley fastened to the car axle. Dynamo requires little attention.

Quick-Acting Parachute

A new parachute that can be successfully used at an altitude of less than 100 feet and that needs no skillful packing has recently been invented by J. M. Russell of Dayton, Ohio. Even if the ropes are tangled, this parachute will operate. It is shown in the various photographs above. In the one at the left, the inventor is dropping from an altitude of 100 feet, after having purposely tangled the lines.

What Is Cold Light?

An Explanation of Just What Constitutes This Desirable Illuminating Effect

By PROF. CHARLES T. DAHAMA, Ph. D.

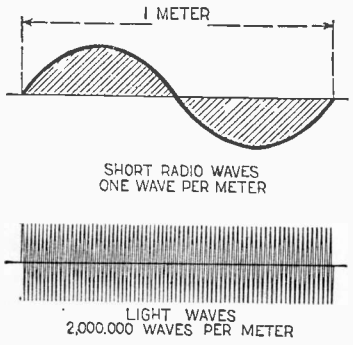


FIG.1

Light, as we know it today, consists of a series of electro-magnetic waves or in other words, light is similar to radio except that the wave-lengths of light are extremely short. Fig. 1 above, shows an imperfect comparison between an extremely short radio wave and a train of waves at light frequency. Although both of the wave forms shown take up the same space in the ether, still there is shown one radio wave to a meter whereas there may be two million light waves per meter. Red light has the longest wave-length, violet the shortest and ordinary white light has almost all wave-lengths found between these two.

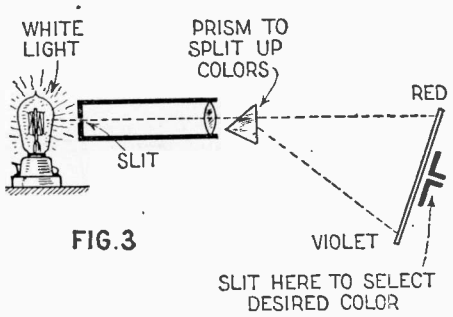
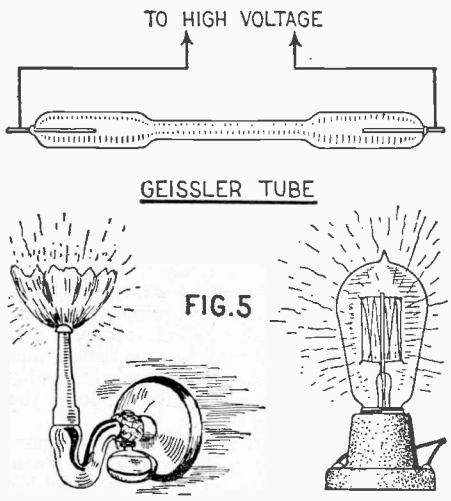
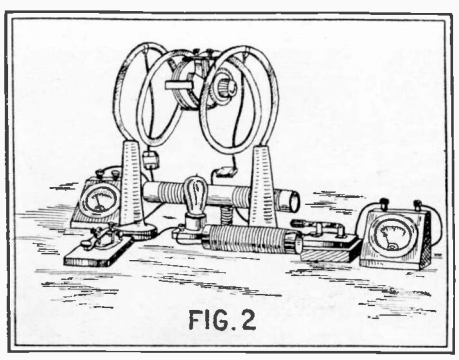


FIG.3

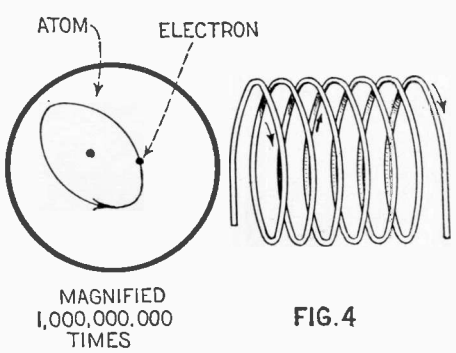
Although waves of only one length can be obtained in actual radio practice, the only method of obtaining light of only one wave-length and color is to filter out all others but the desired one by means of a spectroscope such as is shown in the diagrammatical form above in Fig. 3. The glass prism splits up the white light and the slit in the back of the glass plate passes the desired color.



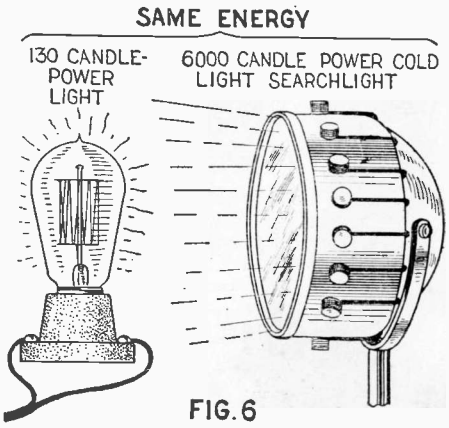
Heat causes atoms to strike against each other and so excites them to oscillation and produce light, as in a gas flame or electric light. In a Geissler tube, atoms are bombarded with electrons giving an illuminating effect.



The usual type of short-wave radio transmitter is shown above. If this could be designed to emit waves as short as those of light, cold light could be produced of any color with high efficiency. The electrical way is the logical way to produce cold light. The best light producers we have are only about 2% efficient.

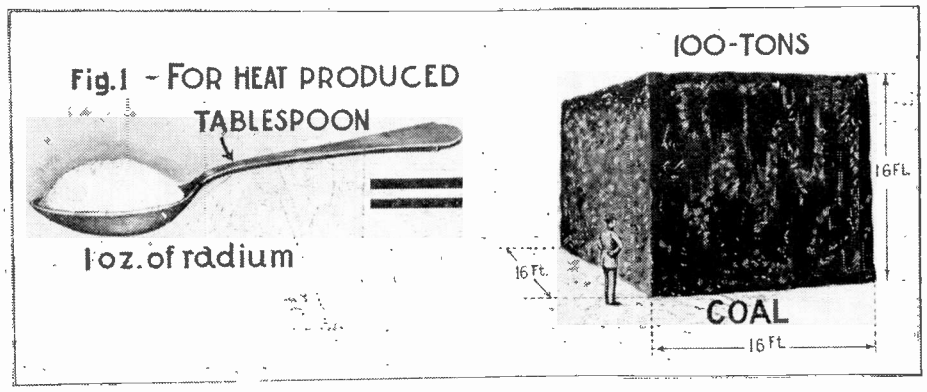


The oscillations of electrons in a coil of wire as shown above produce radio waves. In an unexplained way, these oscillating electrons also give off waves but owing to the small traversed path, the wave-length is very short. Possibly cold light will some day be evolved from this source.



A 100-watt bulb of the present-day type gives 130 candle power of light. If the same energy were employed for producing cold light, 6,000 candle power could be realized. This is because of the inefficiency of present-day methods and the high efficiency of light without heat.

What Causes Earthquakes?



Prof. J. Joly, a well known English geologist, has recently advanced a theory which will assign the cause of earth tremors to radio-activity. The disintegration of the elements uranium and radium is accompanied by the liberation of a huge quantity of heat. Radium, as shown above in Fig. 1, liberates about 132,000 times as much heat as an equal amount of coal, or one tablespoonful of radium equals 100 tons of coal in heat delivered. Although there are only small quantities of uranium and radium in the earth's crust, the total energy evolved is so great, that possibly the earth is hotter at the end of a year than at the beginning of that same period of time. Possibly such heat aids the production of earthquakes.

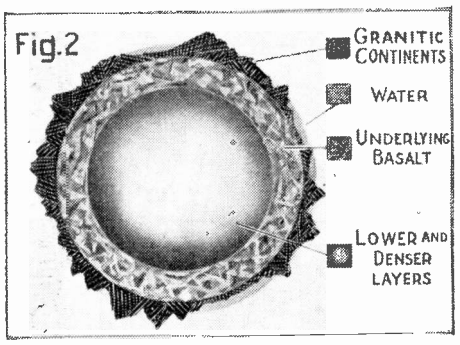
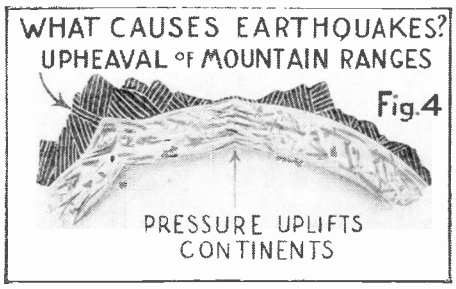


Fig. 2 shows a diagramatic representation of the earth's structure. The radio-active materials in the granitic continents and in the underlying basalt structure are constantly giving off sufficient heat to cause the basalt layer to melt and hence, to eventually force its way through the earth's crust and cause earthquakes. The tremblors are a direct result of upheavals in the earth's surface such as would be produced by this heat.



As crystal basalt is increased in temperature and finally melts, it also increases in volume until when it is finally melted, it is 10% larger than its original size. When we consider that a basalt structure underlies the entire earth's surface, it can readily be realized that such an expansion will have disastrous results. As shown above, the pressure exerted by this basaltic layer, when melted is amply sufficient to cause the upheaval of mountain ranges and to cause great cracks between continents and ocean beds. All such changes in the topographical features of the earth cause tremors that can be felt for hundreds of miles and that are known as earthquakes. Sometimes they create great havoc but often are slight and barely perceptible.

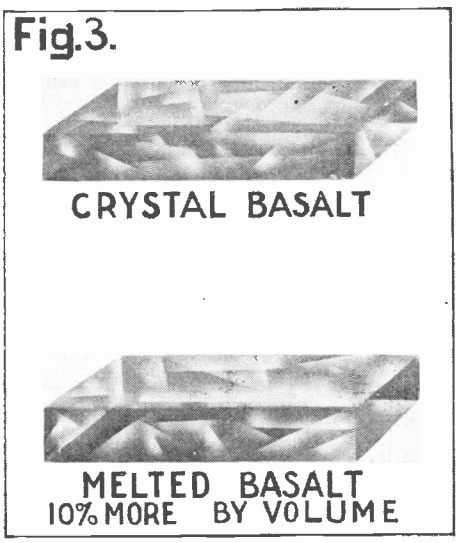
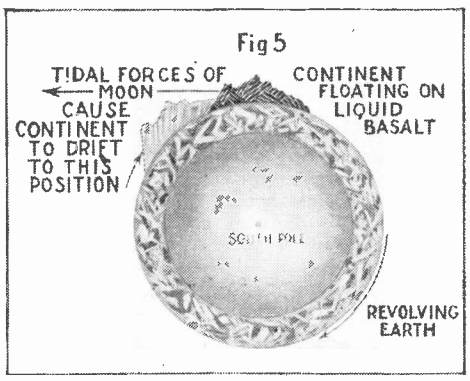
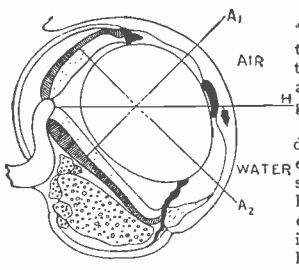


Fig. 3 above shows how basalt, the underlying structural layer of the earth, increases in volume as it is heated and finally melted. The increase is on the order of 10%.

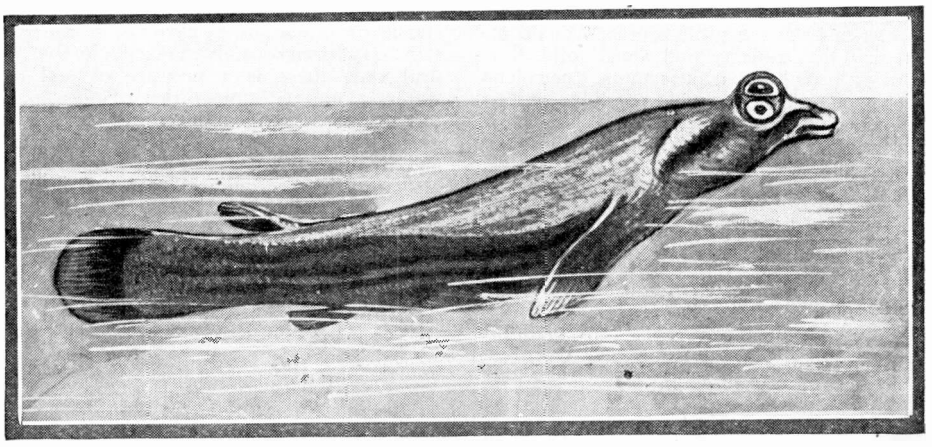


It is calculated that in thirty million years the layer of basalt will be completely liquefied and solid continents will be left floating free on the surface. These continents will then respond to tidal forces and, the liquid basalt being relieved of its insulating cover, the continent, will crystallize and the complete cycle will start over again. One cycle is now in the process of completion and is occasionally shown by earthquakes and other unusual upheavals. No complete change may be expected for millions of years.—Prof. Charles T. Dahama, Ph.D.

A "Four-Eyed" Fish



There is a fish that is a native of tropical America and which at first glance appears to have 4 separate and distinct eyes. However, upon analysis, it is found to have two eyes, each of them being divided into halves. One of these halves is for sight in air and the other for seeing when in water. Because of the different refractive properties of light in its passage from air or water into the eye, it is necessary that the sections of each eye be differently designed in order to see properly in both mediums. The diagram above shows a cross-section of one of these unusual eyes. There are two distinct lenses and each of them has its own retina, indicated at the ends of lines A1 and A2. This reminds us of bi-focal spectacles used for seeing both near and distant objects.

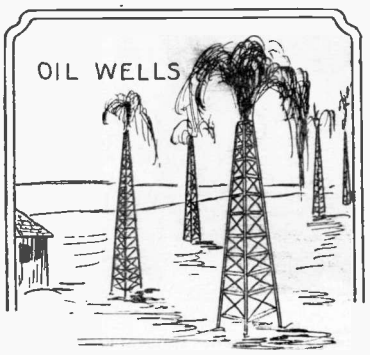


The so-called "four-eyed" fish has a habit of swimming through the water with the "air" half of its eye above the surface and the "water" half below the surface, as shown above. Thus, this fish has perfect vision in either of the two elements mentioned.

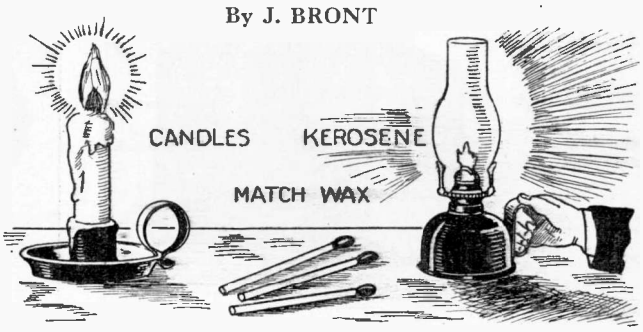
Petroleum the Versatile

The Ramifications of the "Family Tree" of Crude Petroleum Are Varied

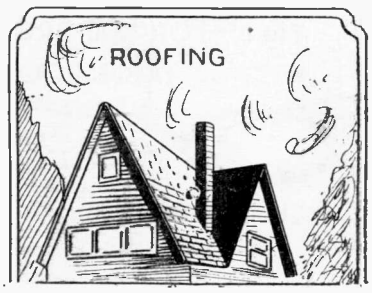
By J. BRONT



The crude oil, obtained from wells is refined and many by-products of widely different uses result.



Various types of illuminants are obtained from crude oil. Different waxes, applicable to the making of candles and matches as well as kerosene oil are three of the best known examples.



The roofs of houses are protected by crude oil. One by-product is made into an effective roof covering material.

THAT chewing gum, gear wheels, TNT and lipstick could emanate from the same source is highly interesting. Further, that these products could originate from crude petroleum, is rather startling, yet the ramifications of crude petroleum refining and processing are endless. The total number of chief products that may be evolved from the black contents of crude oil approaches the half of a thousand mark. There is further promise of the production of many other products with the application of the proper "cracking," distilling and refining methods.

As another instance of the contrast in the products evolved from crude oil, consider the production of alcohol, pharmaceutical, oils, roofing, and electrical insulation from the same source. Or consider the fact that coke, candles, sulphuric acid and welding gases are available from crude oil under process of distillation and "cracking" of the various residues obtained. Imagine the production of axle grease, automobile tires, and soap from petroleum—or ink oils, arc carbons, drug solvents, dust-mop oils, and cosmetics from the same source. Would one imagine that railway and signal oils, flowers of sulphur, disinfectants, petroleum jelly and alcohol could possibly proceed from the source? The fact is obvious if the methods of the modern oil refinery are studied and understood.

The sealing compound which seals the top of your radio dry cells, the brushes which lead the house wires to the electric fan commutator, the black paint on your iron fence, the wax on your match sticks, the fuel for the vessel which took you abroad, the pentane which gauged the candlepower of your electric light globes, or the coke in your heater, may have all come from the original substance: crude petroleum. The versatility of this precious mixture of hydrocarbons is readily obvious. There is hardly a moment of modern existence which is not, in any way or another, affected by petroleum. The actual products emanating from crude petroleum depend upon the processes involved, and the physical properties of the "crude."

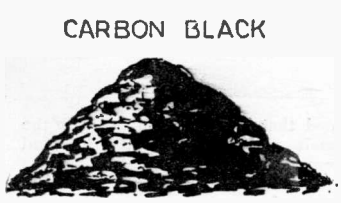
Crude oils vary in physical properties, generally respectively with the definite "fields" from which they are produced. Different localities produce petroleum of different constituents, but in all petroleum, the main body is simply a mingled variety of hydrocarbons. The latter are in varying degree and therefore various substances appear in the final analysis, however, except for traces of sulphur, oxygen, nitrogen and compounds of the same, the actual substance of crude oil is covered in the caption: Hydrocarbons. Necessarily in the natural state there is a mixture of soil and water, along with quantities of gas.

The main classifications of crude oils are given as the paraffin base, napthenic base and the asphaltic base. There are mixtures also of the three main classes, and it is almost certain that even in any given isolated "base" oil, there will be inevitably some trace at least of one of the other bases, more or less.

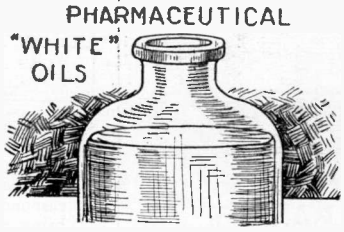
Fig. 3. gives an idea of the constituents of the crude oil as delivered to the refinery from the field of production. At the refinery the process of separating the various components would be a highly difficult matter were it not for the fact that each group (or hydrocarbons which make up the bulk of the crude petroleum) possesses a different boiling point. This latter fact is of great value in the processing of the raw petroleum.

The "crude," as it is popularly referred to, is placed in large containers and heat applied. The most volatile group of hydrocarbons may boil at a temperature so low that the heat will not harm the skin and the hand might be thrust into the contents of the containers without risk of injury. The degree of heat necessary for the vaporization of the first group is maintained at a steady figure until all the members of that group have evaporated, being subsequently condensed in cooling coils or led off to storage in the form of gas. The fact is that little or no boiling is sometimes necessary for the production of this gas. Fuel gas, petroleum ether, and natural gasoline are some of the derivatives from this product.

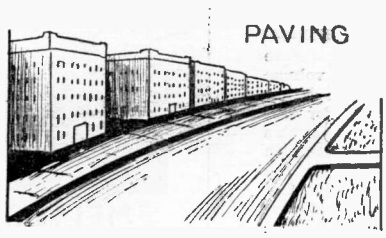
When the last of this group of hydrocarbons has passed from the contents of the "boiler," it is then necessary to raise the temperature of the remaining contents, so as



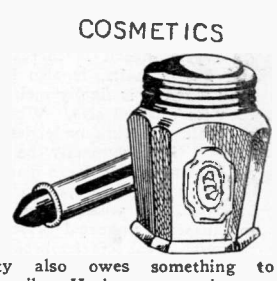
Pure carbon, useful in a hundred different ways is the ultimate residue of the distillation of crude oil.



Many oils adapted to the preparation of medicines are products of certain distillation processes.



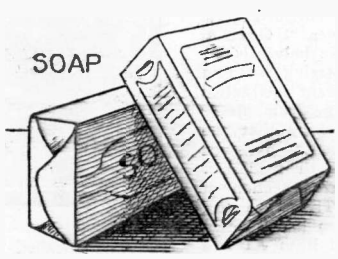
Compounds used for paving street surfaces are obtained at one stage of the treatment of crude oil.



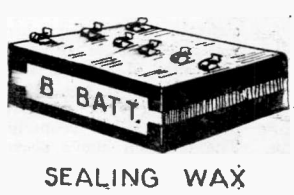
Beauty also owes something to crude oil. Various cosmetics are made with its aid.

Varnish and paint vehicles as well as black pigments are by-products.

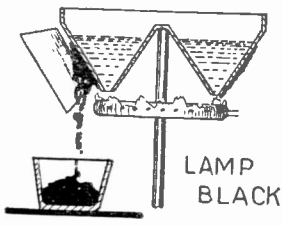
Benzine, usually used by dry cleaners, comes from the petroleum refining stills.



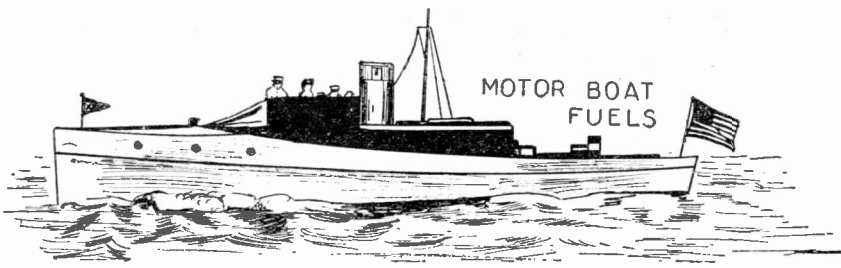
Soaps of all kinds and for various purposes use products of certain fractional distillation.



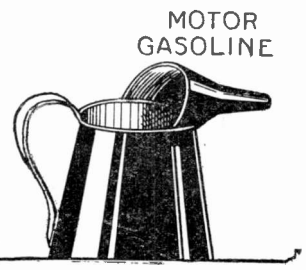
Sealing compound used for sealing dry and storage batteries, is a product of petroleum.



Lamp black, used in many ways such as in the preparation of inks is another product.



Naphtha, a popular fuel for motor boats as well as gasoline and other engine fuels are all obtained from the stills through which crude oil passes during its complicated refining process.



Gasoline for all forms of internal combustion engines passes off from the stills.

to reach the "boiling" point of the next group of hydrocarbons. From the latter group is derived naptha, which is the basis for gasoline, cleaner's and dyer's naptha, airplane petrol, and the various substances used in the paint and varnish manufactures. When this group has ceased to vaporize from the residual "crude" remaining in the "boiler," the temperature is again raised to meet the point of vaporization of the next group of hydrocarbons. Refined oil is the result of this step. From refined oil, all "signal" oils and kerosene are made.

With a subsequent raise in the boiling temperature applied to the distilling apparatus, this next step produces a product with which probably not one person in a thousand is familiar, as it is produced, yet in all probability has used it for a life time, more or less. The product is "gas oil" and is used for raising the qualities of "city" gas.

Paraffin distillate is another class covering an additional group also vaporized by another step in the upward trend of the treating temperature, at the boiler. All petroleum waxes, as a general rule, are derived from this step in the process. With the extraction of the wax by chilling, there is a residue left from which lubricating oils are evolved.

Further, paraffin "slop" is again run through the still, breaking up into lesser volumes of each of the classes already mentioned. The same re-run process is accorded to the gas oil mentioned in a former paragraph, a good grade of gasoline being obtained, as well as less valuable products. The re-run process is, however, a duplicate, practically, of the original process, with the exception of a difference in manipulation.

"Wax Tailings" are used in roofing manufacture and similar work.

The ultimate residue in the still approximates to pure carbon in the form of coke. The latter is made into a hundred different products, beside being used as fuel, making electrical motor "brushes," battery electrodes, and one instance is even known where a company is using the finely ground carbon (coke) to manufacture gears.

During the refining process, if any residue, from any step of the whole manipulation, appears to be worthy of a re-run, it is rehandled and with the result that the whole original list of individual hydrocarbon groups is represented in the succeeding substances evolved. Further, each individual product is re-run and "cracked" as many times as is practicable or desirable. The result from distilling and cracking shows that more than 500 different individual items may be evolved from the original "crude" as it emanates from the well and is delivered to the refinery. The illustrations show only a very few of the products possible from the refining process.

In cracking of heavy "gas oil," the latter is broken up in boilers under pressure and at a temperature of about 700° F. Condensation and separation of the evolved constituents is deferred until a desired time, when the pressure is relieved, and the vapors then rapidly escape in volume, at the same time leaving a deposit of carbon (coke). The vapors are condensed and led to proper storage tanks. The process is akin to the original crude distillation.

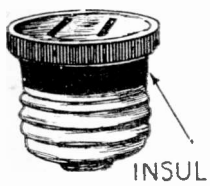
From hydrocarbon gases and light distillates, are produced fuel gas, gas black, rubber tire filler, inks and paints. Alcohols, —isopropyl, butyl, amyl, hexyl. Lacquers, essential oils and soaps. Welding gases, natural gasoline, various forms of napthas, pentane, airplane petrol, drug solvents, motor car gasoline, rubber solvents, dyer's and cleaner's benzine, railroad and signal oils, lighthouse oil, stove and tractor oils.

Medium distillates are the source of: gas oil (mentioned heretofore), and other products. Thick distillates are the base for waxes of all kinds: candle wax, laundry wax, etcher's wax, roofing wax, paper filler, chewing gum and match wax. The heavy distillates also produce: lubricating oils of all kinds, ink oils and transformer oils, beside many other substances of similar application. Residues from the distilling process produce vaseline or petroleum jelly, various medical applications, cup grease, boiler fuel, floor oils, salves, creams, roofing filler, paving material, and a host of other products. Coke is evolved from the residue, and is made into electrodes, brushes, gear wheels and the like after being ground fine and moulded or otherwise treated, in addition to the coke being used in a score of other ways. Sulphuric acid, sulphonic acid, dyes, and pitches are obtained by extraction or elimination in like manner.

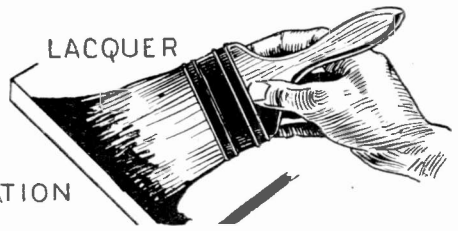
From "oil shale" is obtained a good portion of the variegated chemical items involved in distillation. One substance, pyridine, is used in the denaturing of alcohol so that it may be sold tax free. Dyes, disinfectants, icthyol, and ammonia are among the products obtained.

It is obvious that the modern oil refinery is in truth an enormous chemical factory which separates the natural content of crude petroleum into a half a thousand constituents, and it must be prepared to be able to handle a number of products probably unequalled by any other industry under the sun. It is only by the extraction of the individual components of the original petroleum, subsequent refining, and finding of a proper use and market for each, that the work of the modern refinery is fulfilled. Every available process and machine of chemical, electrical and mechanical properties is utilized in this work. The actual benefit of the modern refinery to our present-day existence is tremendous.

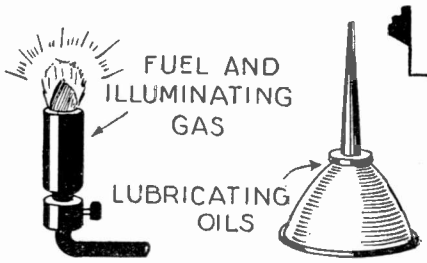
Without coal tar and petroleum the industrial world would come to a stand-still.



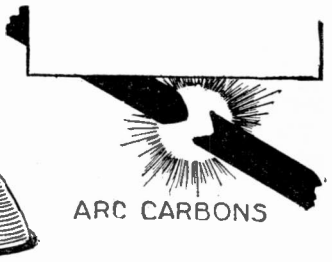
One of the solids obtained from crude oil is made into insulations of various kinds.



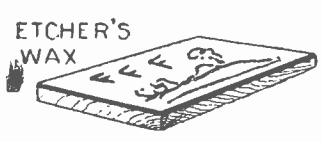
Lacquers are made with different materials that are obtained from oil.



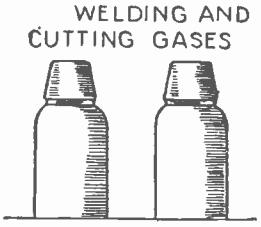
Gas for fuel and illuminating purposes as well as lubricating oils come from petroleum.



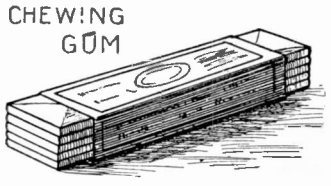
A carbon by-product is one that is often used for compressing into arc carbons.



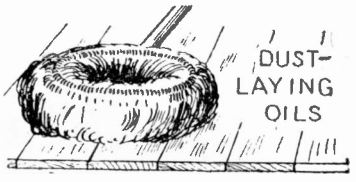
An especially refined wax for use by etchers is a product of petroleum by fractional distillation.



Gases for welding and cutting purposes are obtained and compressed into tanks.



One of the many wax products of crude oil is eventually made into chewing gum.



Oils used for dusting and polishing purposes in the home are also products of crude oil distillation.

The Evolution of the Spring

By GEORGE ARTHUR LUERS

The development of the spring from the archer's bow to the present air-sprung motor tire, extends backwards over thousands of years. During this period the classification of springs is divided into four stages of development dependent upon the means and material which the human race possessed. The first stage is that embodying wood. The archer's bow is the foremost example. The catapult developed from this. Today the same name is applied to huge and powerful mechanisms which propel airplanes from the deck of ships. The caveman used a bent tree to spring a snare to trap wild animals. Later long ash members were placed between the axles and body of wooden chariots to effect greater speed. The second age occurred when bronze came into use, and the knowledge of hardening this by hammering was devised. The hammering treatment added elasticity to the metal, and made it more suitable for a spring. Most of our present-day spring shapes, such as spiral, helical, laminated leaf and torsional, originated in bronze. The third stage occurred with the advent of steel, which surpassed bronze for elasticity, hardness and strength. The tiniest spring used in a miniature wrist watch to the heavy springs capable of handling the entire weight of a locomotive, or the entire trainload of cars, are now made of steel.. Laminated leaf springs for automobiles, springs for beds, chairs, typewriters and doors, are likewise made of the same product.

BRONZE USED FOR SPRINGS IN ANCIENT CLOCKS

ARCHERS BOW EARLIEST EXAMPLE OF WOODEN SPRING

STEEL HELICAL SPRINGS IN TOWING LINE

AND DOOR SWING

SPRINGS IN UPHOLSTERED CHAIR

LIGHT AND COMPACT WRITING MACHINES ARE ONLY MADE POSSIBLE THROUGH USE OF SPRINGS

WOVEN SPRING BED

LAMINATED LEAF AUTOMOBILE SPRING, WITH OIL PROTECTING COVER

COMBINATION STEEL SPRING, AIR & OIL IN MODERN AUTOMOBILE SHOCK ABSORBER

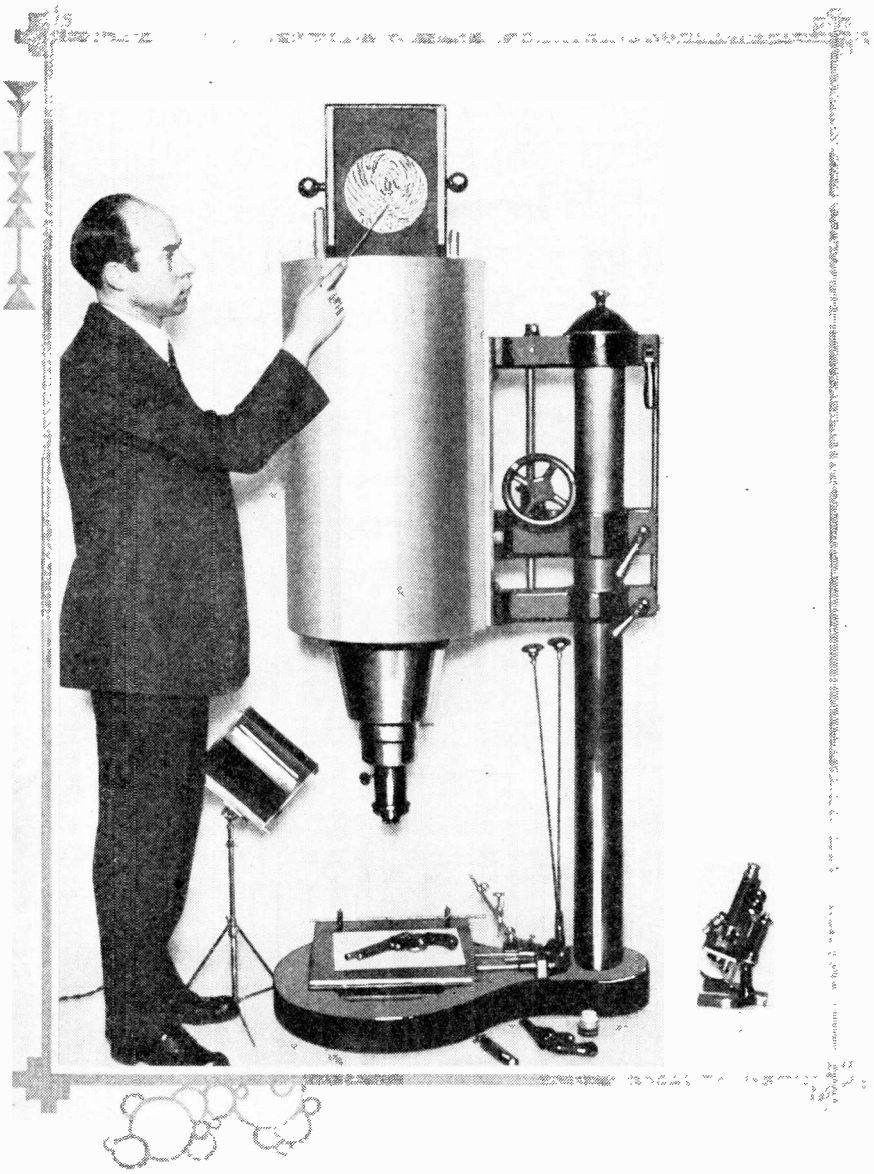
PNEUMATIC DOOR SILENCER

STEEL SPRINGS MAKE POSSIBLE CONSTRUCTION OF ACCURATE MINIATURE WATCH

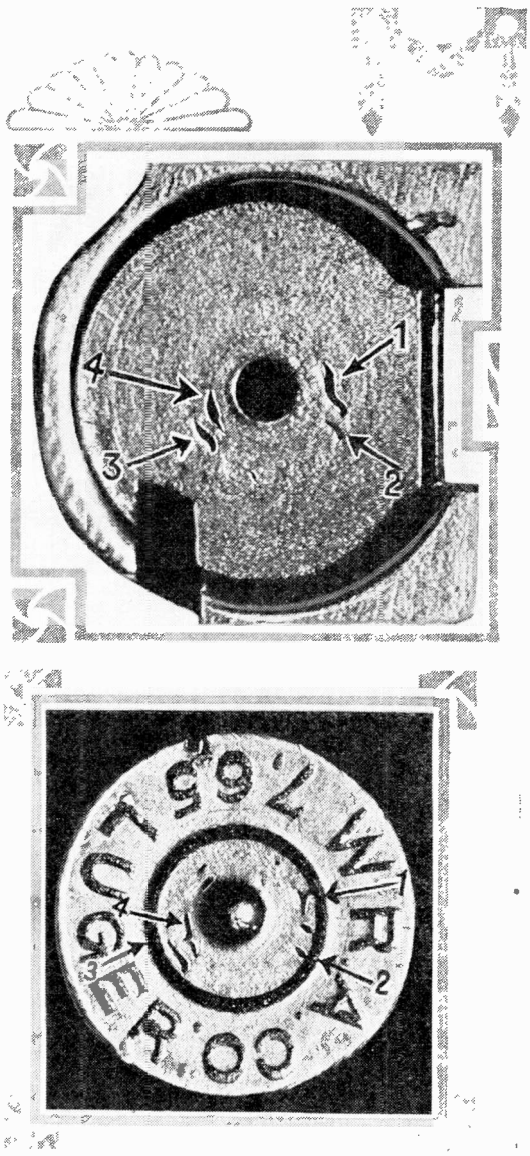
FACILITY OF AIR SPRING TIRE EQUIPMENT TO ABSORB AN IMPACT LOAD

For cushioning purposes, the extreme flexibility of air is now being used. This will be found in the automobile tire, airplane wheels, shock absorber and pneumatic door silencers, as well as on heavy artillery to lessen the recoil of big guns. It seems that at the present time we are entering into an era of air springs. The possibility of replacing steel springs as they have replaced wood and bronze seems near.

A Giant Among Microscopes



The photograph above shows this new giant microscope compared with a standard size of compound instrument which is located in the lower right-hand corner of the photo.



Top photo above shows a magnified view of the breech of a gun, the surface of which is defective. The resulting markings were impressed upon a shell, lower photo, by the force of the explosion.

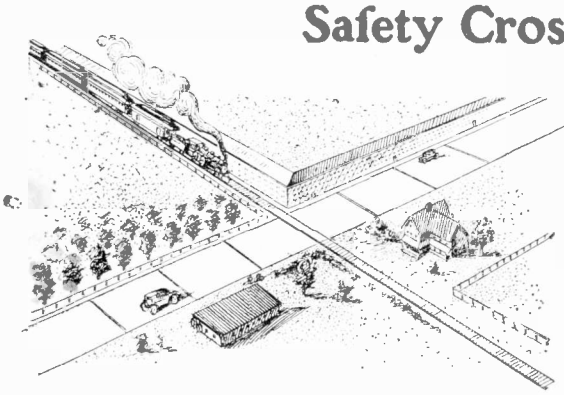
RECENTLY a well-known criminologist, Luke S. May, found his eyesight becoming overtaxed by the constant use of the microscope and, therefore, he immediately ceased all work of this nature, and set to work to design the enormous microscope shown in the photographs above. By means of this instrument, the magnified images of objects can be brought up to such a size that they can be viewed without the least bit of eye strain. This instrument stands eight feet high when set at its greatest height, weighs nearly 500 pounds, and is shown compared with a standard microscope. It is so large that reflecting mirrors have to be placed so that the magnified image can be viewed from the side, rather than from above the microscope. A micrometer scale is included in the instrument, so that it is possible to measure objects less than one-hundred-thousandth of an inch in diameter. The entire microscope is mounted on a specially designed air cushion, so as to eliminate vibration and make photo-micrography possible. Magnification of from two to five thousand diameters is possible, and, with special lenses, one hundred thousand diameters can be reached.

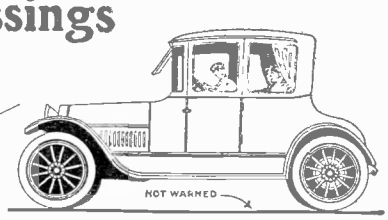
This instrument is constantly used in criminology, and one example of its work is shown in the two photographs directly above. The breech of a gun taken from a murder suspect was photographed, as in the upper illustration. Shells used in this gun showed distinctive markings, as indicated by the numerals. A shell found near the scene of the murder also had these markings, and guilt was established.

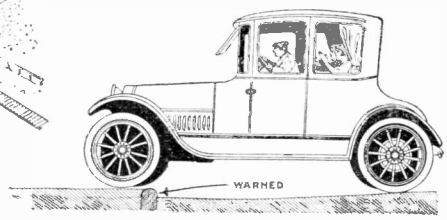
Since this instrument is so arranged that any part of the 18-inch stage can be brought under the lens for examination, textiles and other large objects can be quickly and easily viewed in their entirety.

—GARY E. WILLIAMS.

Safety Crossings

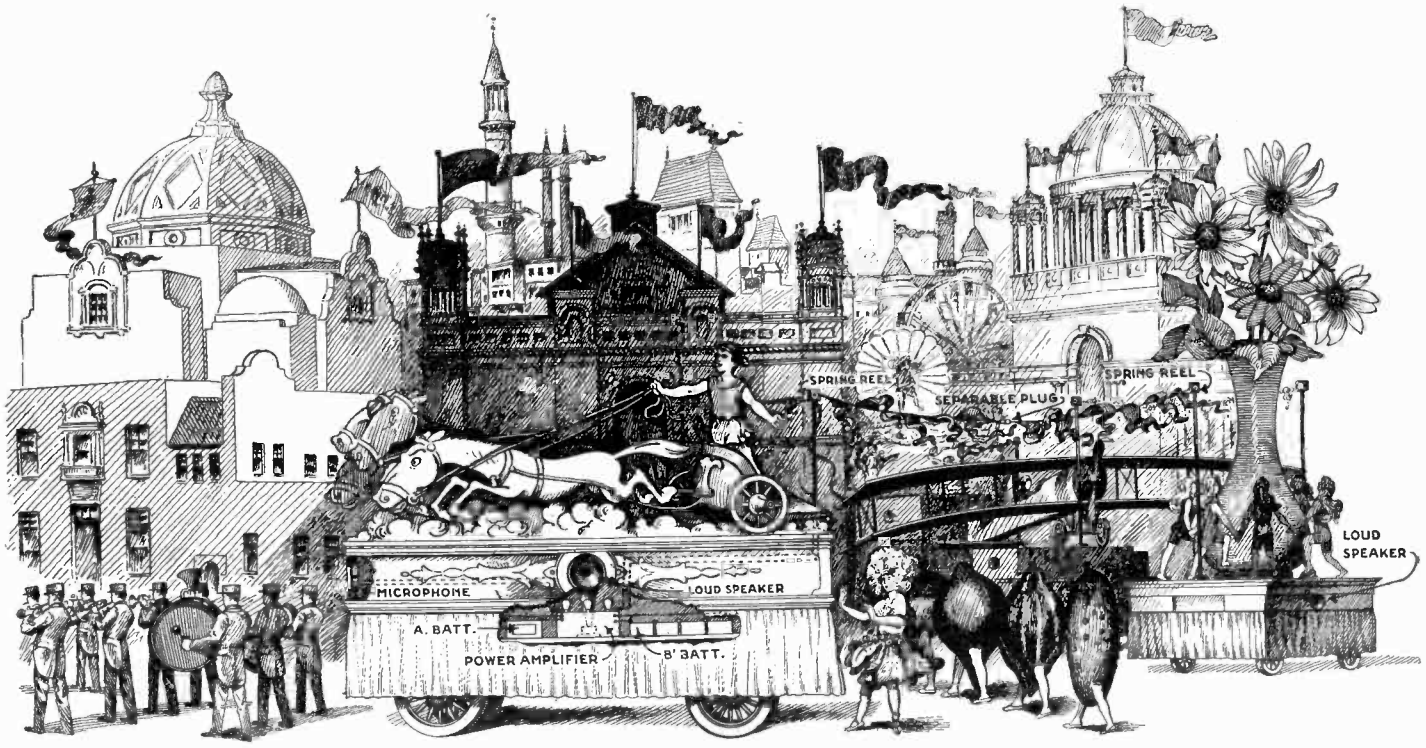


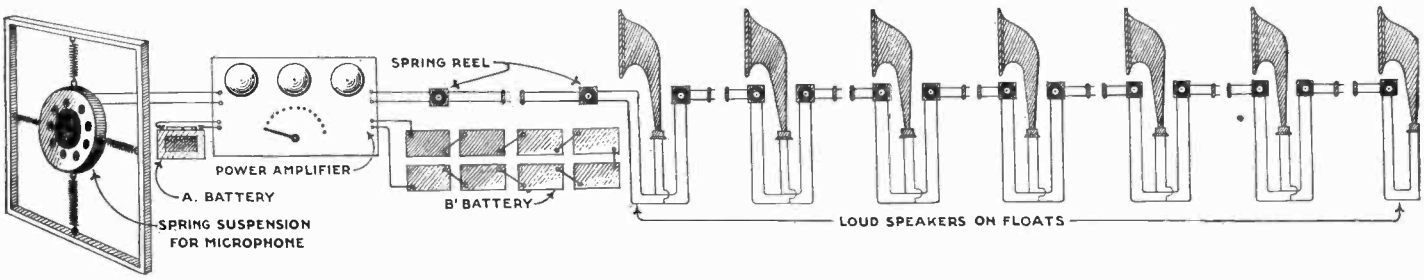




Mrs. Elsie M. Wrightson has designed and patented the safety crossing system shown. Raised ridges in the roadway force vehicles to slow up at crossings.

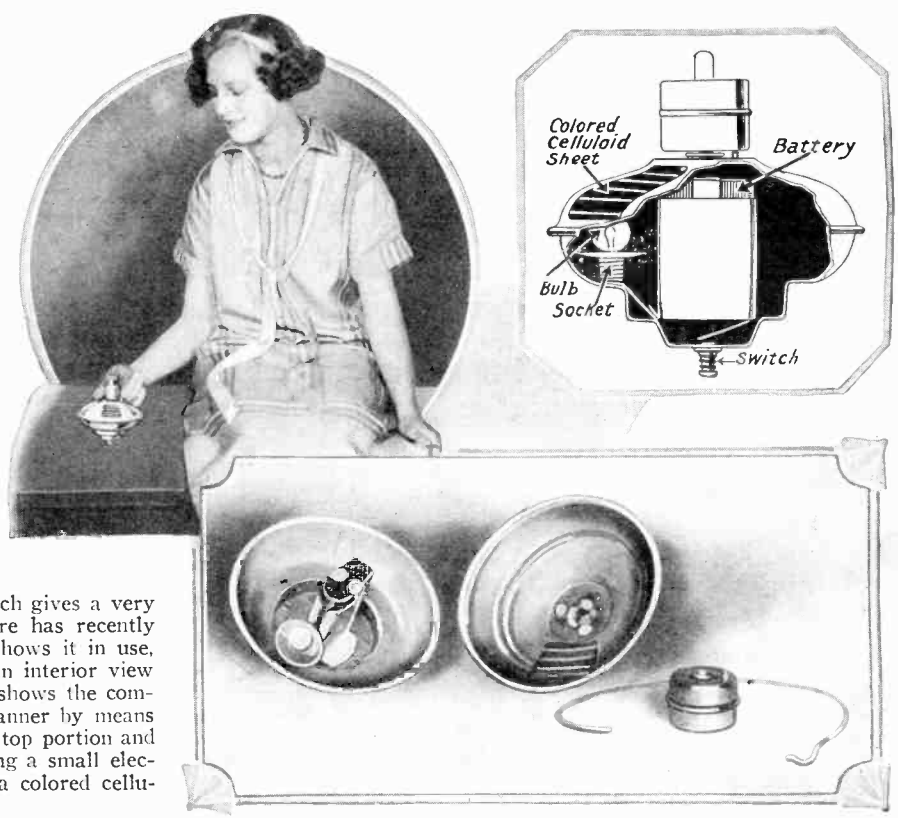
Continuous Music for Parades





OFTEN much of the effect of parades is destroyed because of the lack of music at certain portions of the line. Bands are expensive and often there are not enough of them, so that everyone along the line of march can hear the music at all times. It is quite possible to make one band furnish sufficient music for even a very long parade if the suggestion illustrated above is followed. Their music is picked up by a microphone, fed through a power amplifier and then out to loud speakers, one being located on each float. The floats are connected together by flexible wires or chains covered with decorations. Spring reels at each end allow for the inevitable changing intervals between the floats and separable plugs will pull apart if one float should stop and the one ahead of it should proceed.

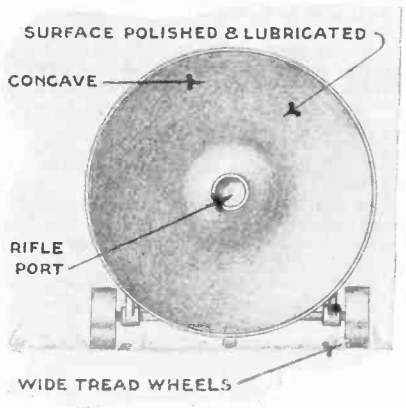
—James McEvoy, Rep. No. 8096.



Luminous Top

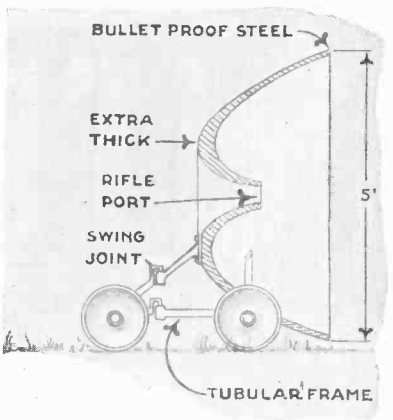
A NEW top that is amusing to children and which gives a very pretty effect because of its luminous feature has recently appeared on the market. The photograph above shows it in use, the drawing to the right of the photograph gives an interior view of the same, and the photo at the immediate right shows the component parts of the top. It is spun in the usual manner by means of a spring contained in the cylindrical detachable top portion and when it hits a flat surface a switch is closed causing a small electric light bulb to light. This casts light through a colored celluloid window.

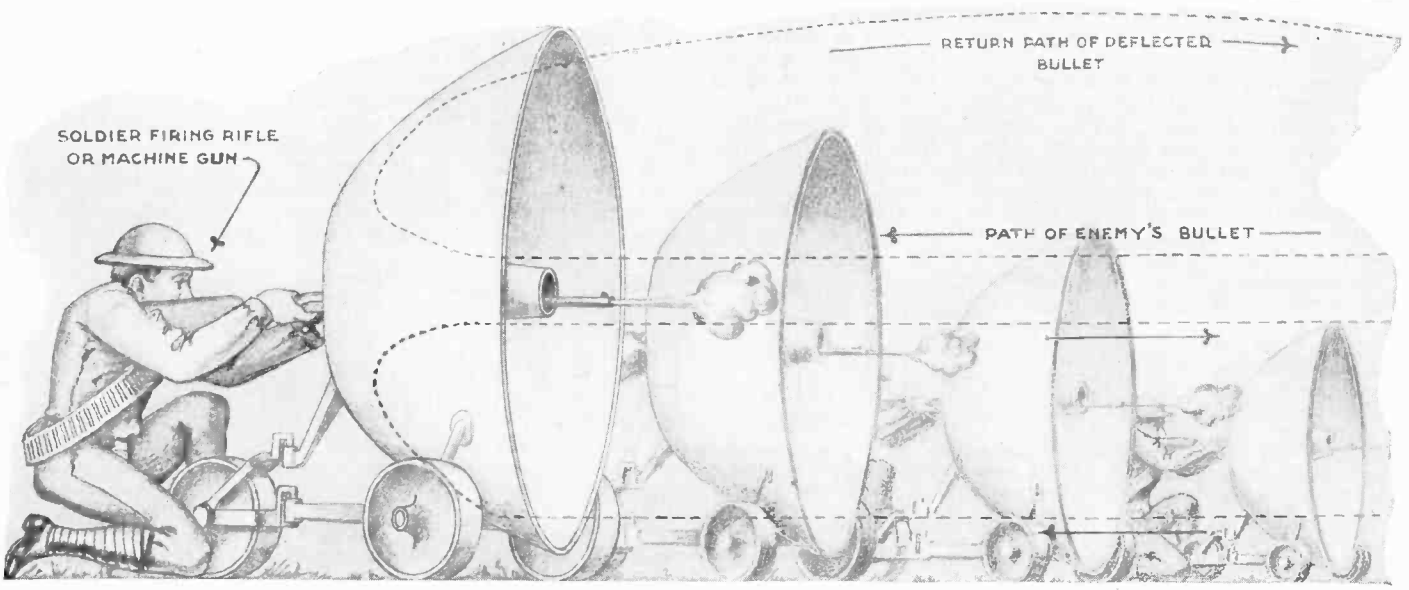
Boomerang Shield for Use in Warfare



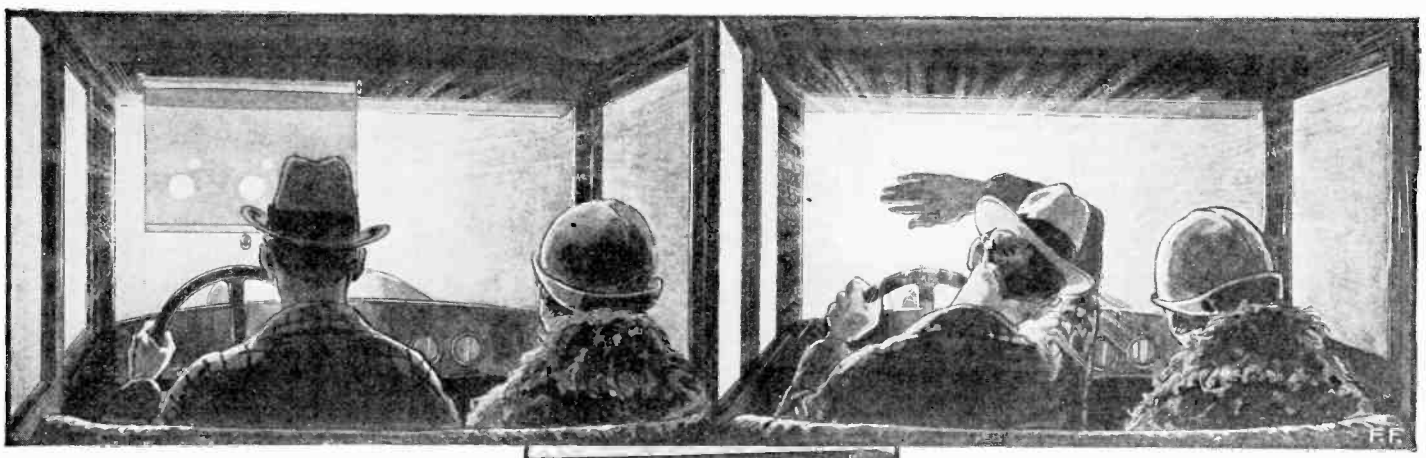
A MASSACHUSETTS steel manufacturer and inventor has devised a steel shield of the nature shown in the illustrations on this page which appliance he calls the "Boomerang Shield." It is so formed that it not only protects the soldier operating it, but sends most of the bullets back to the enemy's lines. The peculiar shape of the device, as can be seen at the left and right, make this possible. The paths of bullets as deflected by this shield are indicated below. The entire shield is mounted on small trucks so that it can be pushed forward as the infantry or machine gun squad advances. While the bullets which return to the enemy may be spent, still the peculiar results would aid in destroying their morale.

—*L. B. Robbins.*

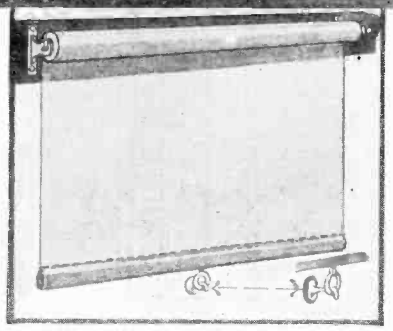




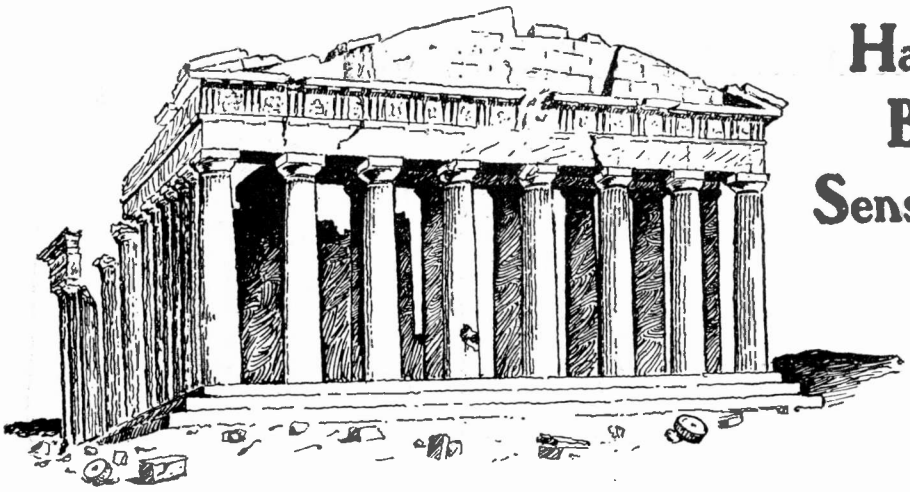
Automobile Glare Preventer



DRIVING against a strong sun early in the morning or late in the afternoon or against blinding headlights of approaching cars often results in automobile accidents if some method of eliminating the glare thus produced is not used. Various state laws attempt to aid this situation by making the use of glare-preventing lenses on headlights imperative. This, however, does not always cure the trouble and in any event has no effect on the glare produced by the sun. The well known roller shade is called upon to help the autoist.



The glare-preventing roller shade illustrated in detail at the left and in use in the upper left-hand photograph meets all the requirements of safe driving. It can be rolled up out of the way in the same manner as an ordinary window shade, or can be pulled down to any distance desired and fastened in place. The hook which holds it is attached to the glass of the windshield by means of a suction cup, as shown at the left. The shade is composed of a transparent green flexible material that allows perfect vision, but prevents glare.



Had The Old Greeks Better Architectural Sense Than We Moderns?

By ARTHUR T. BROWN

It is most surprising to note that the vertical and horizontal lines of that famous old Greek building, the Parthenon, were not straight as they appear to be, but were slightly curved so as to produce an optical effect of straightness. This is explained below.

THE Parthenon has been justly called "the finest edifice on the finest site in the world, hallowed by the noblest recollections that can stimulate the human heart."

In recent years it has been discovered that there is scarcely a single straight line in this magnificent temple, yet its general effect is that of absolute symmetry everywhere. The Greeks recognized the fact that a straight line does not always appear straight, and they were the first to seek to correct this optical illusion.

Absolute perfection of beauty was attained in the Doric order of the Parthenon. The shaft of the column diminishes notably as it approaches the capital. It has, also, a slight convexity. This latter optical correction is scarcely noticeable, yet completely satisfies the eye, and must have been measured to a hair's breadth. Without this curvature the shaft would appear concave. In later architecture the true purpose of this correction has evidently been misunderstood and the curvature greatly intensified, producing barrel distortion, a hideous bulbous effect displeasing to the eye.

Then too, all horizontal lines were arcs having their centers at a common point somewhere beneath the structure. All vertical axes inclined toward an imaginary point, located a mile above the temple.

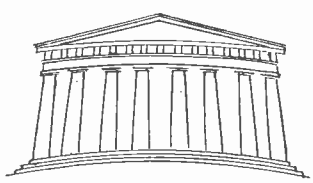
The Greeks also discovered that white columns against a dark background looked sturdier than dark columns against a light background. Therefore, to correct this optical illusion, the corner columns which would appear dark against a light sky were made sturdier and were placed closer together than those columns which would appear light against the dark background of the temple wall.

By looking at some of our public buildings in this country where an attempt has been made to imitate the Gothic style, we are led to believe that the ancient Greeks were probably a little more adept in the art of pleasing the eye in architectural work by recourse to what must be termed "optical illusions."

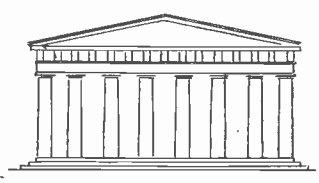
The illustrations in the center of this page show how optical corrections in building design overcome certain tendencies. The first one of the illustrations, that is the one on the left in the center, shows the effect of exaggerating the inclined vertical axes and of too much curvature of the horizontal lines. The center drawing shows the appearance when corrections have been made and that at the right shows how the building would look without corrections.

Now that we have learned something about the scientific end of the construction of the Parthenon, it would not be amiss here to say a few words relative to its history. It was originally built as a temple to the virgin goddess Athena, and is situated on the Acropolis of Athens, Greece. The building is 101 feet wide by 228 feet long and its extreme height is about 59 feet. The temple was originally started in construction about 447 B. C. It was used continually from the time of its completion up to about the beginning of the fifth century of the Christian era. It was then taken over and used as a shrine for the worship of Christ, and although it was first dedicated to the Divine Wisdom, it was later dedicated to the Virgin. When Athens was captured by the Turks in 1458 A. D., the Parthenon became a mosque and a few changes were made, the most notable of them being the building of a minaret in the southwest corner. In 1687, the Turks used it as a powder store house and during a battle with the Venitians, an enemy bomb fell through the roof causing an explosion which completely destroyed the central part. In the early part of the last century, permission was granted to remove the sculptures from the Parthenon to London. These latter works of art represent the greatest ever produced by the Greeks in the history of their country. They included pictorial representations of historical battles and a long frieze running entirely around the outer wall, wrought in a low relief style. The battle representations showed at the eastern end of the temple a mythological struggle between the Gods and the Giants, while at the western end the battle was that between the Athenians and the Amazons. On the southern side was depicted the battle between the Centaurs and the Lapithæ, while on the opposite side the victory over the Persians and the capture of Troy was shown.

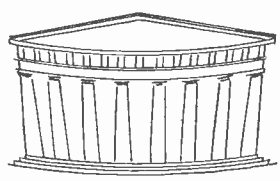
The sculptures did not entirely depend upon the artist's chisel for their beauty but colors and metals were skilfully worked into the design so that, while the result was one of severe simplicity, still they were vigorous in their animation.



The effect of exaggerating the inclined vertical axes and the curved horizontal lines.

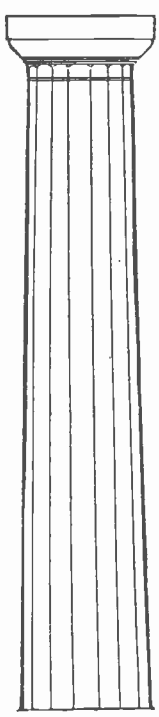


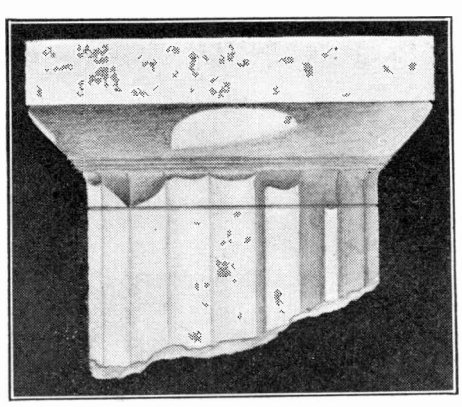
This shows the temple as it appears with the optical corrections giving the effect of straight lines.



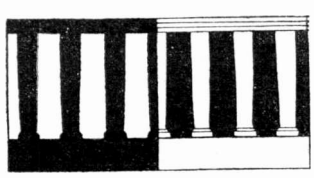
The Parthenon would look as above if curved corrections were not used to give a straight effect.

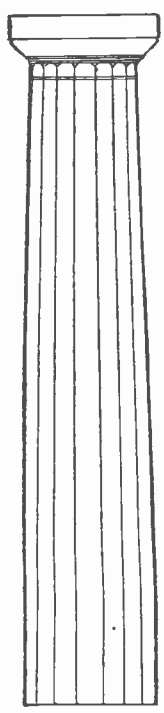
The complete column at the left of the illustration shows the concave appearance of a pillar whose sides are absolutely straight. Right, lower center, shows that white columns appear sturdier than black ones, and therefore black columns are placed closer together to effect sturdiness. The column at the extreme right has slightly convex sides and appears to be most sturdy.



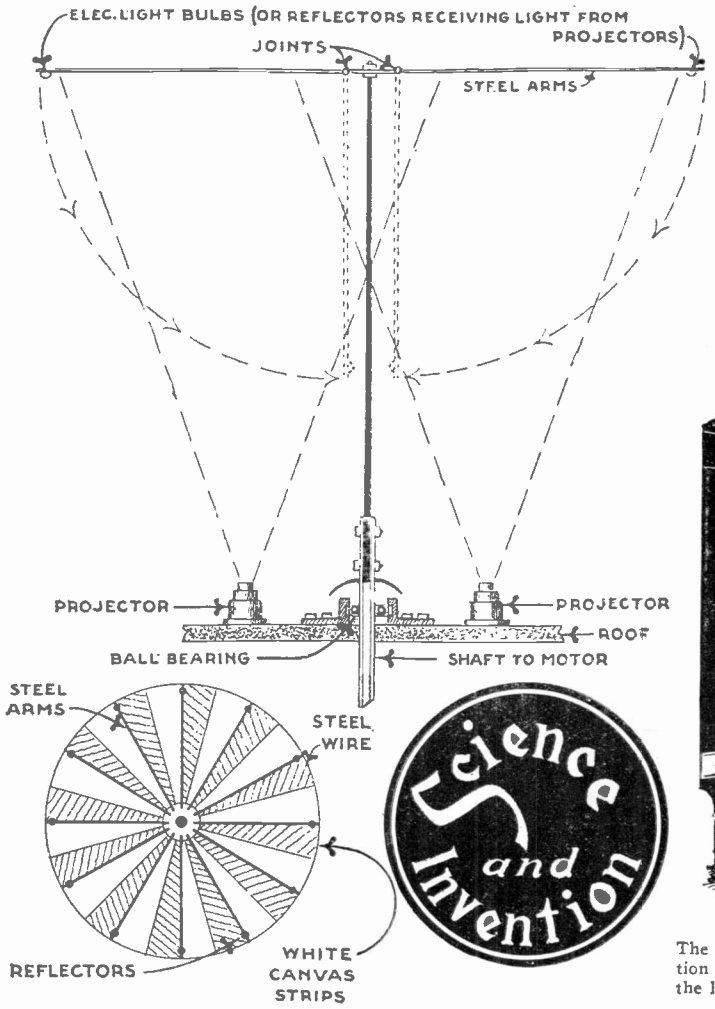


Above: The utter simplicity of the capital of a Greek Doric column is shown. The fluting was so planned as to cast the shadow which tends to relieve the utter simplicity and add to the charm of line without taking away from the ruggedness of the design.





Rotary Illuminated Advertising Sign

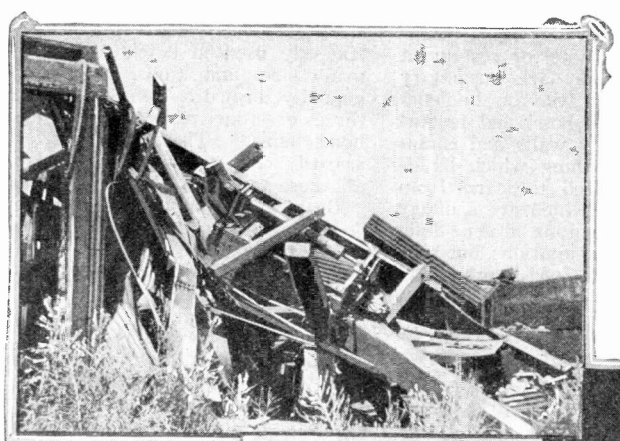


The illustration above shows the appearance of this rotary electric sign when in operation at night. The bulbs or reflectors on the outer edge of the circular frame provide the luminous border. If properly arranged, a sign of this nature is a most attractive night display.

The details of this sign are shown in the various drawings above. White canvas strips are attached by one edge, to the spokes of the rotating wheel. Centrifugal force flattens them out so that the sign projected from below by means of one or more projectors is visible upon the flat surface so formed. A curious fluttering yet distinct outline of the letters is a feature of this sign. The two lower drawings above show the circular "screen" at rest and in action at night with a sign projected upon its surface.—P. C. VAN PETEGEM, Rep. No. 13992.

The Sun an Engine of Destruction

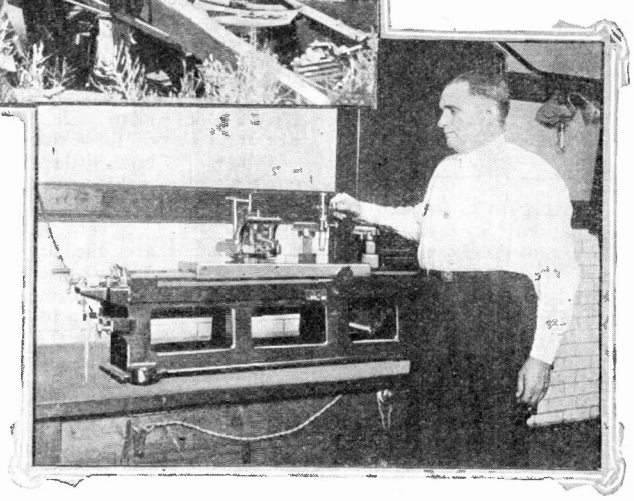
The terrific power than can be exerted by the blazing desert sun is shown vividly in the photograph at the right. The picture shows the remains of a mechanical plant which a few years ago was in operation in a California desert. It was abandoned and the continual intense heat played upon it by the sun's rays tore wood and iron apart almost as effectually as if done with a sledge hammer. Many other monuments to the destructive powers of the sun are to be found throughout the various hot parts of the globe.



Left: The ruins of this Californian desert machine shop should warn everyone in torrid countries of the danger attendant to the neglect of machinery exposed to the direct sunlight. Under such conditions, mechanisms should always be kept in repair.

25,000 Lines to the Inch

In technical design work, it is often necessary to draw a series of lines numbering hundreds or even thousands to the inch. Heretofore, this work had to be done by hand and the results were not at all accurate. Dr. Wilmer Souder, a physicist of the U. S. Bureau of Standards has solved this problem by constructing a machine which can draw up to 25,000 lines to the inch with the greatest possible accuracy. The machine will be of assistance to many phases of engineering design work.



The photograph at the right shows Dr. Wilmer Souder with his newly developed mechanical line drawing machine which, used in technical designing can draw 25,000 lines to the inch. Resembling a small bench lathe in construction, it does the work faster and more accurately than any human draftsman could do.

Electrically operated machinery is used for the task of peeling potatoes.

Hotel Kitchen Science in the Home

By CHRISTINE FREDERICK

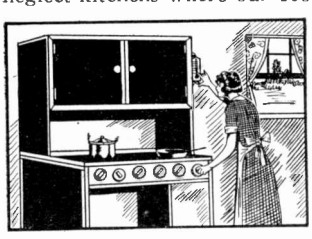
Founder Applecroft Home Experiment Station, Greenlawn, Long Island, N. Y.
Author "Household Engineering"

Dish washing is no longer laborious when machinery is employed.

THE modern hotel kitchen, since the day of the new type skyscraper hotel, is a housewife's museum of marvels. Many large new hotels make a showplace of it, and guides take visiting people and guests through it.

For the reason that in a great hotel kitchen, the average home kitchen tasks are multiplied many times, but still remain the same in principle, every live housewife can profit by what science, invention and management can do to lighten and speed up kitchen work. I suggest that every woman who can do so, visit some large modern hotel or restaurant and ask to see the kitchen. This is more than a sight-seeing trip, and more even than a trip to get pointers. It is also a civic duty. Women are the natural guardians of personal health, and specialists in food and food preparation. If women will take more interest in our public kitchens, they may aid in holding up higher standards of health and diet. More and more are we becoming a nation of restaurant patrons; in some western cities women are ceasing to cook much at home and are going to cafeterias.

But solely for their own special benefit women can learn much from the hotel kitchen. Personally, I am convinced that soon we are going to see a forward movement, to bring home kitchens more up-to-date. It is a crying scandal today how home kitchens are 100 or more years behind the times. A business man who prides himself on his modern office comes home and dines on food prepared in a kitchen whose standards would astonish him if he really knew them. Not that they are unclean or untidy, so far as constant cleaning can make them. But nowadays modern standards start with the material a place is built of. Who, nowadays, cares to go into a hotel or restaurant built of the old-fashioned, dark unsanitary materials? We look for tile or linoleum or "composition" floors in hotel and restaurant kitchens, and sanitary walls and equipment. This is the first thing which builders of home kitchens need to learn from hotels—to build kitchens which are sanitary to start with. We have gone a very long way in home bath room sanitation; but why neglect kitchens where our food is prepared?



Heat for cooking can be accurately and easily regulated with the modern types of electric ranges.

Wall paper in a kitchen is an unsanitary abomination. So is carpet. So are all curtains except easily washable light material. So are all bare wooden surfaces, except bread cutting boards, etc. Germs and food particles too easily lodge in them. You do not see them in modern hotel kitchens, where the very latest metallurgical science supplies them with Monel metal for work surfaces.

But quite naturally, our interest centers considerably on the mechanical equipment in hotel kitchens, and certainly there are "eye-openers" here. Take the matter of the "stove." Great numbers of women still use coal stoves in their kitchens, winter and summer. Contrast this with the latest in electric stoves. There are homes with electric ranges, but only in recent years has a thoroughly practical one been evolved. A "heavy duty" electric range is now used in hotels and restaurants since a heating stand has been developed for heavy duty heating. It makes the old-type hotel or restaurant kitchen, with its high temperature and sweltering cooks, rather obsolete. These electric ranges come in four-foot units, so that a kitchen is expansible on the principle seen in sectional book cases or filing cabinets. There are many homes with enough people to cook for to warrant one of these 4-foot range units.

The old method of peeling potatoes need not be resorted to in the up-to-date kitchen.

Naturally electricity is the greatest single revolutionizing agent in modern kitchens; and one of the most labor-saving of all electrical contrivances is a device, now extensively used in hotels and restaurants, in many sizes and kinds. It is what is colloquially termed a "mixer." There are now three or four makes which are built in home size. These "mixers," occupying scarcely one square foot of space, will do all these tasks:

Beat eggs or any other ingredient.
Mince, whip, beat, stir, crumble, strain, mash, rice.
Knead bread.
Churn butter.
Make ice cream.
Mix or stir at various speeds.
Boil and mix at the same time—by a gas burner underneath bowl.

This one device eliminates a very considerable amount of ordinary kitchen hand labor. It's astonishing, if you have one of these devices in your kitchen, as I have, how little time and energy it requires to make some of the things women have hitherto spent long hours in producing.

Several other very novel electrical devices are the automatic electric toaster, which browns the toast just right and then stops. These come in a size for from 3 large slices up to 12 large slices at a time. Then there is the electric waffle iron, which certainly is an improvement over the old family iron, used only a few times a year because it was so outrageously hard to clean. The electric waffle iron is greaseless, and made of aluminum, and is such a joy. It has a cute little electric light signal on it.

Then there are bread and meat slicing machines, electric juice extractors, for lemons and oranges; machines which cut vegetables and potatoes; machines which pare hard root vegetables solely by friction; machines to open cans; even machines to automatically form Hamburger steak cakes without human touch.

The ovens of such hotels and restaurants as do their own baking are revelations. What would grandmother, whose pies are justly famous, say after looking at one of the pie machines, into which pies are fed on a conveyor and come out baked at the other end!

Last, but not least, dishwashing—that dreaded drudgery of the home! But it doesn't daunt the hotel kitchen management, even when there are 1000 people's dishes to wash. The dishes are fed into a dishwasher, where they are cleaned by a marvelous, powerful spray system, and come out of the machine practically dry. It saves 60 per cent. in dish breakage and cuts labor cost in half. Incidentally it cleans silver as well as dishes.

The working surfaces in hotel kitchens are up-to-date too. They are often of the new Monel metal, which doesn't rust or corrode, nor chip, as enamel does.

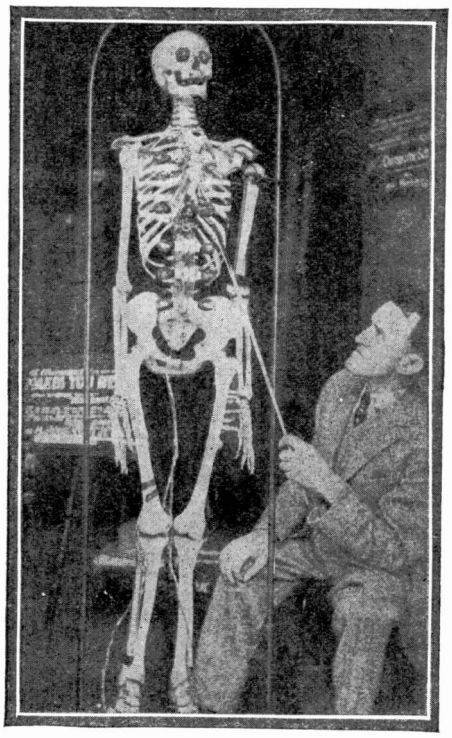
Of course one might go on indefinitely and tell of the coffee-making machines, the ice-making machines, the utensils, and the scheme of management. But it is not the purpose of this article to merely describe hotel kitchens; rather to draw useful lessons from them for home use.

The scarcity of servants is making it each year more certain that the kitchen of the future must be mechanically as near up-to-date as possible, if women are not to be kitchen drudges as of old. Our modern food and sanitation standards are much higher than in grandmother's day, so that there is twice as much work as grandmother had to do, unless women get mechanical aid. I have proved it to my own satisfaction that with a really up-to-date kitchen a woman can do her own housework and still have lots of leisure. But she will need a very alert intelligence. She will need to get persuaded—and so will her husband—that it is worth the price to have

Machinery is now employed for mashing potatoes and for doing other kitchen duties of similar nature.

up-to-date kitchen equipment, just as it is worthwhile to have up-to-date office equipment. If women are to be content to stay in the home and not scrap the home for hotel and cafeteria, they will have to be provided with the means of minimizing home drudgery. Slowly but surely this is happening. Architects are beginning to plan more correct kitchens; a "bride's equipment" is now no longer a matter of some aluminum pots and pans and a coffee percolator, but a battery of kitchen equipment more extensive and also more expensive.

Electric Demonstrating Skeleton



A skeleton for demonstrating the effect of displacement of the osseous structure of a human being upon the nerves; displacing the joints opens the electric circuit and puts out lamps, or weakens them by reducing the current.

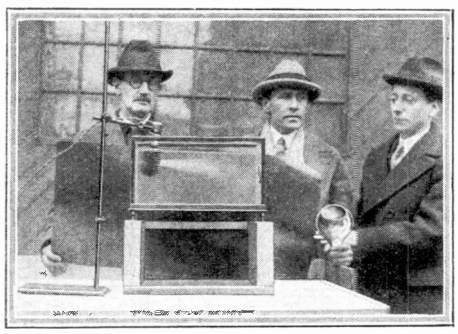
A LOS ANGELES chiropractor has suspended a skeleton by a metal support and installed electric globes at various points along the spine and in the eye sockets to demonstrate the principles of chiropracty.

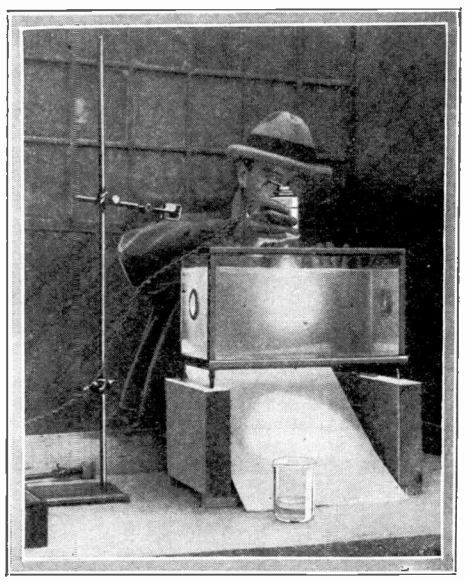
When all the nerves are functioning properly, nervous energy is presumed to be sent to all the vital organs, this condition being likened to the electric lights burning brightly. But when one or more nerves become pinched, the stream of nerve energy is partly shut off, this being shown by the chiropractor by dimming the electric lights on the skeleton. When one or more nerves are totally cut off, the organs do not function at all, this condition being demonstrated by cutting off the electric current to the lights.

This is a fine idea for schools.

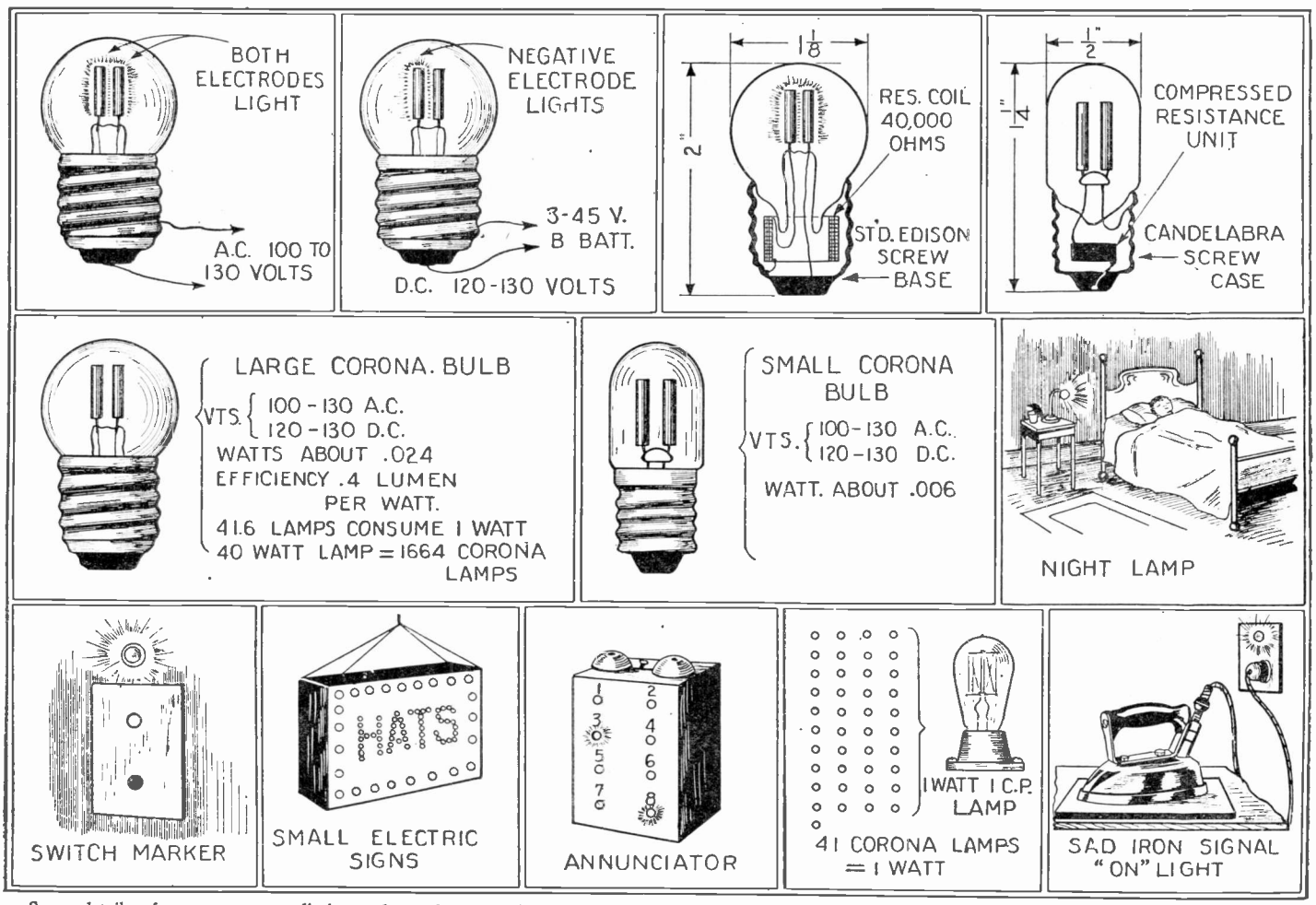
New Lens Absorbs Heat

A new lens, composed of a liquid enclosed in a container of a concave shape has the property of absorbing heat rays and so producing a nearly cold light that is admirably suited to the treatment of tuberculosis and to the projection of motion pictures. The photographs at the right and below show tests being made of the lens and in the lower illustration the inventor, E. W. Boerstler, is seen in the center of the group. The lens will control powerful beams of light.



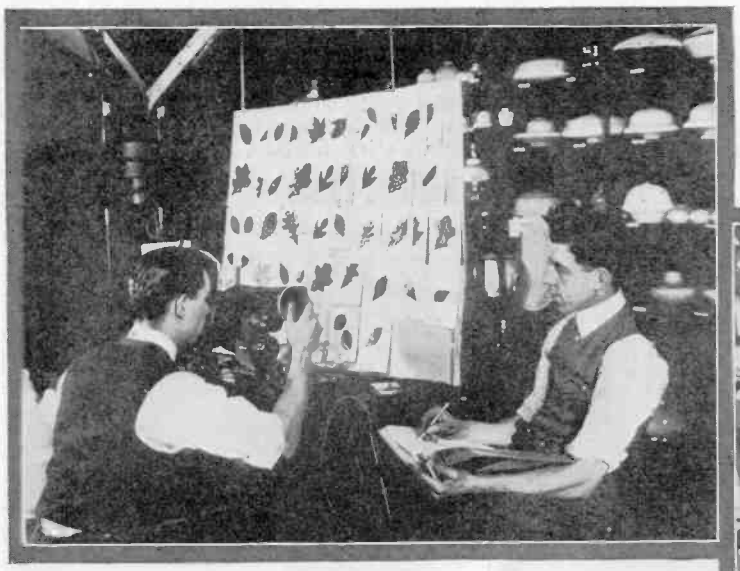


New Corona Lamps Are Nearly Wattless

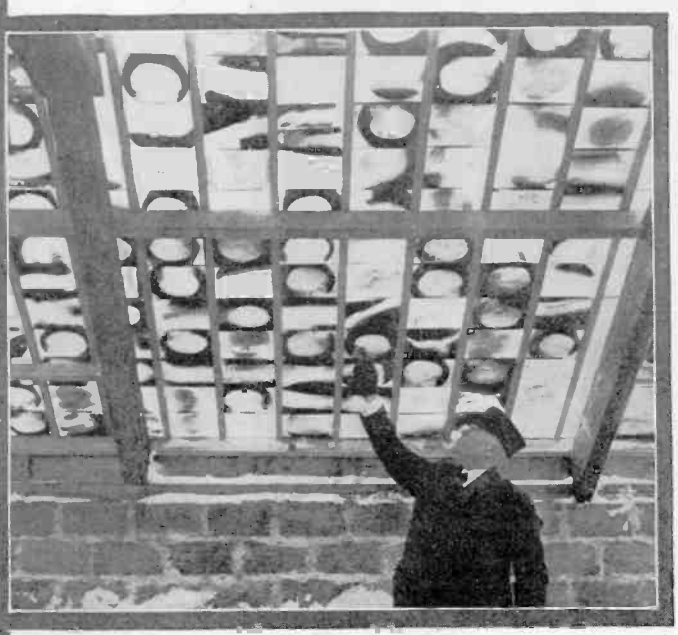


Some details of a new corona discharge lamp developed by the Edison Lamp Works of the General Electric Co. are shown in the above illustration. Two types are made, the large one consuming approximately .024 watts and the small one .006 watts. Extremely high resistance coils are connected in series with the discharge elements. The uses of such economical lamps are multitudinous and only a few general suggestions are illustrated.

Odd Science Photos

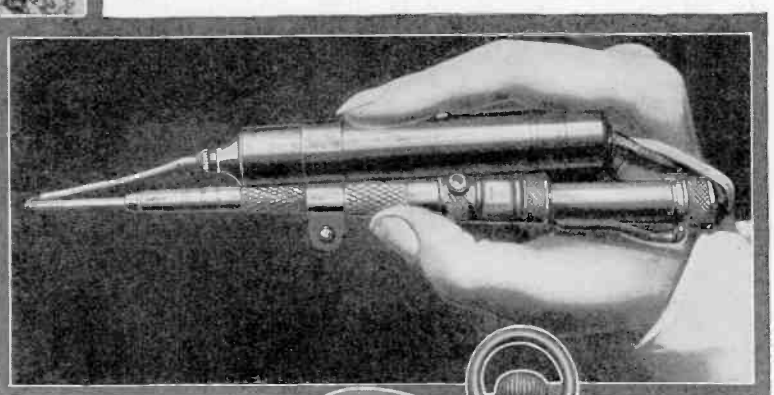


The leaves of the trees turn red and yellow in the fall due to the presence of alcohol. In the photo at the left, experts are shown measuring the amount of light reflected by leaves at different stages of their life cycle. During the summer months, leaves absorb 90% of the sunlight, but in the fall, they reflect most of it and their growth is retarded. The leaves ferment, alcohol is formed and the green pigment is absorbed, leaving the red and yellow colors well known to all of us.

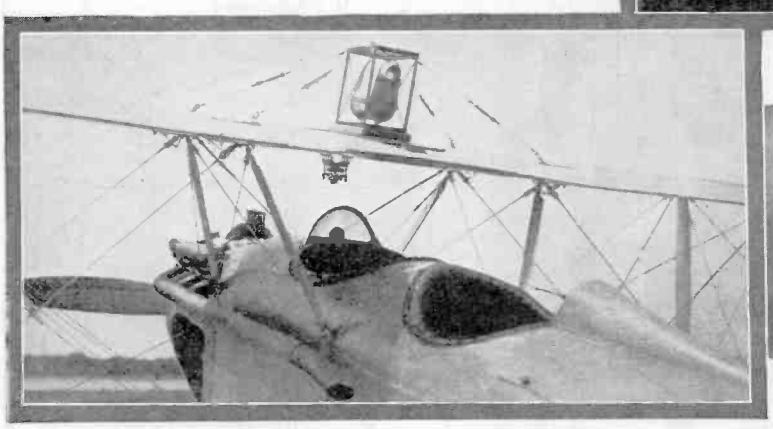


An odd effect has been produced in a green house by using old glass X-ray negatives as shown at the right. These negatives, obtained from a hospital, cast shadows of various parts of the human anatomy.

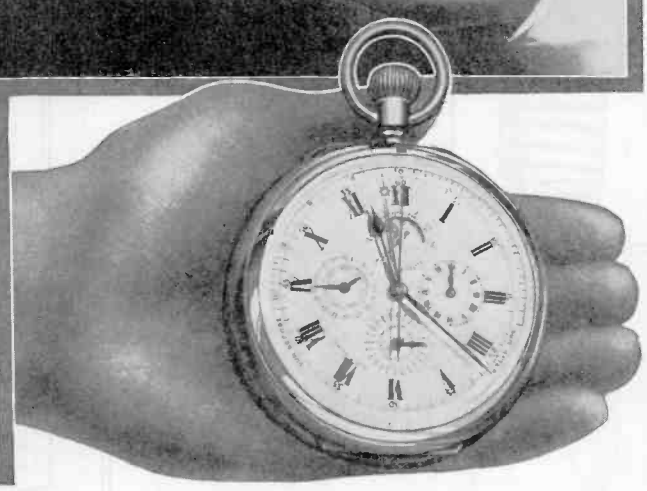
A new dental combination, shown in the photo below, injects cocaine into the tooth being drilled at the same time that the operator works on that tooth with the drill. This instrument, of German origin, is said to be very effective in producing painless dental work.



Above: A new method of planting and growing strawberries makes it possible to obtain three times the ordinary yield from a given size of garden. The strawberries are planted in soil filled boxes and then stacked in tiers, thus conserving space, yet allowing full growth.



A specially equipped airplane has recently been placed into service by the U. S. Weather Bureau for the purpose of studying the conditions of the upper air. This plane is shown in the photograph above, with some of the special apparatus visible. It makes daily flights in all kinds of weather.



The illustration above shows a very remarkable astronomical watch. This watch is so arranged as to perform many functions and in order to accomplish this, the movements are built in three tiers, jeweled throughout. This watch strikes the hours and also indicates when it is run down.

The Month's Scientific News Illustrated

By GEORGE WALL

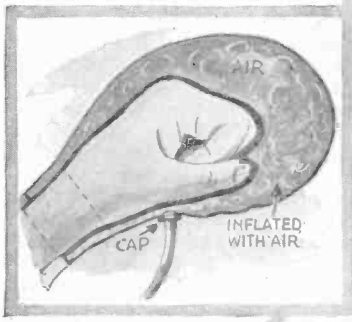
The city of London has been so long in fog and smoke that an aviator is making considerable money by taking up passengers above the obscuring mists and allowing them to bask in the sunlight.

In order to reach a fur store and rob it of its valuable stock, robbers recently tunneled through 60 feet of ground from a near-by cellar to that of the fur store. Details of their feat are shown in the above illustration.

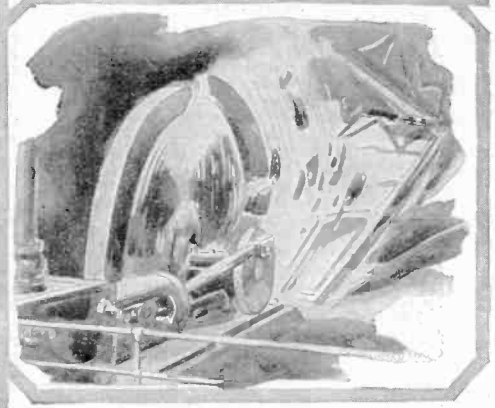
The water found in gas pipes may freeze. One man attempted to thaw out such a pipe with a match. The freezing had burst the pipe and the gas ignited.

An astronomical expedition to Sumatra to study an eclipse of the sun recently returned with some excellent photographs and a story of the natives' terror at witnessing the phenomenon. They fired off guns and performed other antics in an attempt to bring back the sun which they thought was being taken away by a devil.

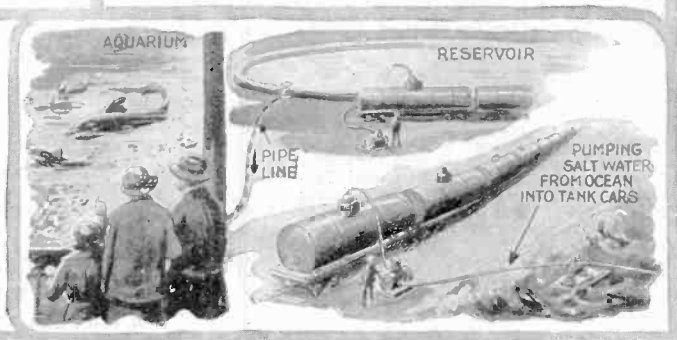
A new method of purchasing "dope" is shown at the right. The buyer thrusts his arm through a slot, carrying the payment in his hand and a "shot" is administered.



The disfiguring effects of boxing matches may soon be eliminated if a new boxing glove, shown in section above, comes into use. It consists of a thin yet strong rubber casing adapted to fit the hand and equipped with a valve so that it can be inflated with air.

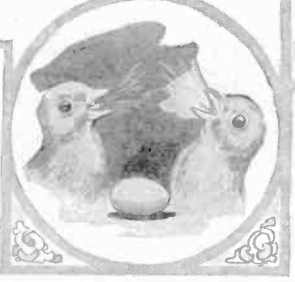


A 12-ton flywheel 20 feet in diameter recently burst while traveling at a high rate of speed and completely wrecked the engine room and two adjoining buildings. The damage done was estimated at $3,500.



In order to provide fish in a Chicago aquarium with the required salt water, a special train of tank cars is to be employed to transport the water from a suitable source of supply to a reservoir from which it will be pumped as required into the fish tanks.

Although the motion pictures are famed for the using of artificial sets to produce certain results, still one company recently made use of a natural ice jam in the Allegheny River for the filming of one of the scenes of the famous play of Uncle Tom's Cabin wherein Eliza is pursued across the ice by a pack of bloodhounds. Taking advantage of this natural jam saved much time and money.



Twin canary birds were recently hatched from a single egg at a Texas bird farm. Both birds were perfectly normal in all ways.

Out of three eggs in a setting, two were broken while the third produced twin canaries.

While cleaning out the rear compartment of a divided truck body designed for carrying coal, a helper was recently buried by the coal in the forward compartment working loose and sliding backward, effectually pinning him in place so that he could hardly move. The fire department had to be called out before he could be released from his unusual predicament. The accident resulted in severe contusions of the body, necessitating hospital treatment.

Tarrano the Conqueror

TWELFTH INSTALLMENT

By RAY CUMMINGS

First American and Canadian Serial Rights

"Get up, I tell you. Put on those garments you wore when we arrived. We are going travelling again." He stood waiting; and beneath his gaze she shrank back, drawing the fur rug over her.

SYNOPSIS

IN the spring of the year 2325, all of the rulers of the various countries of the earth are mysteriously murdered. Jac and Grayson, employees of a large news organization, find that the murders are the result of a plot on the part of the inhabitants of Venus. Tarrano, an erstwhile lower official of the Cold Country of Venus is found to be at the head of a plot to rule the universe.

Dr. Brende, a friend of Jac's, has discovered a medical method whereby human beings may be kept from growing old. The Doctor is killed by a group of "Venus-Men" and Jac, Elza, the Doctor's daughter and Georg, the Doctor's son, are captured and taken to Venia, a city on the earth inhabited by people of Venus.

The next day, Tarrano offers to return the papers and models of the invention made by Georg's father, which he has confiscated and brands young Brende as an impostor. To offset this accusation, Georg is to tell his story to the earth as well as to Venus and Mars by radio and helio. He and Princess Maida go to the station but there they disappear.

Jac, Wolfgar and Elza, still captives, are removed from their prison and taken to the top of an enormous tower. Here, in the instrument room, where communication with the various planets is held, they view the disappearance of the Princess Maida and Georg by television. The abduction has been done by Tarrano's agents. On Mars, Tarrano's followers are attacking the ruling class and Tarrano offers Dr. Brende's secret to the public if they will surrender to his cohorts. They agree. Tarrano then announces to the Earth people, that he will not give them the Brende secret and declares war upon them.

The air war vessels of the Earth government start to attack Venia, but Tarrano sends up a bomb of surrender and then, with Elza, Jac and Wolfgar, he escapes through an underground passageway to a space-flyer. They go on board and are taken to Venus to where Georg and the Princess Maida have previously been transported. They are royally welcomed and go to the palace of the Princess Maida. Here they are attacked by Argo, one of Tarrano's men, who shoots a violet-colored beam of light across the room, separating Maida from the rest of the party. He threatens to kill her, when suddenly Wolfgar throws himself into and through the violet beam.

Wolfgar dies soon after he confesses to Maida that he loves her and Maida has made a similar declaration.

The evening after the burial of Wolfgar, Jac chances to be alone in a small boat near the palace and he is warned by a "slaan," a Venus man, to guard himself well. He also sees below the surface of the water and encased in a diver's cap, the face of an Earth man. Later that evening, preparations are rushed through for the great Water Carnival of Venus and to it proceed Georg and Maida; Elza and Tarrano; and Jac without a partner.

At the carnival all of the inhabitants of the planet are seemingly given over to the pursuit of pleasure and love. However, there is a vicious undercurrent of events noticeable to Jac but which does not seem to claim the attention of Tarrano. At one place there is a swimming pool in which girls are constantly sporting themselves. Watching them, Jac sees one of them drag a Tarrano guard to the edge and with him grasped in her arms, plunge into the pool. A few seconds later the girl comes to the surface but the man is never seen again.

Toward the climax of the celebration, a notorious Venus character, the Red Woman, performs a dance particularly for the benefit of Tarrano. In the midst of it, the large hall in which it is being held, suddenly is darkened and rays of death shoot out over the place. Jac, forewarned, drops to the floor out of their range and throughout the entire assembly, "slaans" in the employ of Princess Maida wreak havoc with their long knives. The cry goes up, "Down with Tarrano. Loyalty, everyone, to your Princess Maida." The Venus people, followers of Maida, have revolted; the Red Woman is deo . but Tarrano—?

Tarrano escapes. Taking Elza with him he travels via aircraft to the Cold Country.

In the meantime, at the Water Festival, other terrifying events are transpiring. The "slaans," thinking that they have been downtrodden, suddenly rise against their own Princess Maida. Maida and Georg attempt to stop them from an attack on the palace but they proceed. Georg turns a cold ray cylinder toward them but sweeps it upward into the tree tops and suddenly, groups of "slaans" who have been hiding in the trees drop to earth, killed by the ray. Snow starts to fall due to the condensation effect of the ray.

Elza and Tarrano reach the City of Ice in the Cold Country and there they found that some of Tarrano's men have been using the Brende instrument for making people immortal. Tarrano refuses to use it.

Back at Maida's palace, the tide has been turned against the "slaans." Maida and Georg are married and rule a section of Venus. Jac suddenly receives a telepathic message from Elza who warns him of danger and rushing to the top of one of the buildings they behold a huge black cloud rolling toward the city. Elza's message to Jac says:

"Death, Jac! Death to all the city! The black cloud of death!"

CHAPTER XVII

TARRANO THE MAN

"WAKE up, Lady Elza."

A silence. His hand touched her white shoulder. "Wake up, Lady Elza. It is I—Tarrano."

Elza opened her eyes, struggling to confused wakefulness. The white walls of her sleeping room in Tarrano's palace of the City of Ice were stained with the dim red radiance of her night light. She opened her eyes to meet Tarrano's inscrutable face as he bent over her couch; became conscious of his low, insistent, "Wake up, Lady Elza;" and his fingers half caressing the filmy scarf that covered her shoulders.

Terror flooded Elza; that time she had always feared, had come. Yet she had the presence of mind to smile, drawing away from him and sitting up, with the fur bedcovering pulled to her chin.

"Tarrano? Why—"

He straightened, and into his expression came apology.

"I frightened you, Lady Elza? I'm sorry. I would not do that for all the worlds."

Her terror receded. The old Tarrano, over whom she still held sway. She summoned a look of haughty questioning.

"You are bold, Tarrano—"

His gesture was deprecating; he seated himself on the edge of her couch. She saw now that he was fully dressed and armed with a belt of many dangling instruments.

At this time Elza had been in the City of Ice for a considerable period. Irksome, worried days of semi-imprisonment; and through them, Tarrano's attitude toward her was unchanged. She saw little of him; he seemed very busy, though to what end, and what his activities, she could not learn.

Within the palace, half as guard, half as maid-servant, Tara was generally Elza's only companion. And then, one evening when Tara's smouldering jealousy broke forth in Tarrano's presence and Elza uttered an involuntary cry of fear, Tara was summarily removed.

Elza was left practically alone; until at length came this night when invading the privacy of her sleeping room, Tarrano awakened her. He sat now upon the edge of her couch.

"I have a confession to make to you, Lady Elza." He smiled slightly. "As you know, there is no one else in our habitable Universe to whom I would speak thus frankly."

"I am honored, Tarrano. But here, at this hour of sleep—"

He waved away the words. "I have asked your pardon for that. My confession—as once before, Lady Elza, I come to you most humbly, confessing that my affairs are not going as I would like. You do not know, of course, that Mars—"

"I know nothing," she interrupted. "You have kept me from the News-mirrors, if indeed there are any here—"

"Mars revolted against me," he went on imperturbably. "The Little People are again in control. Fools! They do not realize, those Governors of Mars, that their public ultimately will demand this *Everlasting Life* of mine—the Brende secret—"

She frowned. "No one knows better than you, Tarrano, that my father's secret does not bestow immortality. To cure disease, in a measure—"

He checked her; his smile was ironical. "You and I know that, Lady Elza. We know that on this plane we would not want everlasting life if we could have it. But the public does not know that—Let us not discuss it. I was telling you—confessing to you—I have lost Mars. Temporarily, of course. Meanwhile, I have been preparing to invade the Earth." His gesture was expansive. "I have been planning, from here in the Cold Country, to send armies to your Earth."

He paused an instant. "I think now I shall wait until the next opposition—we are far from Earth now, but all in good time we shall be closer . . . Strange is it not, that I should like to tell you my plans?"

She did not answer; she watched his smile fading into a look of grimness. "In the Great City, here on Venus, they are getting ready to attack me. Did you know that?"

"No," she said.

"You supposed they were? Your brother, and that Jac Hallen?"

"Yes."

"And you hoped they were, of course?"

"Yes," she repeated.

He frowned. "You are disconcertingly frank, Lady Elza. Well, let me tell you this—it would come to nothing. The Rhaals are with them—all the resources of the Central States are to be thrown against me. Yet it will come to nothing."

Her heart leaped. Tarrano was making his last stand. Beyond the logical sense of his words, she could see it in his eyes. He knew he was making his last stand. He knew too that she was now aware of it; and that behind the confidence of his words—that was the confession he was making.

Tarrano's last stand! There seemed to her then something illogically pathetic in it all. This man of genius—so short a time ago all but the Emperor of three worlds. And now, with them slipping from his grasp, reduced to this last stronghold in the bleak fastnesses of the Cold Country, awaiting the inevitable attack upon him. Something pathetic . . . .

"I'm sorry, Tarrano."

As though mirrored from her own expression, a wistful look had come to him. Her words drove it away.

"Sorry? There is nothing to be sorry about. Their attack will come to nothing . . . yet—" He stopped short, and then as though deciding to say what he had begun, he added:

"Yet, Lady Elza, I am no fool to discard possibilities. I may be defeated." He laughed harshly. "To what depths has Tarrano fallen that he can voice such a possibility!"

He leaned toward her and into his tone came a greater earnestness than she ever heard in it before.

"Lady Elza, if they should be successful, they would not capture me—for I would die fighting. You understand that, don't you?"

She met his eyes; the gleam in them held her. Forgetful of herself, she had allowed the fur to drop from her: she sat bolt upright, the dim red light tinting the scarf that lay like gossamer around her white shoulders. His hand came out and touched her arm, slipped up to her shoulder and rested there, but she did not feel it.

"I will die fighting," he repeated. "You understand that?"

"Yes," she breathed.

"And you would be sorry?"

"Oh—"

"Would you?"

"Yes, I—"

He did not relax. His eyes burned her: but deep in them she saw that quality of wistfulness, of pleading.

"You, my Elza, they would rescue—unless I killed you."

She did not move, but within her was a shudder.

"You know I would kill you, my Elza, rather than give you up?"

"Yes," she murmured.

"I—wonder. Sometimes I think I would." Suddenly he cast aside all restraint. "Oh, my Elza—that we should have to plan such things as these! You, sitting there—you are so beautiful! Your eyes—limpid pools with terror lurking in them when I would have them misty with love! My Elza—"

The woman in her responded. A wave of color flooded her throat and face. But she drew away from him.

"My Elza! Can you not tell me that even in defeat I may be victorious? It is you more than all else that I desire."

Without warning his arms were around her, holding her fiercely to him, his face close to hers.

"Elza! With you, defeat would be victory. And with you—now—if you would but say the word—together we will surmount every obstacle.—"

He was kissing her, bending back her head, and his grip upon her shoulder was bruising the flesh. No longer Tarrano, Conqueror of the Universe, just Tarrano the man. Terror surged within Elza.

"Tarrano!"

"Elza dear—my Elza—"

"Tarrano!" She fought with him. "Tarrano, do you dare—I tell you—"

The frightened pleading of a woman at bay. And then abruptly he cast her off. His laugh was grim.

"What a fool I am! Tarrano the weakling!" He leaped from the couch and began

(*Continued on page* 170)

Like a tiny volcano, at their feet, lava from it was flowing down. A little stream of melted rock, viscous, bubbling a trifle; red at the edges, white within, and with wisps of smoke curling up from it.

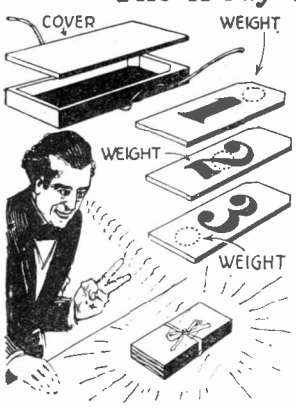
MAGIC By "DUNNINGER"

THE MAN WHO MYSTIFIED

Pres. Coolidge
Prince of Wales, Ex-President Harding, Taft, Roosevelt, and other celebrities
Writes Exclusively for
SCIENCE AND INVENTION

NO. 39 OF A SERIES

The X-ray Eye



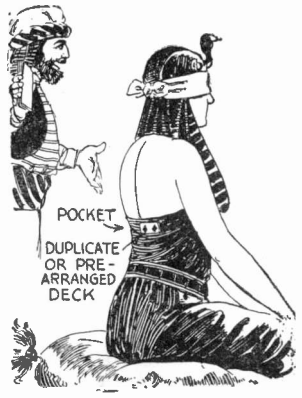
An interesting stunt performed with the aid of three wooden blocks numbered as shown is here illustrated. One of the blocks is put into the box and the performer without opening the box tells the number of the block.

IN performing this stunt the magician passes an empty box and cover and three wooden slabs for examination. During his absence from the room, one of the spectators places one of the slabs into the box, and the other two are secreted in his pocket. The wizard enters and demonstrates that his X-ray eye can "see through the cover of the box," by correctly calling the number of the slab contained in the receptacle. The secret lies in the fact that the blocks are weighted as indicated by the dotted lines. The string which is used to tie the cover in place really acts as a pivot, and by holding the box between the fingers at the knot, it tips correctly indicating the slab which it contains.

It will be noted that the weighted blocks of wood can only be put in the box with the tops facing one end. In this way it is impossible to fool the performer inasmuch as the box will be heavier at the top for block No. 1 regardless of whether or not it is placed upside down.

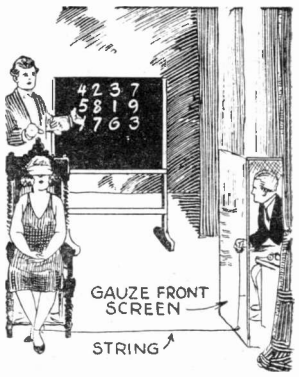
Card Mind Reading Extraordinary

THE most unusual and extraordinary method of apparent mind reading is described. A young lady psychic is introduced when she comes forth in a costume of oriental splendor. She sits herself upon a chair in the middle of the platform facing the audience. The magician walks down amongst the audience, exhibits a package of cards and has them freely shuffled. On returning to the stage, he blindfolds the lady, and then stepping considerably toward the rear, she reads the exact order of the cards. This effect is accomplished by substituting the shuffled deck for a prearranged deck under cover of the blindfolding operation. The lady has memorized the prearranged order of cards.



The diagram above shows the position of the prearranged deck and the position assumed by the magician in performing this trick.

Mind Reading Calculator



The illustration here shows position of the magician and his assistant and also the location chosen by his invisible assistant behind a gauze screen for producing an interesting, yet simple effect in mind reading.

THE simplest and yet one of the most mystifying methods of producing a mind reading act has been originated by the writer, and is herewith offered for publication for the first time. A blindfolded mind reader seated upon a stage calls totals aloud of a series of numbers on the blackboard in back of her. She also describes objects picked by the magician in his journey through the audience. The secret lies in the fact that an assistant behind a gauze screen manipulates a string attached to her ankle and codes the message to her. Field glasses are used for auditorium observation. If the unseen assistant is located in back of a screen with no light behind him, his position will not be observed by the audience, yet he himself can look out from in back of the screen without very much difficulty.

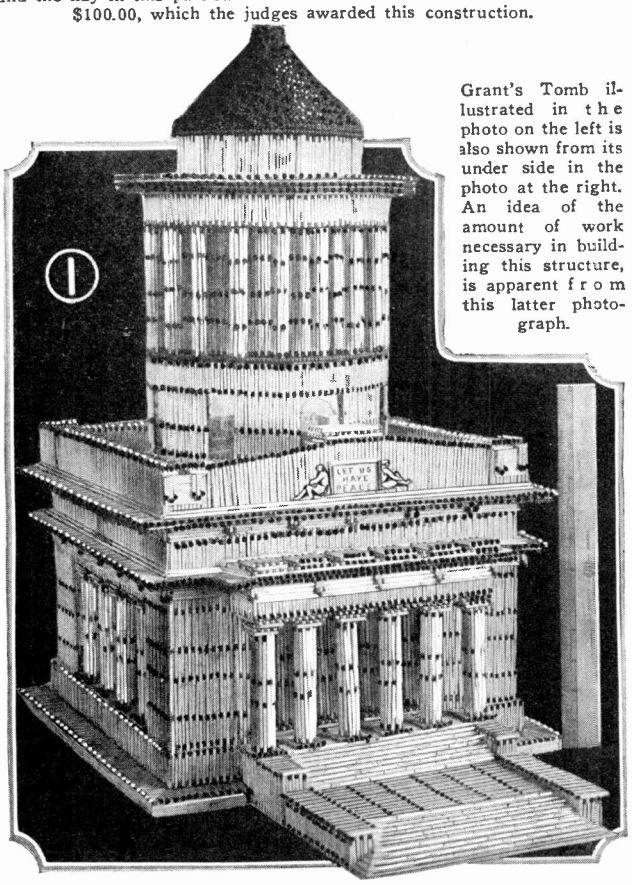
A series of coded messages should be arranged, so that it will not be necessary to jerk ten times upon the string for the number 10. A short sharp jerk could indicate the figure 5.

EFFECTS of an unusual nature are scarce in conjuring, but the readers will agree that this one is an item of unusual interest. A tray of toy rubber balloons is offered for inspection and one is selected which is blown up to its fullest extent, and the air valve is tied. The balloon is then rested on a nickel stand. A borrowed watch is apparently smashed and its demolished pieces placed into a magician's pistol, and fired at the balloon. The balloon bursts and the watch is found hanging from a thin wire on the pedestal. The secret lies in substituting a duplicate watch for the borrowed watch, smashing the duplicate and fastening the borrowed watch to a spring. A sharp needlepoint pierces the balloon breaking it.

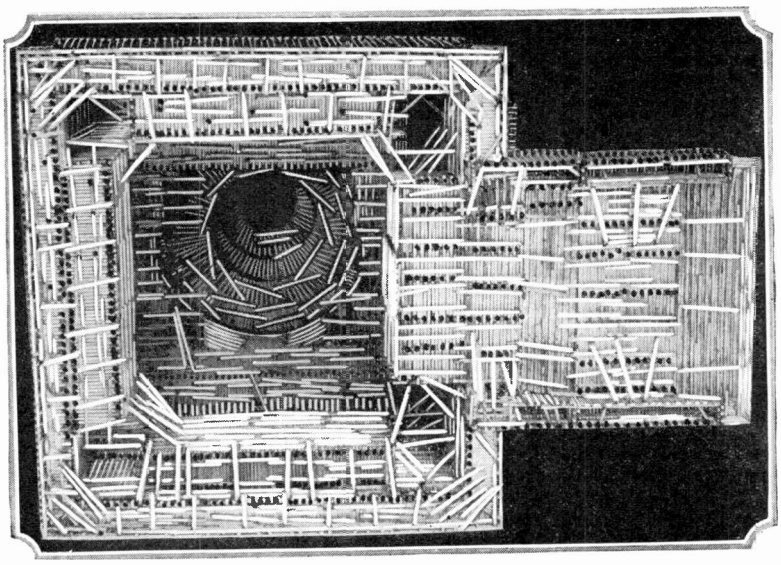
Awards In $5,000.00 Matchcraft Contest

Grant's Tomb Wins First Prize—$100.00.

FOR several months Andrew Tevington of New York City worked upon a model of Grant's Tomb which he was building for the matchcraft contest in SCIENCE & INVENTION Magazine. Of course Mr. Tevington did not work upon the model constantly, but assembled the 19,800 matches required in this construction during his spare time. Spare time to him meant when he was not busy driving his taxi-cab. In other words he was making hay while the sun shone, and the hay in this particular instance is a neat check to the value of $100.00, which the judges awarded this construction.



Grant's Tomb illustrated in the photo on the left is also shown from its under side in the photo at the right. An idea of the amount of work necessary in building this structure, is apparent from this latter photograph.



THE photograph at the left shows the external appearance of this model which is two feet high. The entire structure is self-supporting, the columns being built of a double layer of matches, Le Pages' glue being used to hold the matches together. The replica is quite accurate. The information about the structure was obtained from sketches made by Mr. Tevington on some of his many trips along Riverside Drive. Note in the photograph above the great amount of work required in building the structural foundation of the tomb, and note with what care the matches were laid in place to form the various floors. The two figures on either side of the tablet were whittled out of a block of matches. The dome of the structure is made of the heads of matches, the rest of the match body being used to strengthen the foundation and for building the support for the dome.

$5,000.00 Prize "Matchcraft" Contest

WATCH FOR PRIZES IN JULY ISSUE

FOR the present year, SCIENCE AND INVENTION magazine will award a total of $5,000 in prizes, in a new contest. You are asked to make models, fashioning the same entirely from safety matches. Please observe the following simple rules:

(1) Models submitted must contain at least 90 per cent. safety matches in their construction.

(2) Models made of toothpicks, paper matches, or non-safety matches, are not eligible in this contest.

(3) Models can not be built around boxes or other supporting articles. Walls, roofs, etc., must all be self-supporting and made of matches.

(4) All liquid adhesives, such as glue, shellac, cements, etc., are permissible.
Water Glass makes a good glue and may be used to coat the model giving it a glasslike appearance.

(5) Models may be painted, gilded or silvered.

(6) Models may be of any size.

(7) In order to win a prize, it is necessary that either models be submitted, or, if this is not practical, owing to their size, a 5"x7" photograph of the model may be sent in lieu of the model itself. The best models submitted each month will be awarded the prizes scheduled herewith.

16 Monthly Prizes

First Prize	$100.00
Second Prize	75.00
Third Prize	50.00
Fourth Prize	35.00
Fifth Prize	25.00
Sixth Prize	20.00
Seventh Prize	15.00
Eighth Prize	12.50
9th to 16th Prizes of $10.00 each	$80.00

(8) All models submitted to SCIENCE AND INVENTION Magazine will be promptly returned to the builder, who will prepay all charges.

(9) Where SCIENCE AND INVENTION has any doubts as to the model (where photos only are submitted) complying with all the regulations, the judges may, at their discretion, request that the actual model be sent in for inspection, paying transportation charges both ways.

(10) This is a monthly contest, lasting for twelve months, each monthly contest closing on the first of the month following date of issue. This contest for the month of June will close July 1, 1926, and prize winning announcements will be made in the September, 1926, issue. The July issue will contain April prize winning entries.

(11) Models must be shipped in a strong wooden box, never in a cardboard box, as SCIENCE AND INVENTION can not be held responsible for breakage in transit due to models having been improperly packed.

(12) When models are sent, be sure to affix tag, giving your name and address, to the model itself. In addition, put name and address on outside wrapper of package.

(13) Address all letters, packages, etc., to Editor, "Matchcraft" Contest, care SCIENCE AND INVENTION Magazine, 53 Park Place, New York.

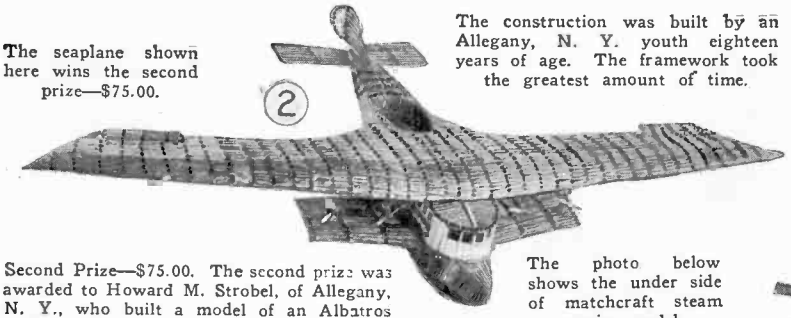
Caution—Soak or cut heads from matches before building your model so that the models may be expressed or mailed.

This contest started Dec. 1, 1925, and will terminate Dec. 1, 1926.

REMEMBER— This is a monthly contest offering sixteen prizes every month. Don't hesitate, send in your model now!

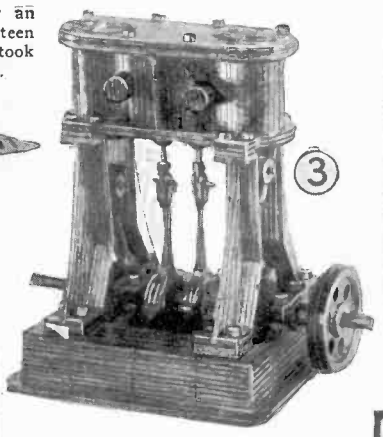
Awards in this Month's $5,000.00 Matchcraft

The seaplane shown here wins the second prize—$75.00.

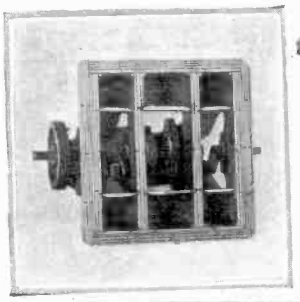


Second Prize—$75.00. The second prize was awarded to Howard M. Strobel, of Allegany, N. Y., who built a model of an Albatros seaplane, as indicated in the photo above. This seaplane measures three and a half feet across the upper wing from tip to tip. There are four motors made of matches connected with four propellers. The internal structure of this seaplane presents a mass of cross braces and structural work seldomly seen in matchcraft articles. The wings themselves are hollow, the elevating rudders and tail move on match hinges.

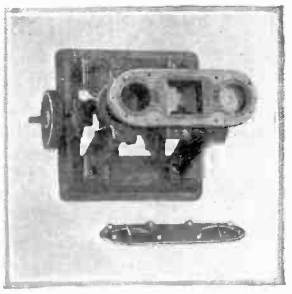
The construction was built by an Allegany, N. Y. youth eighteen years of age. The framework took the greatest amount of time.



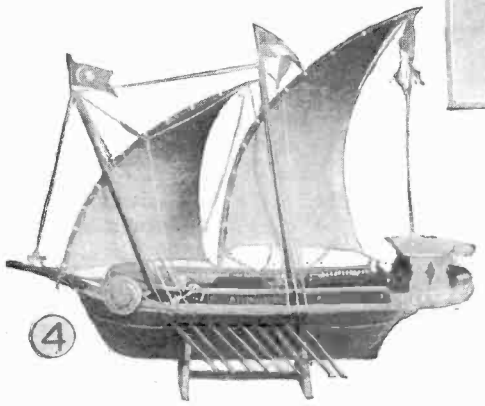
The photo below shows the under side of matchcraft steam engine model.



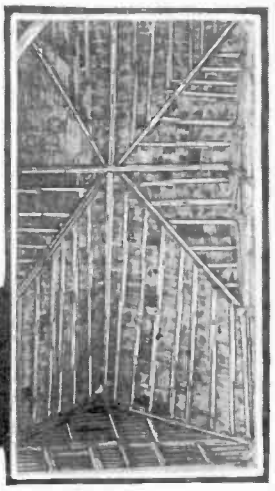
Third Prize—$50.00. One of the prettiest examples in matchcraft engineering is illustrated in photo 3 above. The model of the steam engine, twin cylinder marine type, was made by Mr. Charles Peebles, of Yonkers, N. Y. This won first prize in "The Evening World" contest. It actually works.



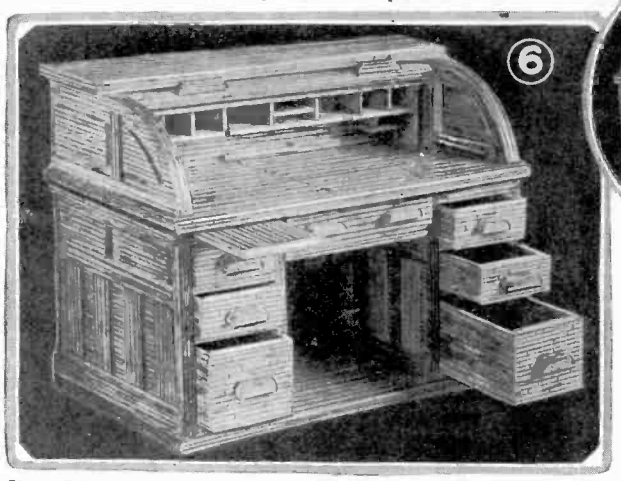
Top View—Right piston up. Square center opening houses valves.

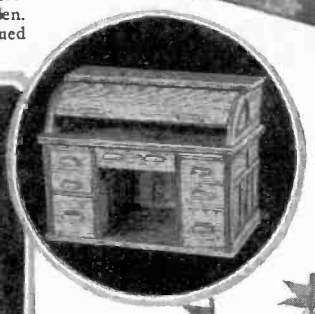


Fourth Prize—$35.00. A very unusual piece of work is that built by Mr. and Mrs. J. C. Kohler of Los Gatos, Calif., shown in photograph No. 4 above. This is a replica of a Roman war galleon, in which the construction is entirely of safety matches with the exception of the flags and ropes. Even the sails of this excellent vessel are made of matches, and they are curved while they are being built up. The entire model was carefully painted and serves as an ornament for a bookcase or for the den. There are ten sets of oars on this galleon also made of matches, glued together, shaped and then painted.

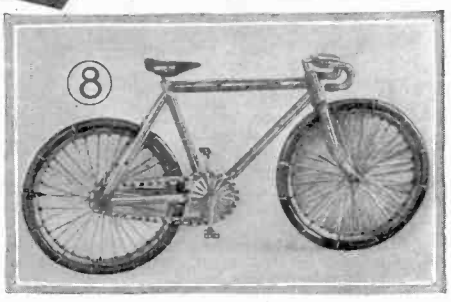


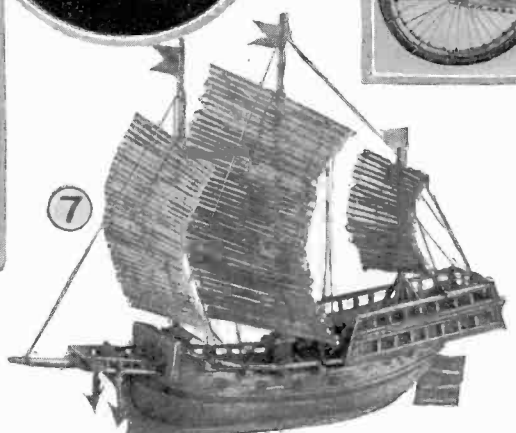
Ninth Prize—$10.00. Mr. Warren I. Waverly, of New York City, was awarded the ninth prize for the construction of a model house illustrated in photo 5, and also immediately above, which view shows the rafter construction for the roof of the house. The roof is made of shingles which shingles are made of matches.





Sixth Prize—$20.00. The model of the roll top desk illustrated in photo 6 contains 11,280 matches. This model is only eight and a half inches long, almost six inches high and five inches deep. It is absolutely complete in every detail, with the exception of a binding strip around the edge which was purposely omitted in order to show the three ply construction of the desk top. All of the drawers work and the top rolls down simulating the large piece of furniture which it resembles. The small insert at the right shows the top in a half rolled down position and the drawers of the desk closed. Besides glue, ninety-six bank pins also entered the construction of this desk. This won one of the prizes in "The Evening World" contest. The winner is Mr. George DeGall, Highbridge, N. Y.



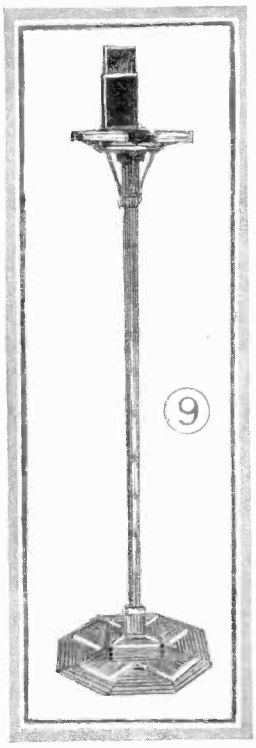


Eighth Prize—$12.50. The Japanese war junk illustrated above was made by Mrs. J. E. McGovern of Brooklyn, N. Y. Even the sails of this construction are made of matches glued end to end and wired together to resemble the bamboo sails on these vessels.

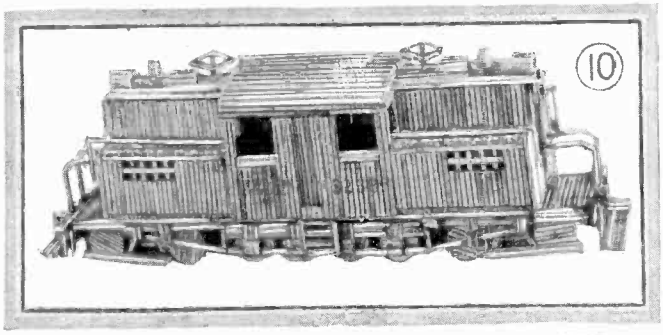
Fifth Prize—$25.00, was won by Oscar Solow, also of New York City. Mr. Solow is a high school student and when not studying he built the bicycle. The frame is of matches in the form of a tube. The spokes are split matches, tire, chain and sprocket wheel being made of the same material. The handlebars were built up of matches and then cut to the shape shown, and the seat is also composed of the same material. Both the front and rear wheels turn. In order to make the holes in the match blocks for the axles, wires of different sizes were heated to redness and the holes were burned through.

Contest $5,000.00

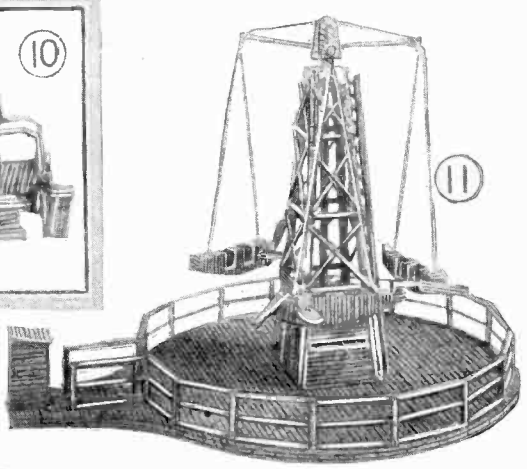
Enter Models for July Contest Now!



Associating matches with a smoking stand is unique.

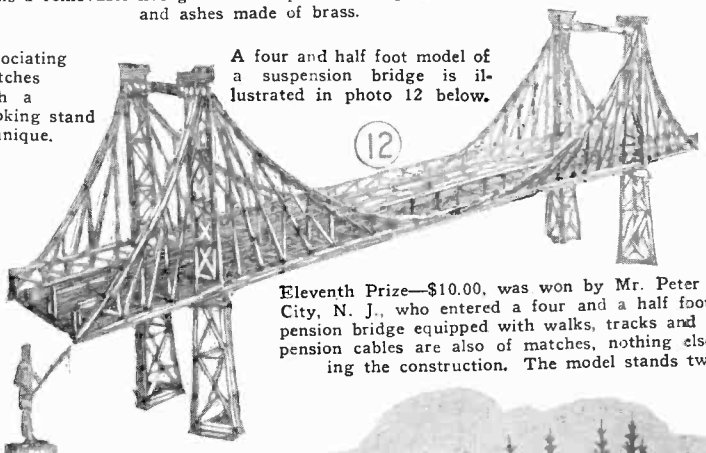


Twelfth Prize—$10.00, was won by Mr. Harry Erno of Ogdensburg, N. Y., for his model of an electric locomotive illustrated in the photograph above. Seventh Prize—$15.00 was won by Mr. Walter T. Plunkett, of New York City, for a smoking stand made entirely of matches. This stand is more than two feet high, and is built entirely of matches. The top contains a removable five grooved receptacle for cigars, cigarettes and ashes made of brass.

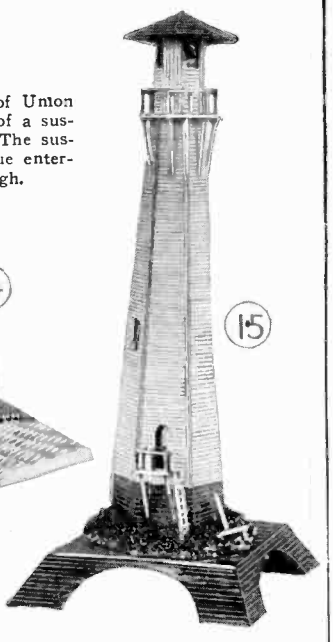


Thirteenth Prize—$10.00, was won by Mr. Thomas Gervasio of Newark, N. J., for his model of a captive airplane amusement device. A small watch motor rotates the airplanes at a fair speed.

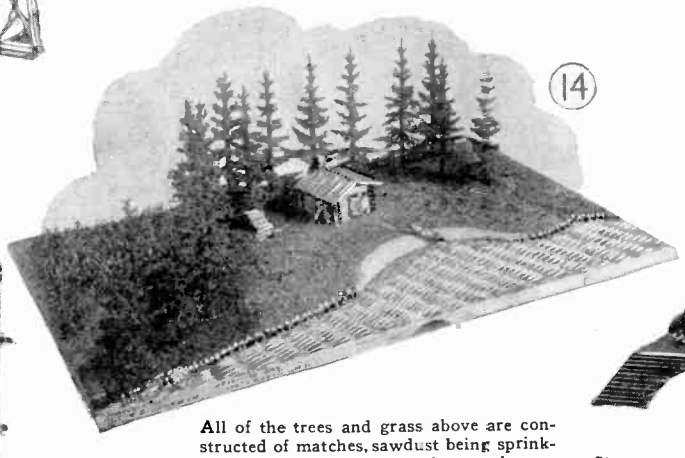
A four and half foot model of a suspension bridge is illustrated in photo 12 below.



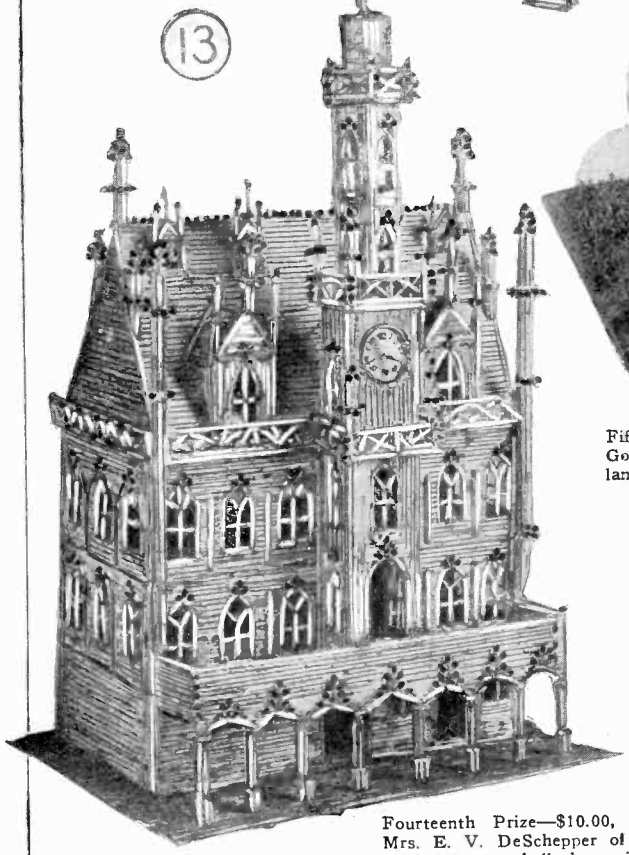
Eleventh Prize—$10.00, was won by Mr. Peter Schano of Union City, N. J., who entered a four and a half foot model of a suspension bridge equipped with walks, tracks and signals. The suspension cables are also of matches, nothing else but glue entering the construction. The model stands two feet high.



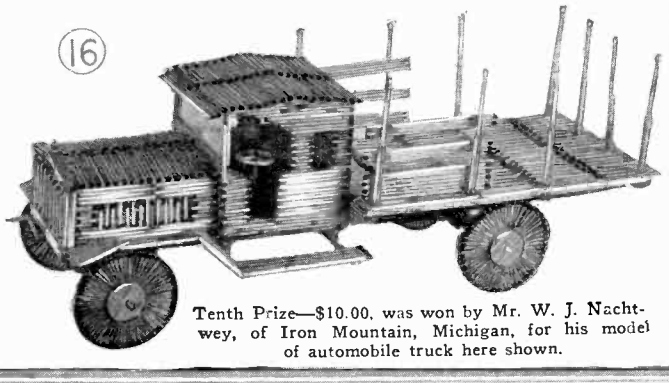
Sixteenth Prize — $10.00. The last of the group of prizes for this month was won by Mr. William Ryan, of New York City for the lighthouse, illustrated above.



All of the trees and grass above are constructed of matches, sawdust being sprinkled on wet glue to form the tree leaves. Fifteenth Prize—$10.00 was awarded to Mr. Leon E. Goodwin, of Portsmouth, N. H., for this very beautiful landscape. The judges decided that such a construction was more trickery than matchcraft.



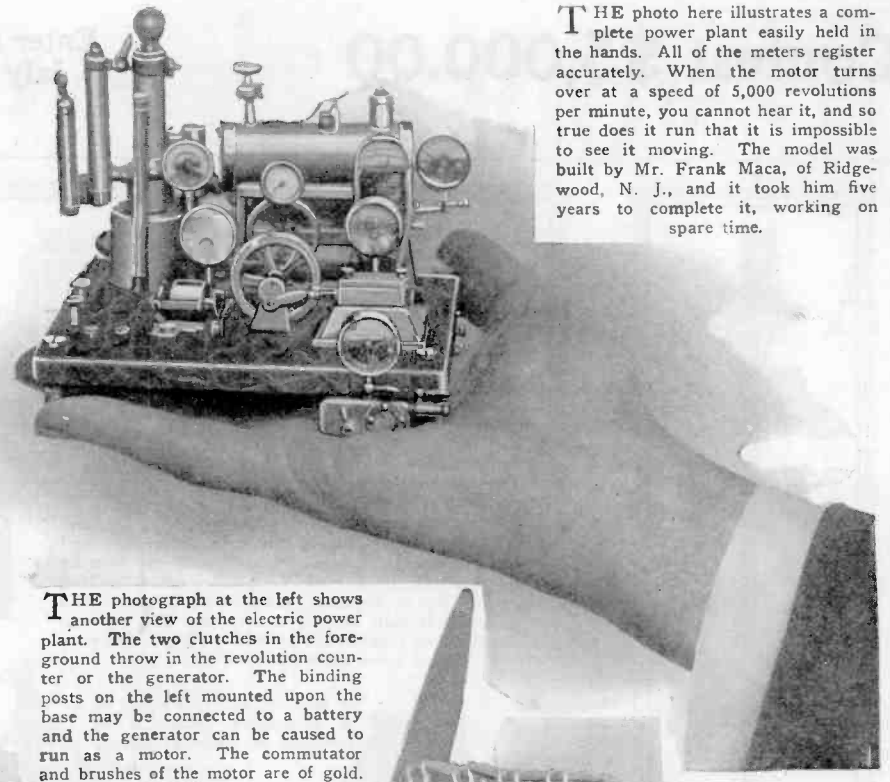
Fourteenth Prize—$10.00, won by Mrs. E. V. DeSchepper of Astoria, L. I., who constructed the replica of Belgian town hall shown in photograph 13 above. Although this construction was originally entered in "The Evening World" contest, where it won a prize, it was subsequently entered in the SCIENCE AND INVENTION Magazine contest.



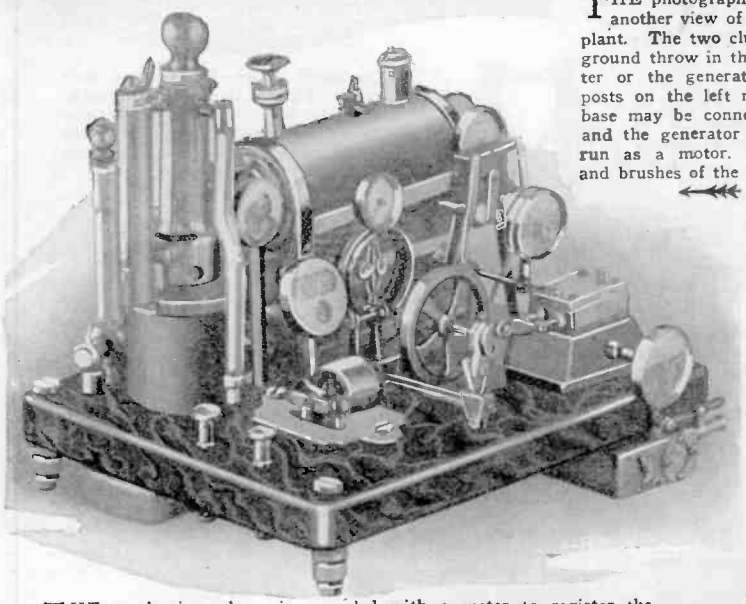
Tenth Prize—$10.00, was won by Mr. W. J. Nachtwey, of Iron Mountain, Michigan, for his model of automobile truck here shown.

Model Engineering Unique

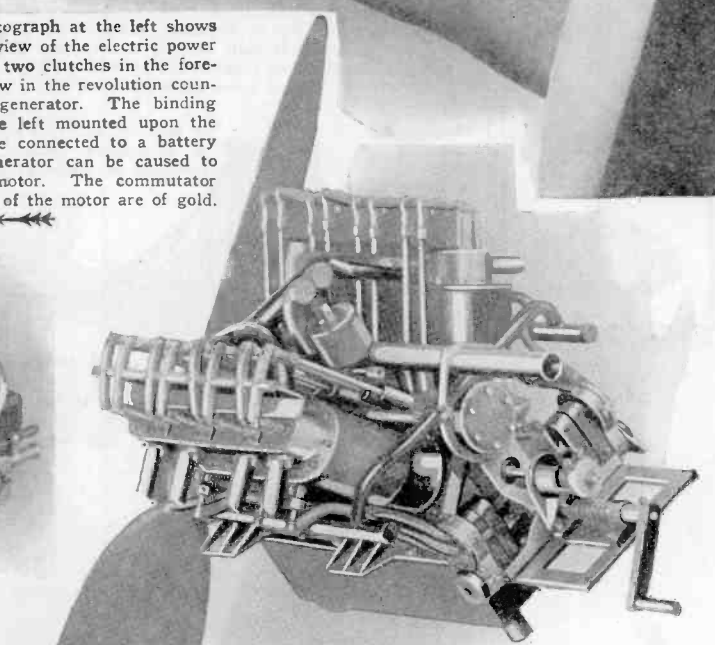
ON this page are found two very unique models. Neither of these models were awarded the cup from the SCIENCE AND INVENTION Magazine contest, but they are certainly worthy of more than passing interest. Both models represent some excellent examples of watchmaker's art and skill. The model in the two upper photographs on this page contains jeweled bearings throughout, whereas that on the lower three photographs is a little more rugged. They are both working models, but were ruled out of the contest because they did not meet the conditions. The builders are however being paid for this article.



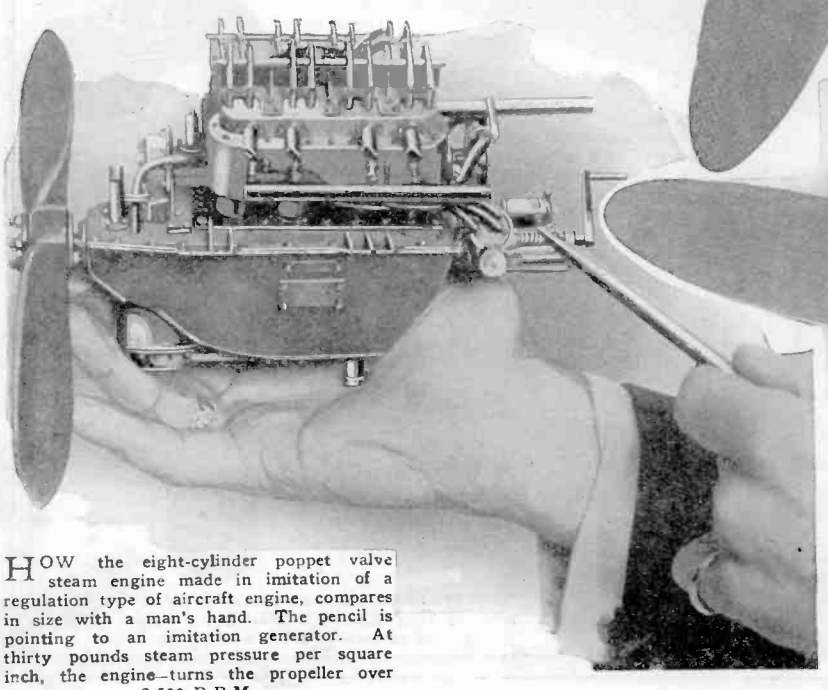
THE photo here illustrates a complete power plant easily held in the hands. All of the meters register accurately. When the motor turns over at a speed of 5,000 revolutions per minute, you cannot hear it, and so true does it run that it is impossible to see it moving. The model was built by Mr. Frank Maca, of Ridgewood, N. J., and it took him five years to complete it, working on spare time.



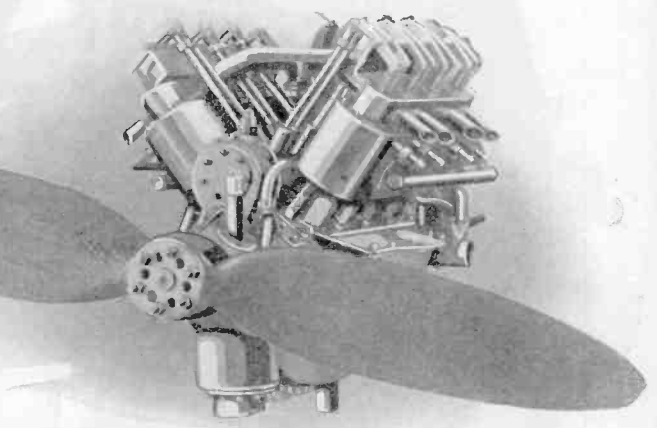
THE photograph at the left shows another view of the electric power plant. The two clutches in the foreground throw in the revolution counter or the generator. The binding posts on the left mounted upon the base may be connected to a battery and the generator can be caused to run as a motor. The commutator and brushes of the motor are of gold.



THE mechanism above is provided with a meter to register the temperature of the flame of the ether burner. The next meter to the right is a revolution counter. To the right of this a meter mounted on top of the governor registers revolutions per minute of the steam engine, and still further to the right we have a millivoltmeter to indicate whether the generator is actually developing current. In front of this a meter registers the cylinder pressure.



HOW the eight-cylinder poppet valve steam engine made in imitation of a regulation type of aircraft engine, compares in size with a man's hand. The pencil is pointing to an imitation generator. At thirty pounds steam pressure per square inch, the engine turns the propeller over 2,500 R.P.M.



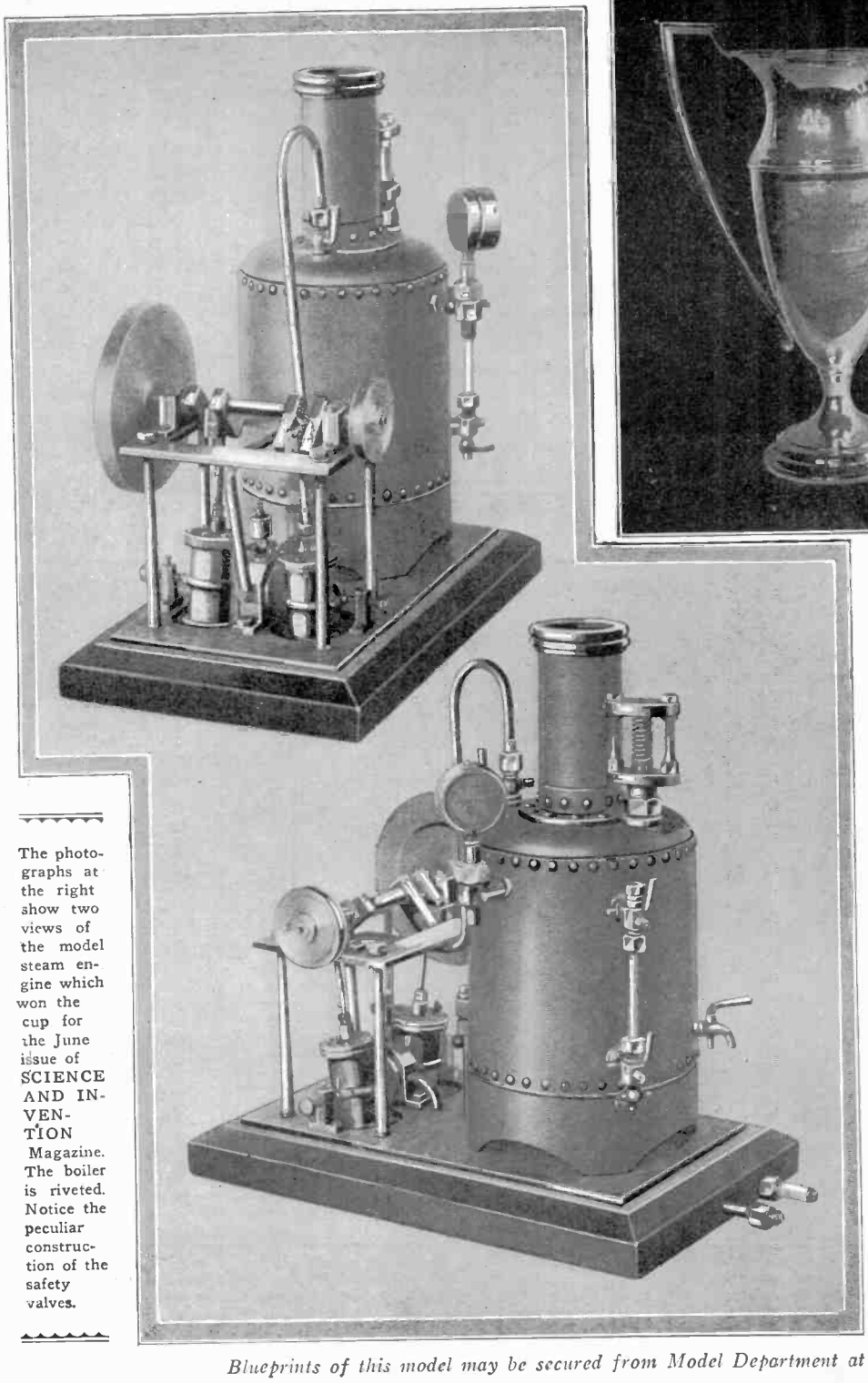
TWO views of the aircraft engine are indicated in the photos above. The models have both been worked out in great detail. Every bit of the engine is hand-made. There was no machine work on it at all. The entire construction consists of copper, brass and steel, which is formed and shaped by hand. There is an oil pump in the crank case which pumps oil to the working parts, lubricating them constantly. It took approximately 800 hours to build this model. The engine was built by Mr. Dominic Sala of New York City, who is a watch-maker by trade, and this work of course is monumental in comparison with his regular profession.

MODEL DEPARTMENT

AND now folks let us introduce you to the prize winner for the June SCIENCE AND INVENTION Magazine Trophy Contest. He is Mr. George Bridge of Plainfield, N. J., who won the cup awarded in this issue for the model of a twin cylinder steam engine. In this particular model the cylinders of the engine oscillate back and forth, and both strokes on each cylinder are power strokes. Although in the photograph two pipes are seen projecting from the edge of the baseboard, in the actual model, the drawings of which may be found on the accompanying page, only one pipe need be employed. These pipes are for an external supply of steam, in event that the boiler is not to be used. The blueprints, however, make no provision for this external source of steam pressure, inasmuch as most builders will want to fire the boiler directly. On the following two pages, all the details for the construction of such a steam engine are given, and the amateur will find them exceedingly clear.

Who ? will win the next cup

The silver cup and its accompanying certificate, which was awarded to George Bridge for his model of the steam engine.



The photographs at the right show two views of the model steam engine which won the cup for the June issue of SCIENCE AND INVENTION Magazine. The boiler is riveted. Notice the peculiar construction of the safety valves.

Rules for Model Contest

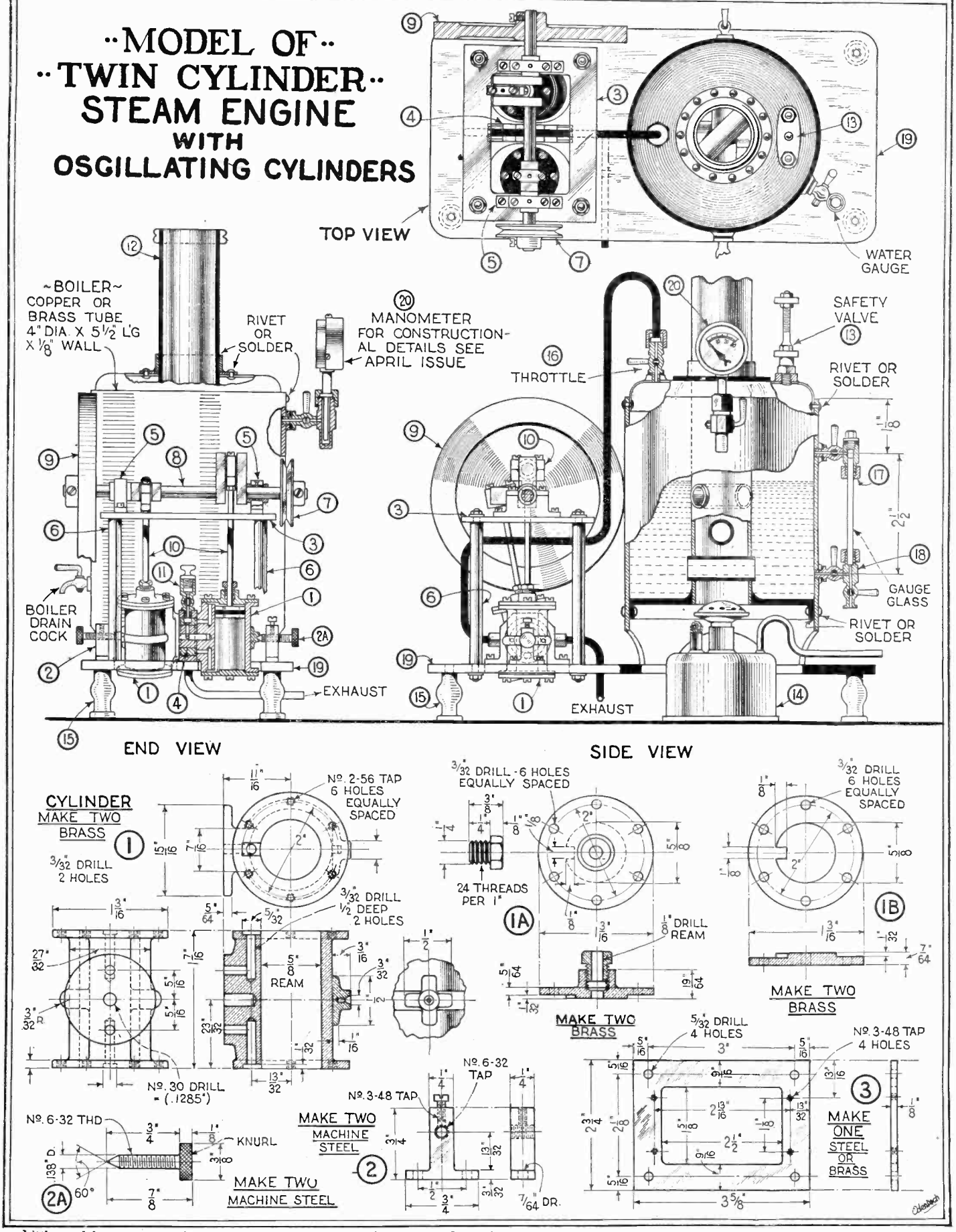
1. A handsome trophy cup engraved with your name, will be awarded as the prize for the best model submitted during the month. The decision of the judges will be final and will be based upon, A—novelty of construction; B—workmanship; C—operating efficiency of the model as related to the efficiency of the device which the model simulates, and D—the care exercised in design and in submitting to us sketches and other details covering the model.
2. Models of all kinds may be entered. They may be working models or not, according to the subject that is being handled.
3. Models may be made of any available material, preferably something that is cheap and easily obtainable. Models made of matches should not be submitted to this department but should go to our Matchcraft Contest Editor.
4. Models must be submitted in all cases. Good photographs are also highly desirable and where the maker does not desire the model to be taken apart, legible drawings with all dimensions covering parts that are not accessible must be submitted.
5. Models should be securely crated and protected against damage in shipment and sent to us by parcel post, express or freight, prepaid. Models will be returned when requested.
6. Models for entry in any particular contest must reach this office on or before the 25th of the third month preceding date of publication. For instance, models for the July contest must reach us on or before the 25th of April.
7. Address all entries to Editor Model Department, c/o Science and Invention Magazine, 53 Park Place, New York City.

Blueprints of this model may be secured from Model Department at $1.00 *for the complete set.*

Drawings of this month's Cup Winner

Twin Cylinder

··MODEL OF·· ··TWIN CYLINDER·· STEAM ENGINE WITH OSCILLATING CYLINDERS

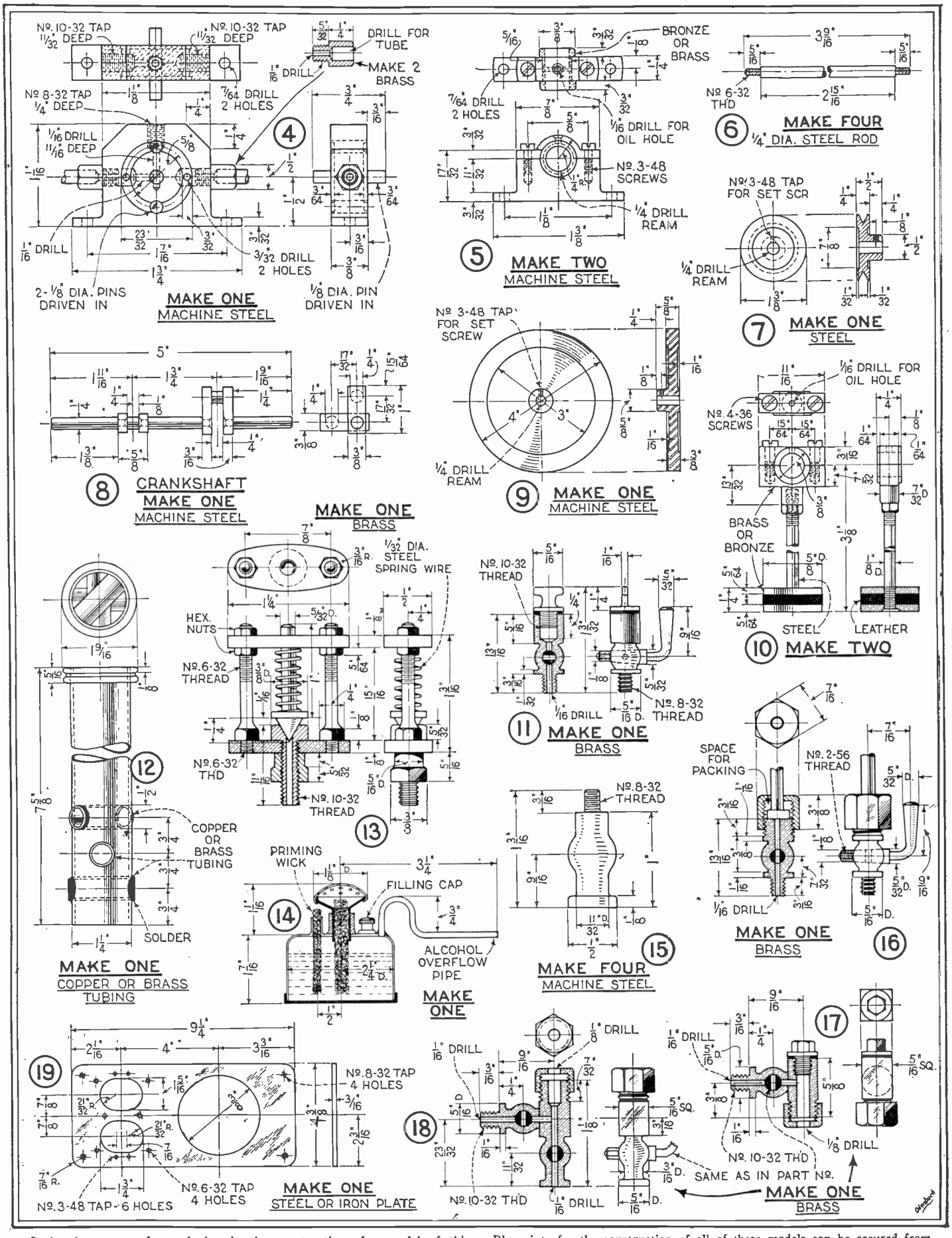


Little need be said about the particular blueprints or sketches above. On this and the accompanying page all the details for the construction of the twin cylinder steam engine with oscillating type of cylinder construction, will be found. It is quite a simple matter to construct the various parts for which these prints call and to assemble them in accordance with the drawings. If the pieces are well machined, this engine will travel at a high speed and develop a surprising amount of power for its size. The engine of course has no dead center, and can be started from any position.

Your model may win a cup. Send it in now!

Steam Engine

With oscillating type of cylinder construction



It is of course understood that in the construction of a model of this nature, any of the optional methods of firing illustrated on blueprint No. 4, shown in the April issue of SCIENCE AND INVENTION Magazine, may be used. The boiler can be fired by alcohol, gasoline, gas or electricity.

Blueprints for the construction of all of these models can be secured from the Model Department of this publication at a very nominal fee. We have received a great many compliments on the clarity of these blueprints. Photos of cup winning model may be found on page 139.

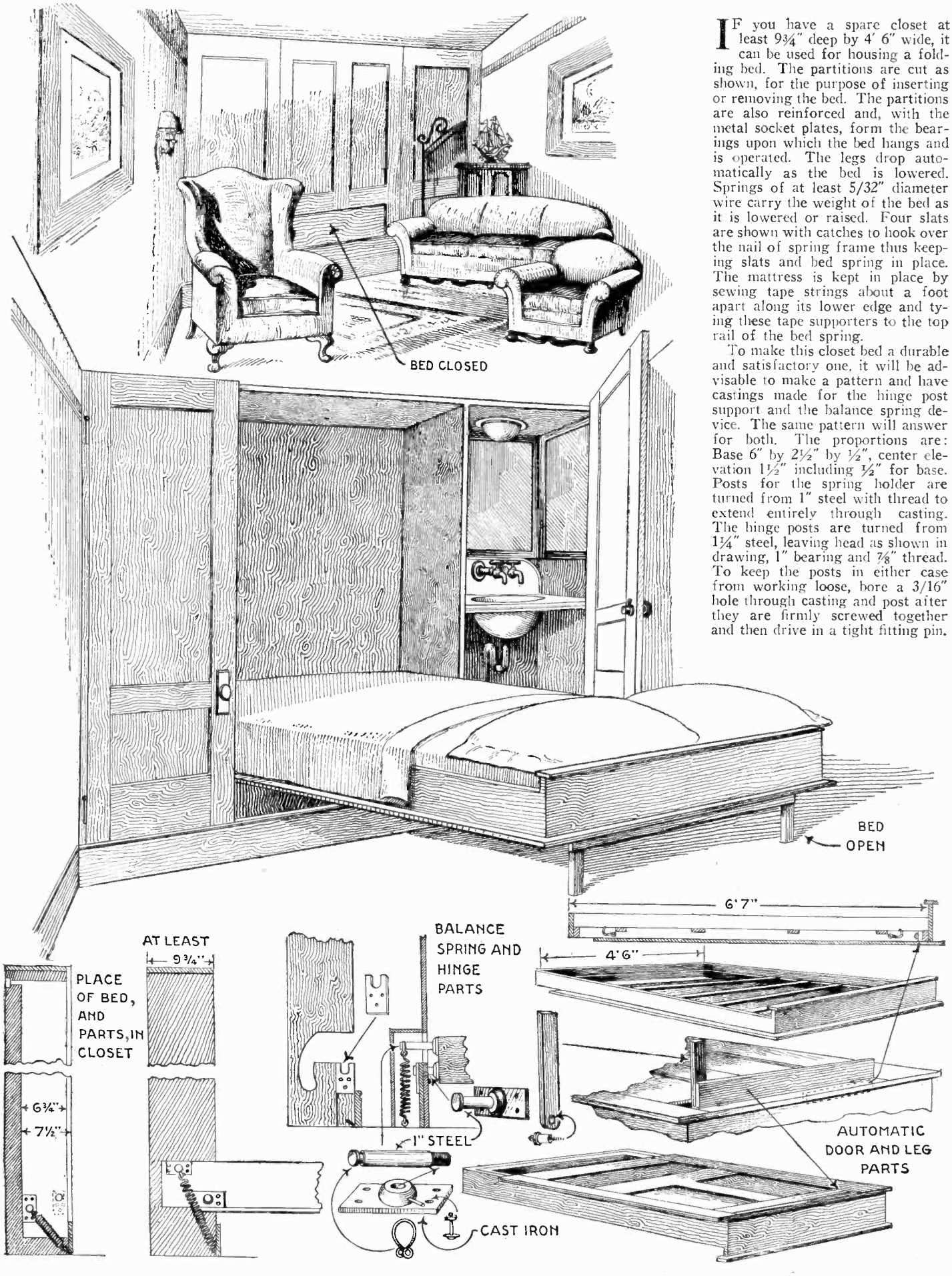
Science and Invention awards a trophy cup a month

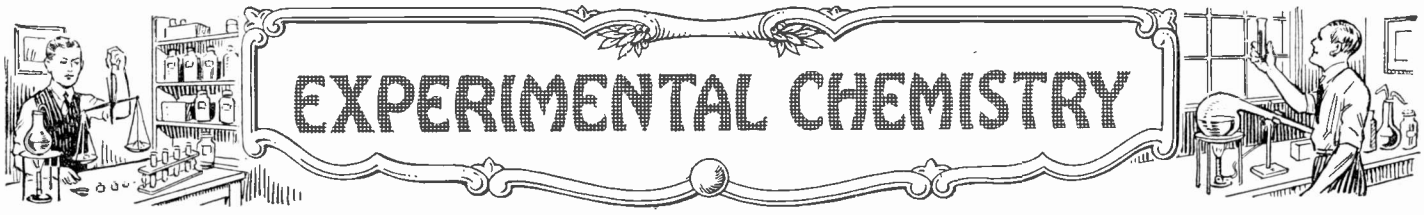
Making a Closet Bed

By WILLIAM M. BUTTERFIELD

IF you have a spare closet at least 9¾" deep by 4' 6" wide, it can be used for housing a folding bed. The partitions are cut as shown, for the purpose of inserting or removing the bed. The partitions are also reinforced and, with the metal socket plates, form the bearings upon which the bed hangs and is operated. The legs drop automatically as the bed is lowered. Springs of at least 5/32" diameter wire carry the weight of the bed as it is lowered or raised. Four slats are shown with catches to hook over the nail of spring frame thus keeping slats and bed spring in place. The mattress is kept in place by sewing tape strings about a foot apart along its lower edge and tying these tape supporters to the top rail of the bed spring.

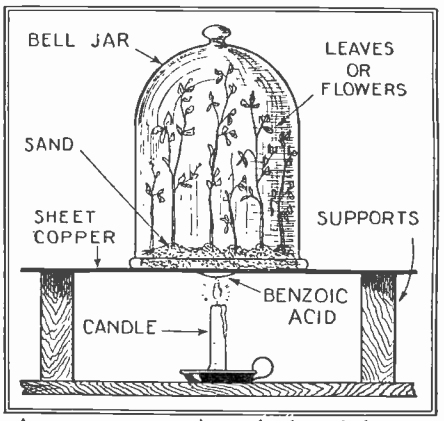
To make this closet bed a durable and satisfactory one, it will be advisable to make a pattern and have castings made for the hinge post support and the balance spring device. The same pattern will answer for both. The proportions are: Base 6" by 2½" by ½", center elevation 1½" including ½" for base. Posts for the spring holder are turned from 1" steel with thread to extend entirely through casting. The hinge posts are turned from 1¼" steel, leaving head as shown in drawing, 1" bearing and ⅞" thread. To keep the posts in either case from working loose, bore a 3/16" hole through casting and post after they are firmly screwed together and then drive in a tight fitting pin.





Artificial Frost

THERE is described here a very spectacular way of imitating frost scenes, with which you can amuse a lot of people, and which does not require much apparatus. First of all, procure a sheet of copper or of some similar metal in which you can make



A very pretty experiment is that of the production of artificial frost by the vaporization and condensation of benzoic acid.

a shallow depression. Then get a glass bell jar which will fit over the metal, and in which are arranged groups of leaves, ferns, etc., supported by small stones at their base, so as to form a miniature picturesque scene.

Finally, in the depression in the copper sheet under the bell glass place a little benzoic acid.

When you have arranged all this, take a candle, and support it underneath the copper sheet and light it.

Allow the heating to go on very slowly and, in time, you will find that the acid will have passed off into vapor, and will have condensed on the leaves, etc.

Calcium Carbide -- Laboratory Preparation and Use

By EUGENE D. LIEBER

A CHEMICAL industry of large economic standing is the manufacture of calcium carbide by the electric furnace. The finished product is subjected to a great many practical uses of which the most important

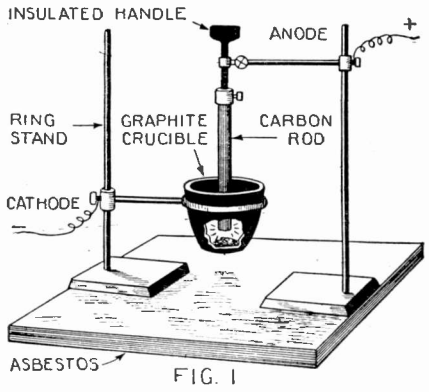


FIG. 1

An apparatus for making calcium carbide on a small scale; a graphite crucible forms one of the electrodes of the arc.

is the making of cyanamide. The production of calcium carbide from coke and quicklime requires great heat, which in commercial work is supplied by an electric furnace; for experimental purposes a direct E.M.F. of about 60 to 100 volts may be used.

A powdered mixture of about 5 parts by weight of quicklime and 3 parts of coke is prepared. A graphite crucible is in electric connection to the metal of a ring stand, which is connected with the negative-poles of the source of current. The positive-pole as shown (Fig. 1) is an arc light carbon which is clamped to the stand and insulated therefrom: all of which must rest upon some insulating material as asbestos. The carbon rod is allowed to touch the bottom of the crucible and withdrawn by the insulated handle on the carbon rod. An arc is thus struck, and the mixture of coke and quicklime gradually added as the action continues with ensuing shrinkage. The apparatus should be carefully manipulated, as the heat produced is quite high; the eyes should be protected from the sputtering mixture in the crucible. The mixture should be perfectly melted before the action is allowed to stop, and if successfully carried out a hard, brittle, dark gray or bronze substance will have been obtained. Let it cool before using in the following experiment.

A 500 cc. reagent bottle (Fig. 2) fitted with a single hole stopper carrying a piece of straight glass tubing ending flush with the lower side of the stopper is next required. It is then filled within 3 cm. of the top with water; a few pieces of the prepared calcium carbide are dropped into it, replace the stopper and after a few moments light the gas issuing from the glass tubing. The gas is acetylene, a gas of wide commercial use.

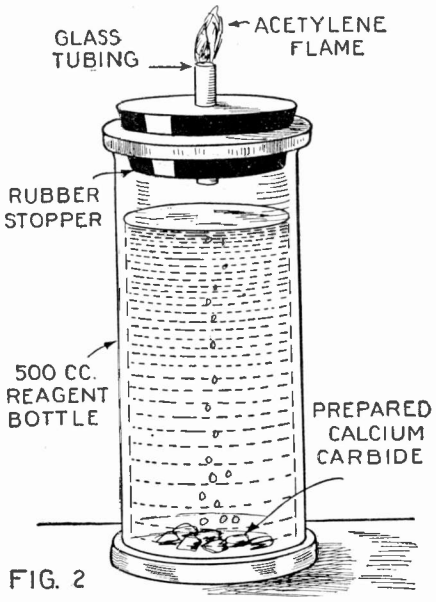


FIG. 2

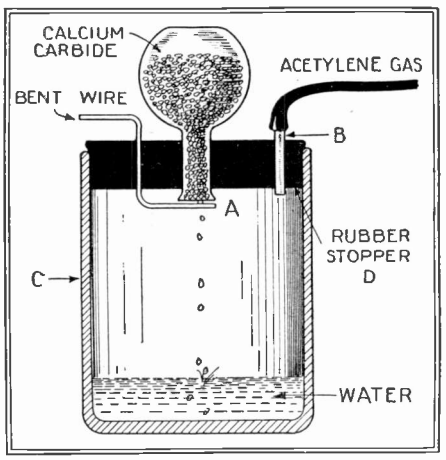
An exceedingly simple apparatus for burning acetylene gas produced from the home-made calcium carbide.

Acetylene Gas Generator

By WAYNE B. GRIEVE

EXPERIMENTERS often need acetylene gas in moderate quantities. To meet this need the generator here described will be greatly welcomed. Calcium carbide (common carbide) is an inorganic compound of a gray crystalline nature. It is composed of the elements "calcium" and "carbon," formulated as CaC_2. Carbide, acted on by water (H_2O) causes two atoms of hydrogen to unite with two atoms of carbon, forming acetylene gas (H_2C_2). Acetylene is an inflamable gas, explosive when mixed with oxygen in proper proportion.

A wide-mouthed glass jar, C, is required,

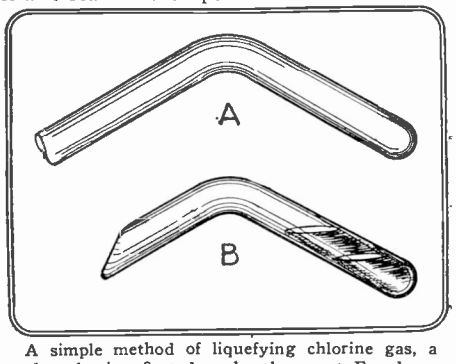


This is an apparatus of a more advanced type for generating acetylene. There is a finger-valve for dropping the powdered carbide into the water as fast or slowly as required.

and a rubber cork of sufficient size to snugly close the top is needed. Fill a Florence flask and invert it as shown, passing the neck through the cork. Bend a No. 9 wire in the shape shown and snugly fit it in the cork so that gas cannot escape. Let the wire be long enough to regulate the supply of carbide coming through the flask at A. Fit a glass tube of ¼-inch diameter into the cork at B, to which a hose is fitted. An inch of water is put in the jar to act upon the carbide. All the joints must be shellacked air tight. Do not shellac the wire in but keep it air tight. If the apparatus is set up as shown, turn the wire by the bent handle so that several pieces of carbide fall into the water. Do not allow too much carbide to fall or the pressure will blow out the cork or possibly burst the glass jar. Keep the water cool. If the generator is regulated properly, it will give excellent results.

Liquefying Chlorine

Immerse a strong, heavy glass tube shaped as shown at A in a freezing solution. Then pass moist chlorine gas into it and seal off the open end. When the tube



A simple method of liquefying chlorine gas, a liquefaction first done by the great Faraday.

is allowed to become warm, the pressure exerted within the tube will be sufficient to liguefy the chlorine which will float on the water which is present in the tube.

Contributed by JAMES R. WRIGHT.

Experimental Spinthariscopes

By CHARLES K. FULGHUM

THE disintegration of all of the radio-active elements is apparently the result of the emission of one or more of three "radiations," *i.e.*, the *alpha* and *beta* particles and the *gamma* rays. Of these three radiations only the *alpha* particles can be detected by the so-called "scintillation method." This method is based on the fact that when *alpha* particles ejected from disintegrating radio-active elements are allowed to bombard certain materials of which a modified form of zinc sulphide, generally known as phosphorescent zinc sulphide, is the one most commonly used, each *alpha* particle as it strikes the sulphide produces a faint scintillation or flash of light. The amount of light produced by each impact is very small, but by magnification can be rendered plainly visible; the phenomenon affording a very sensitive means of detecting and studying the actions of *alpha* particles.

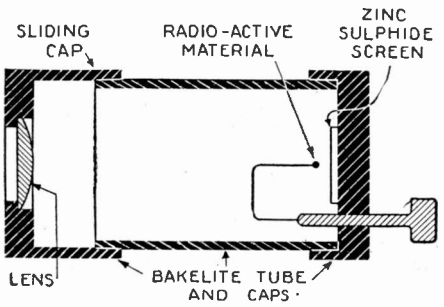


FIG. 1

The new developments of chemistry involve study of radio activity. Above is the simplest form of spinthariscope for showing such action.

A number of years ago, Sir William Crookes devised a simple instrument called a spinthariscope to demonstrate the fluorescence of zinc sulphide under the bombardment of *alpha* particles. The essential parts of the instrument, a modified form of which is shown in Fig. 1, are a short tube fitted at one end with a screen coated with zinc sulphide and at the other with a lens arranged so that it can be focused on the zinc sulphide screen. Inside the tube a short distance from the screen is placed a short wire or pin, the end of which is tipped with a radio-active substance, usually a salt of radium C. The *alpha* particles ejected from the radio-active element strike the screen producing faint flashes of light which are visible when the lens is focused on the screen. The observations should be made in a dark room, and only after the eyes have been thoroughly rested by remaining in a dark room for ten or fifteen minutes.

A spinthariscope of this type is easily made, providing the experimenter can obtain the zinc sulphide for coating the screen and the radio-active substance to furnish the *alpha* radiation. The zinc sulphide required is usually sold as phosphorescent zinc sulphide, special grade, and costs about seventy-five cents a gram. The radio-active element is generally rather hard to obtain; crude sulphate or bromide of radium C, or a salt of polonium being commonly used for this purpose. If nothing else can be obtained, the substance that is used in the so-called permanently luminous buttons or pendants that are sold for switch markers, etc., is often rich enough in radio-active emanations to furnish the *alpha* radiation for an experimental spinthariscope.

For those who wish to construct a spinthariscope of the type shown in Fig. 1, the following information may be of interest. The tube or body of the instrument can be of brass, bakelite, or hard rubber; the caps being turned from the same material. The lens used should be as large as possible, 1 cm. or more in diameter preferably, in order to gather all the light possible, and should magnify to at least ten diameters. The screen can be made by painting a thin slip of glass with a thin paste of zinc sulphide, or the glass can be painted with shellac and the zinc sulphide powdered and sprinkled over it, so that a thick film of the sulphide adheres to the glass. The mounting shown in the illustration for the wire carrying the radio-active element provides an easy means of adjusting the distance between the screen and the source of *alpha* particles. Only a very tiny bit of the radio-active substance, if radium C or polonium is used, is required on the wire.

The only precautions to be observed in using the spinthariscope have already been stated, *i.e.*, the eyes must be thoroughly rested before observations are attempted, the lens must be accurately focused on the screen, and the observations must be made in a dark place.

A much simpler form of spinthariscope is shown in Fig. 2. It consists of a short length of the same tubing, 2 or 3 cms. in diameter, and fitted at each end with a cap. One of the caps is fitted with a lens similar to the one used in the previously described instrument, and is arranged so that it can be focused on the end of the tube. The other cap serves merely to close the end of the tube. Through the tube, near the closed end, are bored two holes about 1 cm. in diameter. A piece of glass tubing about 5 cm. long and of such diameter that it will fit snugly in the holes bored in the bakelite tube is obtained. A small cork should then be forced into one end of the glass tube and cemented into place with sealing wax or shellac. A small quantity of the phosphorescent powder from a "permanently luminous" switch

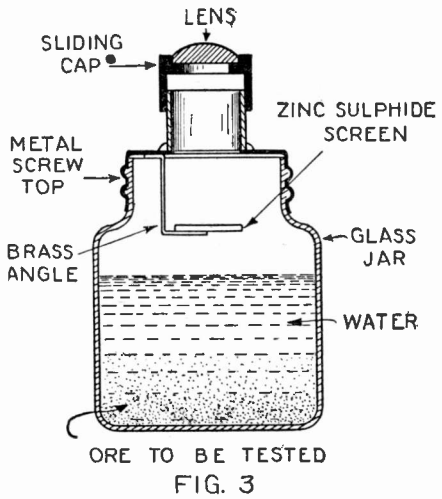


FIG. 3

An apparatus for testing ores for radio activity which can be applied in the analytical laboratory, as a method of qualitative examination.

marker or pendant is to be placed in the glass tube and the other end sealed with a cork and sealing wax. The glass tube is then fitted into the holes in the larger tube as shown in the illustration, and the instrument is ready for use.

To use the spinthariscope, the lens is focused on the wall of the glass tube that is nearest the lens, and the glass tube is rotated slowly so that the powder in the tube has a tendency to be carried up the side of the tube that is toward the observer. The powder that is used in the tube is really zinc sulphide to which has been added a very small quantity of radio-active material. As the tube is rotated, tiny particles of the zinc sulphide adhere to the walls of the tube and are carried into the field of the lens. To the observer, the walls of the tube appear to be covered with hundreds of tiny scintillations, each one representing the impact of an *alpha* particle with a molecule of zinc sulphide. It will be observed that the flashes appear to last but a fraction of a second; probably the actual time the flash lasts is just during the time the impact takes place, an almost infinitely short time. Therefore, properly speaking, the light given out by the zinc sulphide is not due to phosphorescence but is due to fluorescence. The sulphide is, however, phosphorescent. If the cap at the end of the tube is removed and the sulphide in the tube is exposed to strong

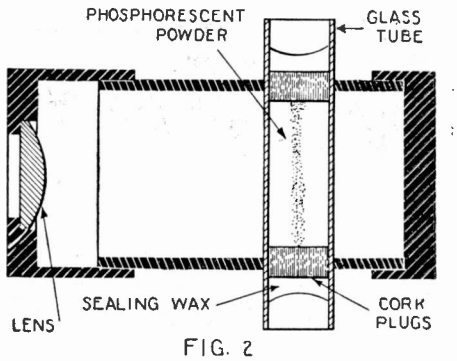


FIG. 2

A very interesting variation of the spinthariscope, using a phosphorescent powder. The powder may be procured from a luminous switch indicator. The large tube must be vertical.

sunlight or ultra-violet rays, and the instrument is then taken into a dark room and examined, the sulphide will be found to be glowing very brightly; so brightly in fact that it will be found impossible to distinguish the scintillations produced by the *alpha* particles. If the spinthariscope is kept in the dark for a time, the phosphorescence caused by the action of the sunlight or ultra-violet light will gradually die out and the scintillations will become visible.

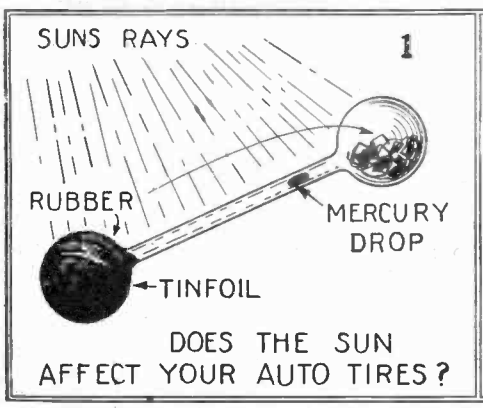
Some people have considerable difficulty in seeing the almost molecular light spots produced in this interesting instrument.

There is on the market an instrument called a radioscope that is a rather interesting modification of the spinthariscope. This instrument, which is illustrated in Fig. 3, is used to detect radio-activity in ores and mineral waters by the scintillation method. The construction of a radioscope is very simple, providing the constructor can obtain a small quantity of phosphorescent zinc sulphide. A rather squat, wide-mouthed glass jar having a tightly fitting metal screw top forms the body of the instrument. In the metal top a hole is cut and a short piece of brass tubing is soldered over the hole. The brass tube should be provided with a sliding cap fitted with a lens such as is used in the spinthariscope previously described. To the under side of the metal top a short brass angle piece is soldered, long enough so that it extends into the jar about 1 cm. when the top is in place. On the end of this angle piece a glass screen about 1 cm. in diameter coated with phosphorescent zinc sulphide is fastened. The method of preparing the screen is the same as that described for the spinthariscope shown in Fig. 1. When the top with the eye-piece

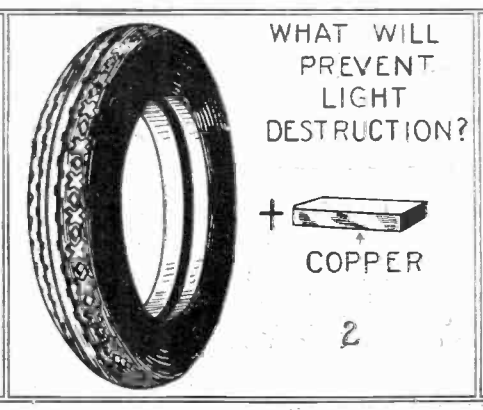
(*Continued on page* 166)

Everyday Chemistry

By RAYMOND B. WAILES

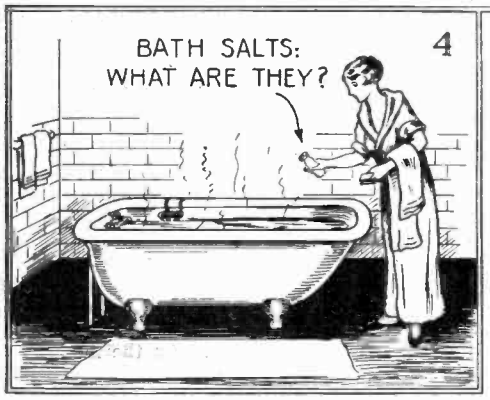


The device shown indicates, by driving the mercury drop along the tube that sunlight is capable of affecting rubber.

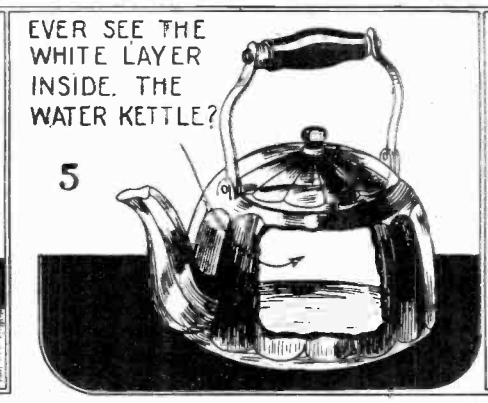


Certain copper salts can be added to rubber that will do away with the deleterious effect of sunlight on auto tires.

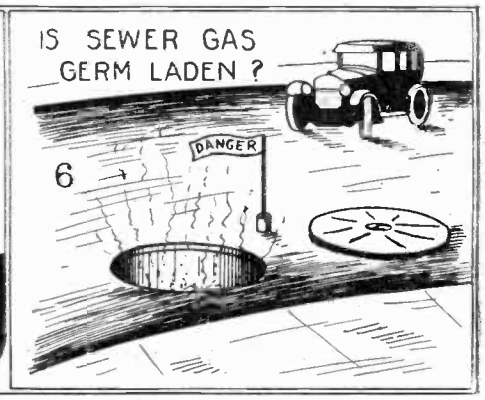
Some nail glosses contain the same materials as found in radio coil cements, namely celluloid dissolved in acetone.



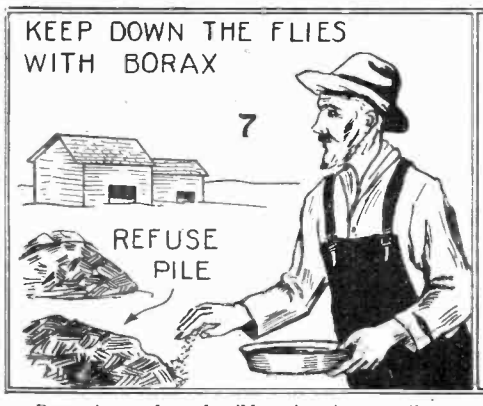
Usually they are nothing more or less than Epsom salts, highly perfumed and sometimes colored for the sake of effect.



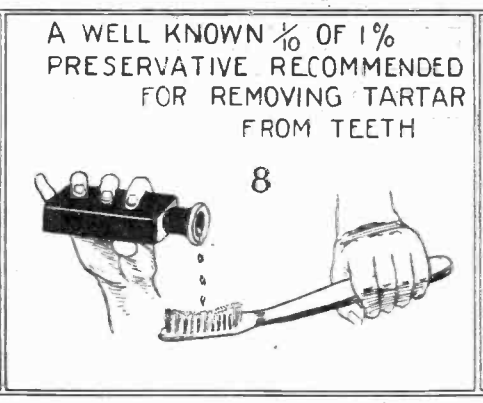
It is similar to "boiler scale" and is formed from the minerals in the water that has been boiled and which minerals collect in the kettle.



Not usually. Bacteria cause most of the gas but they are not carried about by it. Sewer gas is unfit to breathe.

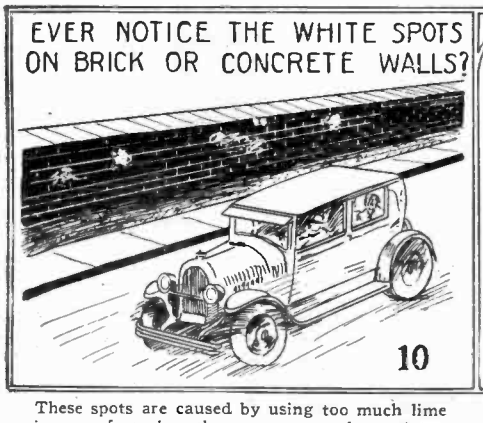


Borax is a safe and mild antiseptic as well as a cheap one. It can be advantageously employed to prevent the laying of fly larvae.

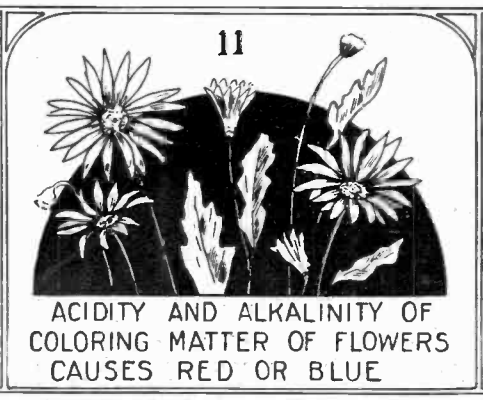


Sodium benzoate will react chemically with tarter on the teeth, removing it. Rinse the mouth with water after use.

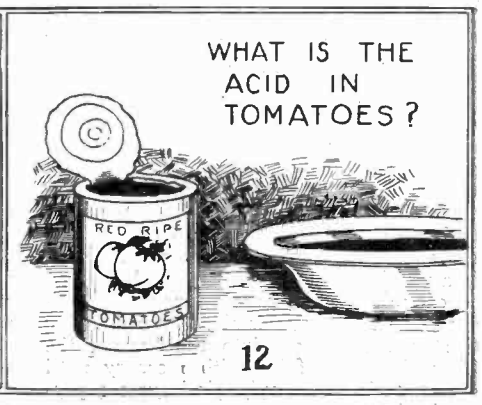
A copper chemical dissolved in an organic liquid is finding very widespread use for ridding pets of fleas and other vermin.



These spots are caused by using too much lime in manufacturing the cement or when mixing the mortar. The spots are not necessarily weak.



Red and blue flowers have been found to have their coloring due to the same dye stuff, in one case being acid and the other alkaline.

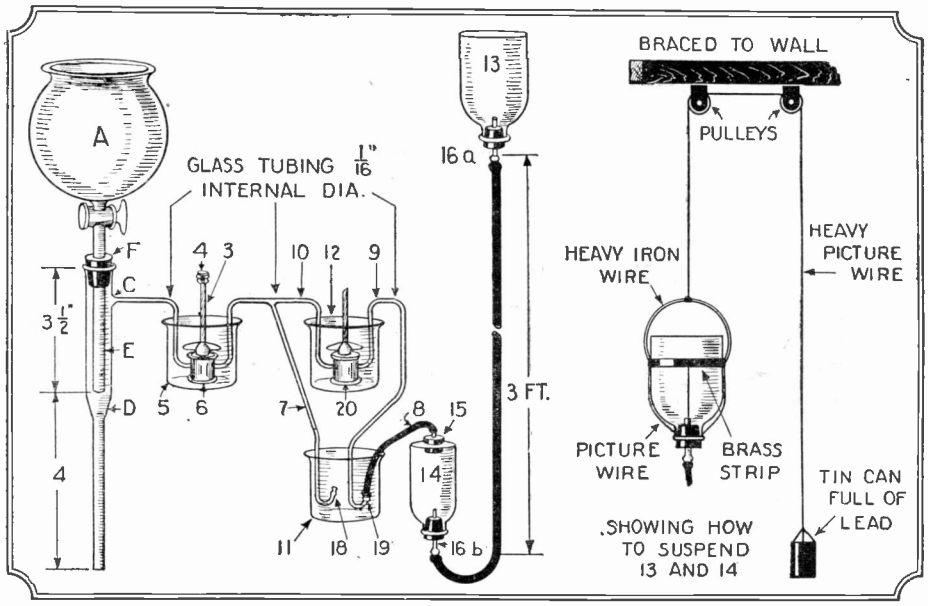


The natural acid found is citric acid and is usually neutralized by the addition of soda. The same acid is found in lemons and citrus fruits.

A High Vacuum Mercury Pump

By HARRY J. COLEMAN

THE biggest cost in this equipment will be the mercury, of which it will take approximately twelve pounds, although the more mercury that is used the higher the vacuum that can be obtained. Of course, more mercury will require larger containers 13 and 14, than specified here.



All of the constructional details of the high vacuum mercury pump described in the text are shown in the above illustration. The suspension of the mercury vessels is shown.

This pump is suitable for experimenting with Audion tubes, Geissler tubes, X-ray bulbs, electric light globes, and any such tubes that require a high degree of vacuum, and also in chemical experiments, etc. First you will have to purchase a separatory funnel equipped with a glass stop cock and a long stem of small diameter, and a glass tube about 3½ inches long and ⅜ of an inch in diameter, this tube should be drawn out at C, and a smaller tube the diameter of tube E, and about four inches long should be sealed on at C. A rubber cork F, with a hole through it to admit E, should fit into D, the small tube which leads to the glass stop cock 6, should be sealed at C. This completes the first part of the lower evacuating system.

The stop cock 6, which is of glass can be bought at any chemical supply house, and it can be had with about a foot of straight tubing connected to it, this tubing should have as small internal diameter as possible; this tube should be bent as shown in the diagram to fit beaker 5, this beaker should be just large enough to admit stop cock 6, and the tubing, as this will save mercury. 3 and 4 is a wooden handle rigged to the handle of stop cock 6, so as to permit turning it without getting the fingers in the mercury. After the stop cock is set into the beaker, the beaker should be filled with mercury until the stop cock is covered, this insures a perfect air tight valve.

Tube 10 leads into beaker 12, constructed the same as 5. There is a tube 7, which leads into vessel 11, and should have a couple of small bulbs blown on the end where the rubber tubing from the vessel to be evacuated will fit. Tube 9, leading from the opposite side of the stop cock, also runs into vessel 12, which has two small bulbs on the end like 18; a rubber tubing 8, is connected here, and is connected with a glass tube which runs through rubber stopper 15. This rubber stopper fits into a bottle which should be about eight ounces in capacity and having a hole drilled in the bottom, this hole can be drilled by applying turpentine and camphor to a good drill and turning slowly until the hole is complete. The hole will have to be large enough to admit rubber stopper 15, which will be about ½ inch in diameter.

The mouth of the bottle 14, should be fitted with a rubber stopper and has a glass tube running through it about two inches long, on which rubber tube 17 is connected, the other end of tube 17 is connected to a glass tube the same as 16, and runs to vessel 13, this vessel can be a bottle preferably larger than 14, with the bottom cut off; cutting the bottom off of a bottle was explained in the December *Experimenter*. Now we have completed our apparatus, and vessels 14 and 13 should be suspended on a strong picture wire, with weight attached as shown in the diagram. Vessel 12 can be placed next to vessel 11, which can also be a beaker, or if the experimenter desires one vessel can serve the place of 11 and 12, as these vessels are only to assure perfect air tight joints which are very essential in this kind of apparatus.

After once understood, the operation of this apparatus is very easy, vessel 13 is to be raised to its highest level, which should be about three feet above vessel 14. Mercury is to be poured into vessel 13, until vessel 14 is filled and also the glass tubing leading to stop cock 20; all stop cocks should be opened while doing this, but after we have poured in sufficient mercury to fill vessel 14, and the tube, stop cock 20 should be closed and the vessel to be evacuated is connected by rubber tubing to 18, stop cock 6, should be left open and the separatory funnel A should be filled with mercury and the stop cock attached to it so regulated as to cause a steady stream of mercury to pass through D, of course; this mercury must fill the tube, D, so that no air will re-enter the apparatus.

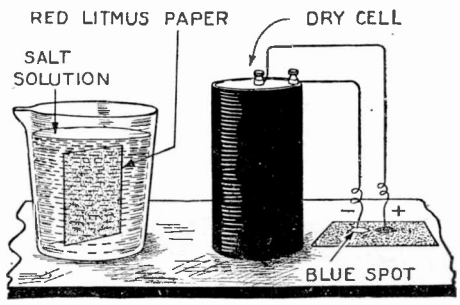
A vessel should be kept under tube D, to catch the mercury as it comes out, and should be large enough to dip the used mercury out to pour back into A, and A should be kept almost full as long as this operation continues, and it should be continued until no more mercury will run through D, then while A is still full stop cock 6 should be closed, and stop cock 20 should be opened.

Now vessel 13 must be slowly lowered until it has filled with mercury, then stop cock 20 should be closed again and vessel 13 hoisted back again to its previous level. This must be done very slowly. As the mercury goes back into 14, it pushes the air which is now in vessel 14, up and out through tube 8. When vessel 14, and the tube leading to stop cock 20, has again completely filled with mercury, stop cock 20 can be opened and the same operation is repeated. Never should stop cock 6 be opened except in the first operation as stated. The lowering and raising of 13 can be carried on a number of times, or until the vacuum that is needed is obtained. Then the vessel that is being evacuated is sealed off in the usual way, which is usually known to the experimenter, or he can refer to the columns of SCIENCE AND INVENTION.

Polarity Test Paper

By GEORGE L. HEYER

A VERY good polarity indicator can be made as follows: Get some red litmus paper and soak it in a solution of salt, one teaspoon to about 200 c.c. of water. Let this dry very thoroughly. When ready to use moisten slightly with water and place the ends of the wire about ¾" apart on the paper. A blue spot will appear at the negative wire and a red spot at the positive wire. The red spot will be stronger in color than the rest of the paper.



Red litmus paper, when prepared as shown, may be readily used as a polarity test paper by moistening with water and applying the terminals. The result is shown.

Sensitive Practical Galvanometer

By J. BRONT

THE galvanometer illustrated in the figure is one of the most efficient types for the experimenter to build. If carefully constructed the sensitivity will be highly gratifying, and the device may be used for innumerable purposes.

Note should be taken of the arrangement of the magnetic gap. Here, triangular pieces of soft iron are secured to the inner face of the magnet poles. The triangular sections serve to concentrate the magnetic force within a thin plane. Within the moving coil, an armature piece is likewise tapered at either end, providing a reduction of air gap, and at the same time aiding in the concentration of the magnetic lines of forces in such a manner that they must almost inevitably pass through the coil. This latter effect further increases the sensitivity of the device. The fixed armature is secured to a magnetic-insulator block, fastened between the legs of the magnet.

For best results, it may be found that two or more magnets may be used, instead of the single one shown in the figure. In this case, the shape of the coil will be somewhat changed, as it will then be elongated, so as to fully "cover" the magnetic force in the air gaps. The central armature piece will of course be elongated in the same proportion as the coil.

As to the coil itself, a suitable form for winding must be found. For improvised construction the form may be made up of a strip of paper wound around a wooden block, to give the required shape, at the same time applying good, clear shellac, so as to bind the layers of paper together and to provide sufficient strength in the complete coil form.

The coil itself may be wound of as many turns of wire as it is practicable to place on the form. The smallest size of wire obtainable should be used, or at least the smallest wire which the experimenter may find it feasible to work with. The manipulation of the finer diameter wire is no easy task, but must be done carefully and patiently. However, the more pains taken, the better the resulting product.

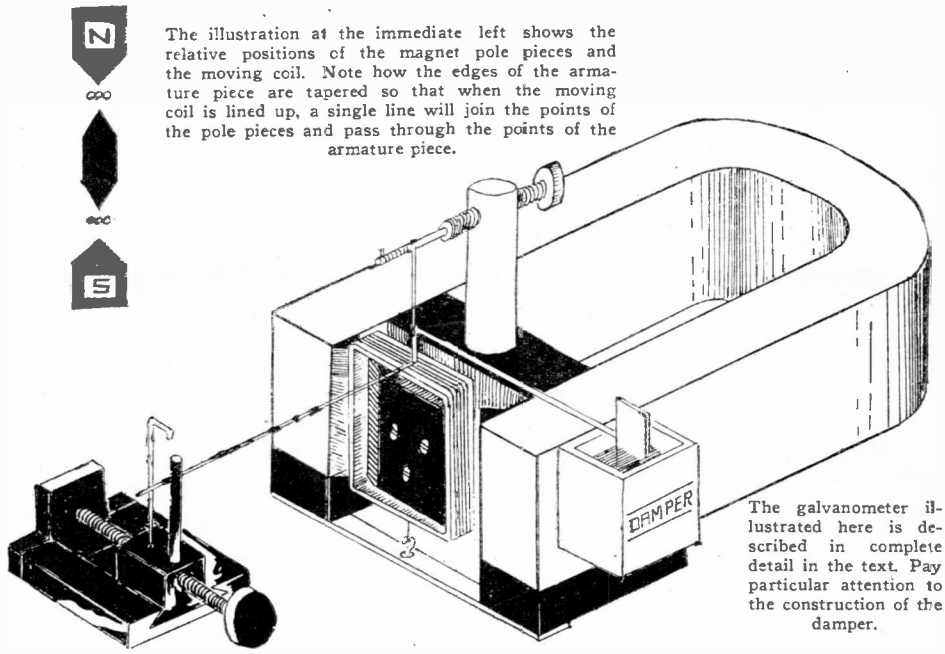
The suspension of the coil may be accomplished in a manner similar to that shown in the figure. A thread running over an adjusting screw supports the coil from the top. Note is to be taken here that, as shown in the illustration, a wire runs from a damper at the side, attached to the suspending thread, and turns off at an angle to form a pointer. As the instrument exactly as represented was used in connection with relay circuits, for telegraphic purposes, nevertheless, if desired, the damper may be dispensed with, although some form of pointer must be employed if the device is used as a simple indicating instrument. The addition of a scale is a simple matter. The damper in the relay work was added to prevent "chattering" of the pointer, the latter having been used as a contactor for a local circuit outside of the device itself. The tank of the damper was filled with castor oil—this is the same as with the galvanometers used in trans-Atlantic cables—in fact the device being described is practically the same as the "siphon printer" used in cable work.

Used as a galvanometer, the contactor shown at the outer end of the pointer, will be eliminated.

In the event that the thread used to support the coil has not sufficient "spring" to return the pointer to a zero reading, a spring may be made by forming two or three turns in a very light wire and securing this to the hook support shown in the figure immediately under the lower side of the coil.

In calibrating the scale, it may be desired to gain some idea of the forces to be measured by the galvanometer in a comparative manner, showing the relation between the distance over the scale the pointer will travel, and the given applied force required to effect it. This is a highly delicate task, but may be accomplished if carefully carried out. Make a very high resistance potentiometer in any suitable manner which may be found convenient. Using a small flashlight battery as a source of voltage, find and mark the galvanometer deflections for given adjustments of the potentiometer. Care should be taken that the voltage applied is not such as to cause a comparatively high current, sufficient to burn out the wiring, or wreck the device. If the calibration is found to be feasible, you will then have a very sensitive calibrated instrument which may be made to read in volts—a voltmeter in every sense.

A thousand and one uses are found for any galvanometer, and the construction of a good device of the kind repays the experimenter to his highest satisfaction.



The illustration at the immediate left shows the relative positions of the magnet pole pieces and the moving coil. Note how the edges of the armature piece are tapered so that when the moving coil is lined up, a single line will join the points of the pole pieces and pass through the points of the armature piece.

The galvanometer illustrated here is described in complete detail in the text. Pay particular attention to the construction of the damper.

EVERY experimenter has use for a good galvanometer and if that instrument is made at home, its value is considerably enhanced. The details of an instrument that will give great satisfaction are given in the text and illustrated here. If carefully constructed, an instrument of this nature can be made very accurate.

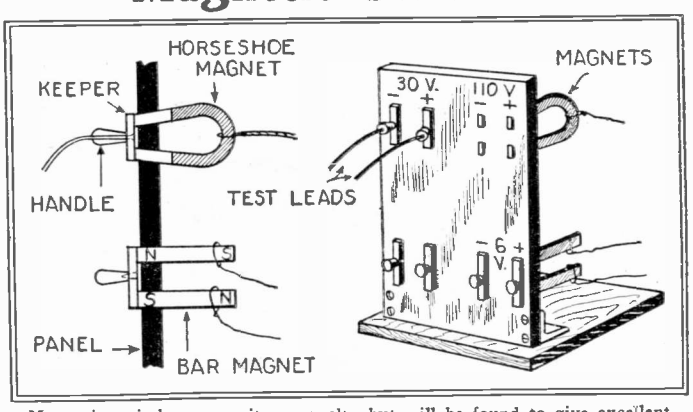
Magnetic Switches

THE illustration shows a unique switchboard panel in which permanent magnets and soft iron keepers are used in place of the usual knife blade switches and binding posts or terminals.

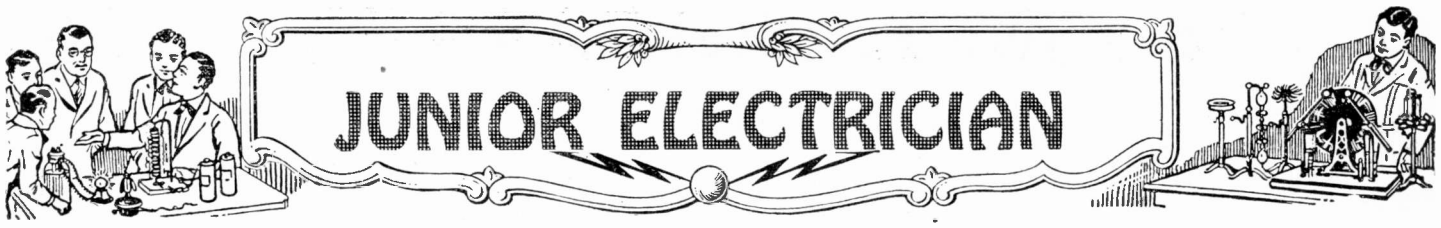
The permanent magnets are imbedded in the panel with the pole tips sticking slightly out from the face of the panel or exactly flush therewith, so that the iron keeper, when placed on the magnets, will remain in place and make electrical contact with the magnets. For use as a switch, wires are connected to the bar magnets which form part of the electric circuit which is closed by placing the soft iron armature across the two bar magnets. The horseshoe magnets are used when it is desired to make connections to different circuits with a pair of test leads. In this case the iron keeper is attached to the ends of the long flexible test leads, so that they may be quickly changed from one voltage connection to another.

There are a number of circuits in which the magnetic switch might be applicable, the illustration is merely a suggestion, to show how the magnetic switch can be used.

Two systems are shown; the horseshoe magnet provides for a single circuit through connection. For simple circuit closing the pair of bar magnets are used with a simple bar of iron.

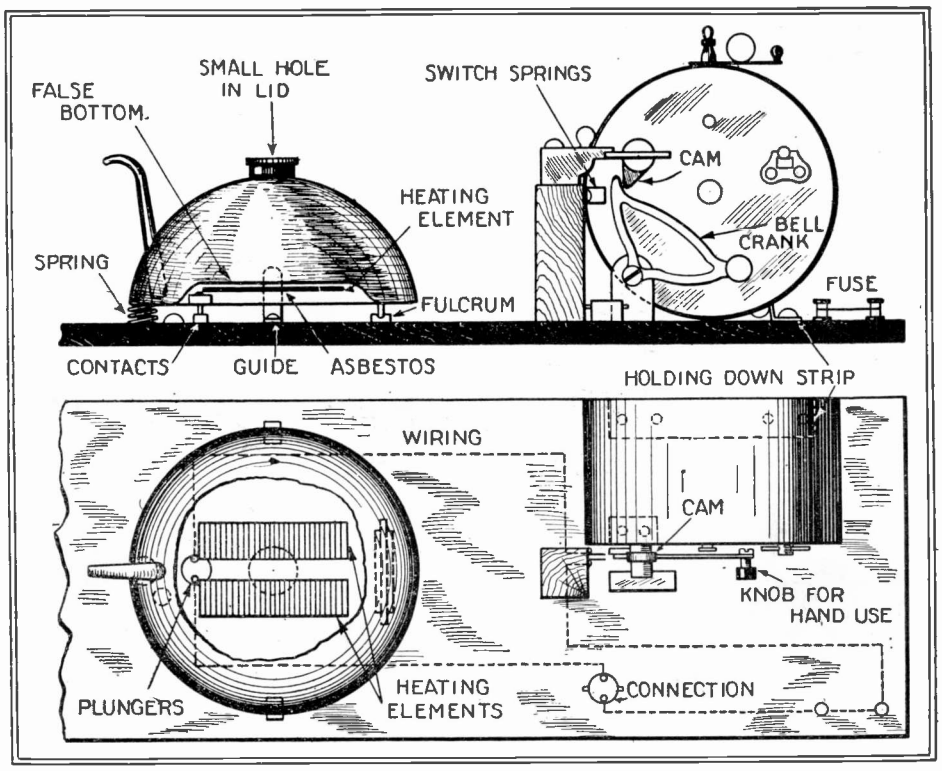


Magnetic switches are quite a novelty but will be found to give excellent satisfaction in the experimental laboratory. There are two main types and they are shown in complete detail in the illustration above. Be sure that the magnet faces project slightly from the switchboard.



An Automatic Tea Maker

By J. HART



This very nice tea-making arrangement is based upon one principal feature—the hole in the lid of the kettle. This hole must be extremely small. All it has to do is to let out air. The minute steam is generated, pressure will be produced simply because the hole is so small that steam cannot get out except slowly.

THE object of this apparatus is to produce a cup of tea or similar beverage at any pre-arranged time.

A kettle was first made just big enough to hold a cup of water. It was fitted with a screwed lid and a false bottom, into which the heating elements were fixed. The spout reached almost to the bottom, about 1-32nd-in. clearance being allowed. The heating elements consisted of two pieces of mica wound with a suitable resistance. This resistance was found by trial. Six yards of resistance wire were hung up from two supports and connected to the electric light socket. It was found that although the wire became hot it did not reach red heat, so it was shortened until this state was attained. The length suitable for the voltage used (100 volts) was found to be just under 14 ft.

Care must be taken to have the wire clear, as when it becomes hot it expands, and the sag so caused is considerable.

This varies, of course, with the voltage to be used. It is very essential that the false bottom is well insulated with mica before the elements are put in place. The ends of the elements were connected to the terminals of an ordinary electric light holder, and then a covering of paste made of asbestos millboard was put over them. A similar piece of copper was then soldered into place and a hole was cut to allow the ends to protrude. A piece of wire was then soldered near the back of the kettle to act as a fulcrum. The use of this will be seen later.

The kettle was then placed on a baseboard so that the fulcrum rested in a piece of brass shaped to receive it, and the ends rested upon two brass contact studs. A spring was then fixed to the board under the kettle, and it lifted the plungers off the two contact studs about 3-32nd in. Two guide pieces were screwed into position just to keep the kettle in place.

An alarm clock was then taken, the two feet removed, and a strip of brass screwed in place, so that the clock could be firmly screwed down on to the baseboard. An extension piece with a handle and a cam fitted was then soldered to the boss of the original alarm spring key.

A bell crank lever was pivoted in such a position that when the alarm was released the cam revolving worked it backward and forwards. A fibre knob was screwed to the end of the lever not in contact with the cam.

Two springy pieces of brass were then screwed to a piece of wood, and the whole fixed to the baseboard in such a position that when the alarm cam moved, it pushed the top part of the bell crank lever between the two pieces of brass. This gave a knife switch operated by the alarm.

On top of the block of wood a small catch was screwed, so placed as to stop the alarm directly the latter had moved the bell crank lever. If desired, the alarm could continue to ring until the spring was exhausted. This catch engages with the cam, and is not shown in the sketch plan.

To finish the job a fuse was fitted and connection piece screwed to the baseboard.

To prepare the apparatus the kettle is filled with water, the weight of which forces down the spring, and makes the plungers rest on the contact studs. If tea is required it is placed in a tea ball, and then put, with milk and sugar, into a cup which stands under the spout of the kettle. The alarm is then set for the time required.

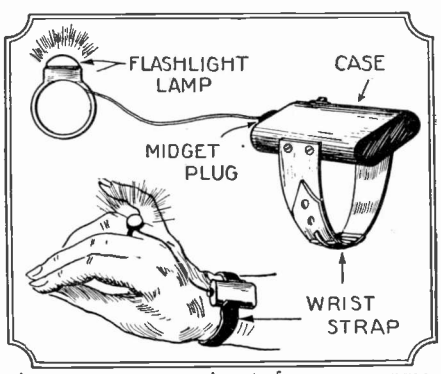
When the alarm goes off, the cam revolves, closes the knife switch and the heating elements begin to heat the water. Hot air is allowed to escape from the kettle through a very small hole drilled in the lid, but when the kettle boils all the steam cannot escape through this hole, and the resulting pressure forces the water up the spout into the cup. The water having gone, the spring lifts the kettle, and the current is thus cut off.

Luminous Finger Ring

By A. LINCOLN GOODYEAR

THE illustration shows an arrangement for having a very small flashlight bulb mounted in a ring, the bulb to be supplied with current from a flashlight battery; the latter is secured to the wrist or arm by means of a strap, with snap catches or a buckle. The drawing tells the story. It may be well to have a switch, although the drawing shows a plug. The removal and replacement of the plug, however, is rather awkward.

In order to make the connection perfectly clear, the wire is shown running over the back of the hand, where it would be too readily seen. There are several ways of concealing the wire. A glove may be worn with a ring over it or a very odd effect—and not a bad one—may be produced by wearing a thin, silk glove, and letting the light show through the interstices of the fabric. Another system which can be perfectly well applied, is to carry the wire under the palm of the hand, and for better concealment of the battery it may be strapped upon the upper arm, so as to be absolutely concealed by the coat. In this case, especially, a switch should be used, because it would be very awkward to use a battery plug, when the battery is so inaccessible.



A very pretty experiment for our younger readers, in which a flash-light is mounted on a finger-ring.

A lamp of the smallest size should be secured and when not lighted, it will pass for some kind of a natural stone. Various effects may be produced by coating it with very thin, transparent colors, or with the regular lamp dips.

With a little ingenuity, several rings may be used on the different fingers, or on one finger, and by proper switching system various effects can be produced.

Window Display

By JOHN BALAZS

A Toy Monkey on a String That Will Travel Up and Down as Long as the Current Is Turned on Makes an Exeedingly Novel and Attention Attracting Display

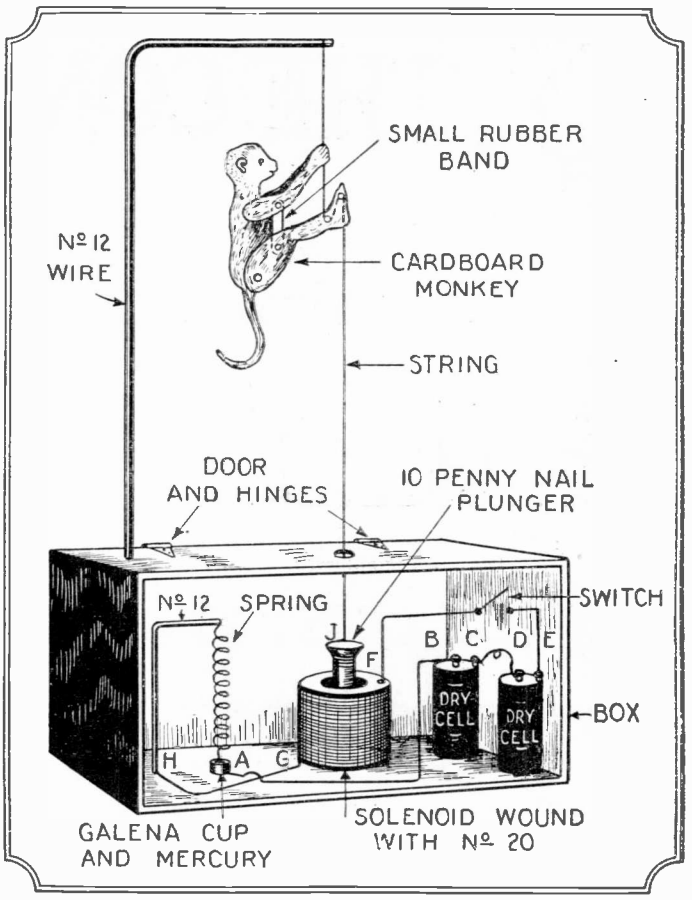
HERE is another attractive window display or may be made just for the sake of experimenting.

It consists of the following parts, the dancing spiral or the automatic circuit breaker, a solenoid that attracts the plunger which in return pulls the string to which is attached a cardboard monkey can be kept climbing up and down the string. A fair sized wooden box contains everything in the way of mechanism, including the dry cells. The back of the box may be put on hinges, to give access for renewing the batteries. Also another good plan is to fix a switch in some convenient place away from view, to shut off the current when not in use.

The connection is as follows: connect a piece of wire from "A" to "B," then "C" to "D," "E" to the switch "I," and "J" to "F," "G" to "H."

And for further explanation, the drawing will help to show the appearance of the apparatus when assembled, or if anything puzzles the maker just glance at the illustration.

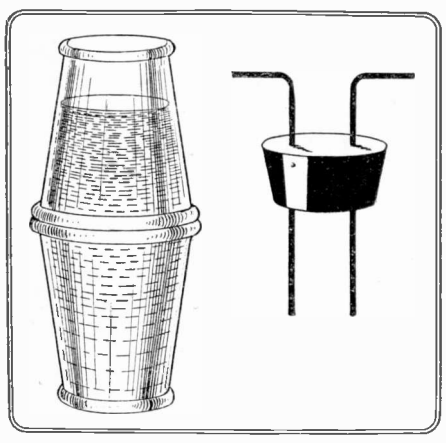
We are all familiar with the so-called "monkey on a string" that can be made to travel up and down by manipulating the string. At the right is shown a similar device that is electrically operated and that when properly constructed can be used as an effective window display. A dancing spiral making contact with mercury at A makes and breaks the circuit intermittently, turning on and off the current in the solenoid and causing the plunger to move up and down. This causes the monkey to travel up the string. If a clockwork mechanism is placed in the circuit instead of switch, it can be timed to open the circuit intermittently, allowing the monkey to descend.



Electric Cigar Lighter

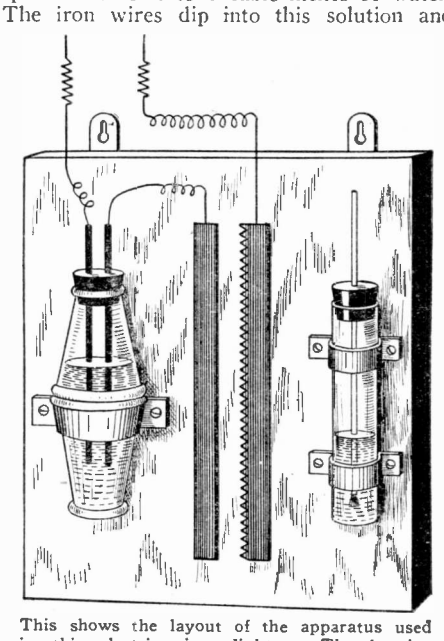
ELECTRIC lighters connected across a 110-volt circuit must have a resistance between the bars and the circuit, between which bars the short-circuit is made for lighting.

It is easy to make an apparatus of this kind, using as resistance either an incandescent lamp or a liquid resistance; the connection of the lamp is familiar to all. It is put in circuit with one of the bars. Special precautions must be taken to insulate the conductors, if a lamp is used for the resistance, but if on the contrary, a liquid resistance is used, a mustard pot will answer to hold the liquid. The cork is preferably heated in melted paraffin wax. This cork is pierced with two holes, through which two iron wires pass, fitting tightly.



The details of the water resistors used in connection with this electric cigar lighter are shown in the above drawing. Any available insulating container may be used for holding the liquid and supporting the contacts.

The vessel is filled pretty well up to the neck with a solution of salt water, a teaspoonful of salt to 6 cubic inches of water. The iron wires dip into this solution and this constitutes the liquid resistance, which is connected as shown in the drawing.

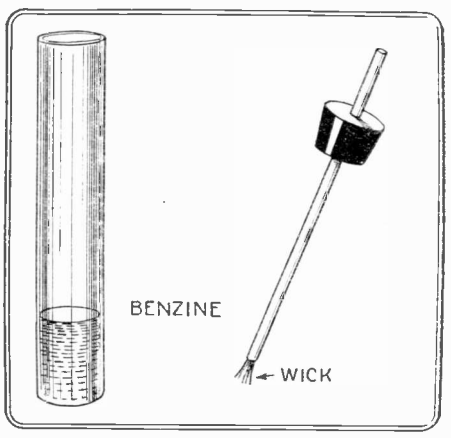


This shows the layout of the apparatus used in this electric cigar lighter. The benzine container will be noted at the right.

The two bars are cut out of brass, one or both of which have saw teeth filed on one edge. They are attached parallel to each other on a wooden base, to which also the liquid resistance is strapped. It is well enough to have a fuse in circuit also. A test tube or equivalent tube contains benzine and into it a copper tube dips, which passes tightly through a hole in the cork fitting the tube. At its lower end, the tube is provided with a wick which is best made of asbestos.

To use the apparatus the copper tube is withdrawn from the benzine tube and is rubbed across the gap between the two plates. This produces a lot of sparking, and the wick is lighted. The strength of the spark is regulated by varying the depth of immersion of the iron rods.

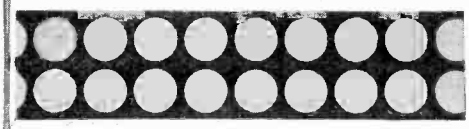
This is probably one of the simplest types of electric cigar lighters that can be designed for use on house current. It will operate equally as well on either A.C. or D.C. without any changes.



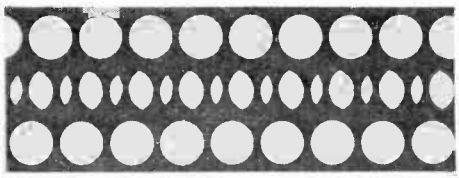
The benzine container is merely a small pill bottle, test tube or other similar vessel. The wick is held in the small copper tube which in turn is placed through a one-hole cork that fits in the mouth of the benzine container.

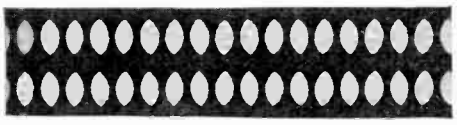
THE CONSTRUCTOR

Mechanical Designing

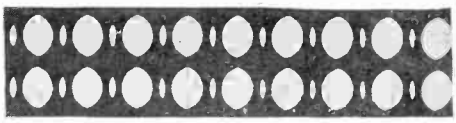


Above: One of the perforated strips used in this designing method.



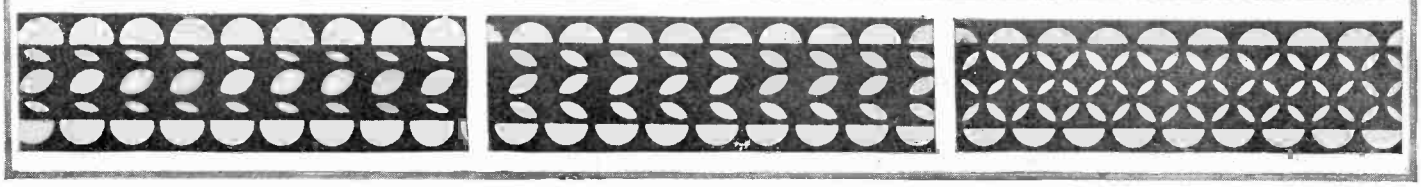


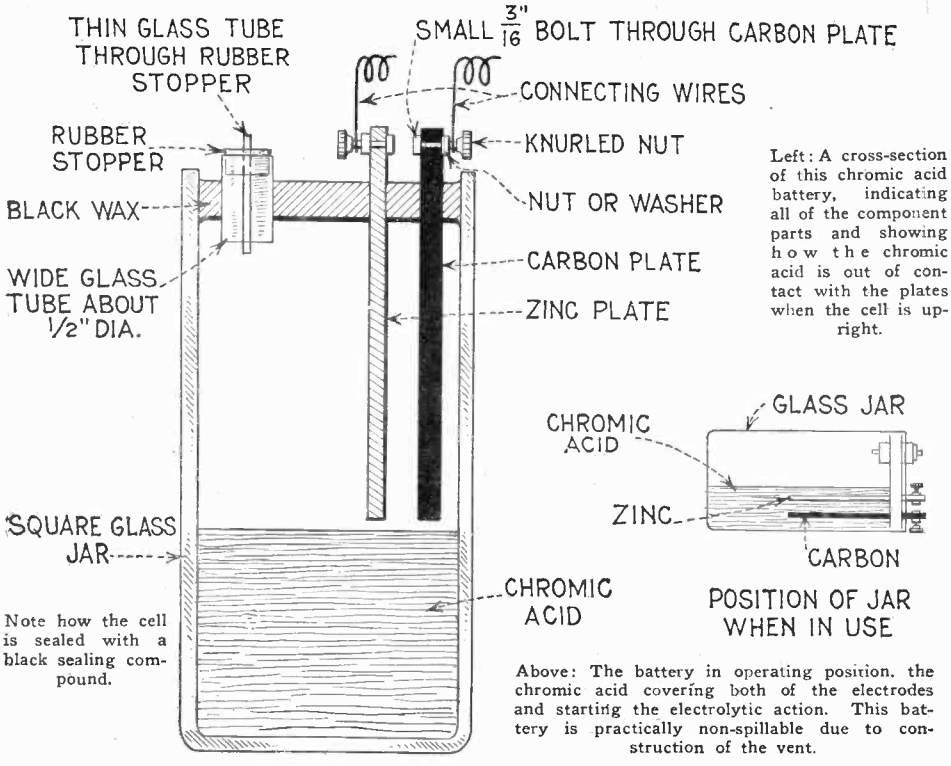
Above: The succession of pointed ovals is formed by two perforated strips.



A VERY successful and simple method of producing unique designs is by preparing several strips of black paper or exposed and developed photographic negative with a series of circular holes as shown in the upper left-hand illustration on this page. These strips are then placed one over the other and moved to different positions, giving rise to some most unique effects. In order to capture these designs and preserve them for future reference, the method illustrated in the photograph in the upper center of this page can be employed. The superimposed strips are placed on a sheet of photographic paper and exposed under a strong light. The positive print so made is developed, fixed and filed for future reference.

THE various illustrations accompanying this article show some of the designs that can be produced with perforated strips. For instance those in the strip directly below were made by laying strips of material with double perforated rows of holes over each other, but overlapping only about halfway. The different designs are produced by moving one or the other of the strips slightly to the left. From this procedure it will be simple to discover ways for producing more complicated or simpler designs, merely by various arrangements of the strips and of their relative placements. Try also using strips perforated with more than two rows of holes in combination with other oddly made strips.—DR. ERNEST BADE.



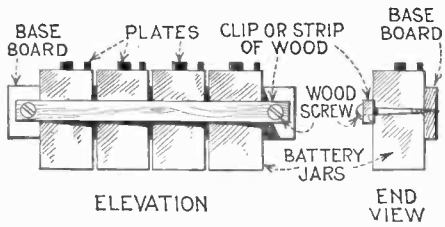


Note how the cell is sealed with a black sealing compound.

Above: The battery in operating position, the chromic acid covering both of the electrodes and starting the electrolytic action. This battery is practically non-spillable due to construction of the vent.

Left: A cross-section of this chromic acid battery, indicating all of the component parts and showing how the chromic acid is out of contact with the plates when the cell is upright.

Chromic Acid Battery

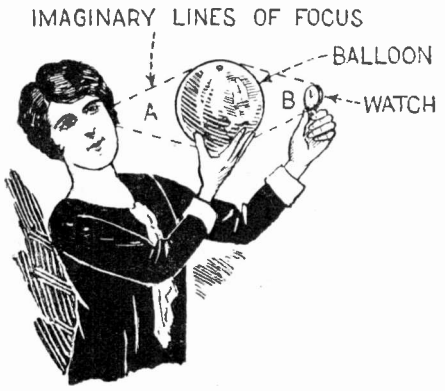


WHERE powerful currents are desirable and storage batteries are not available, chromic acid batteries shown here will be found most desirable. The cells are bolted to a baseboard as shown above and are stood on end when not in actual operation. Laying the battery on its side starts the action. All of the constructural details are shown in the drawings at the left. The vent tubing and the electrodes are held in position by a piece of wood, the cell is filled to within one inch of the top with water and a layer of paraffin wax poured in. This is then covered with a thicker layer of melted sealing wax which is allowed to solidify. The water is then removed through the vent hole and the chromic acid electrolytic solution is introduced.

Scientific Fun with Toy Balloons

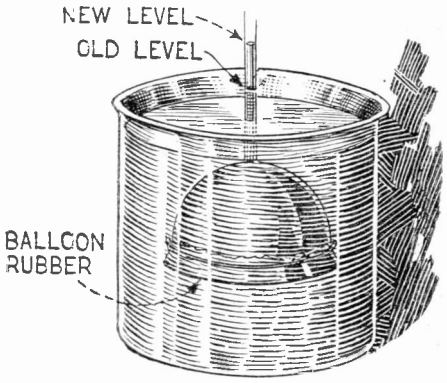
By RAYMOND B. WAILES

Gas Lens



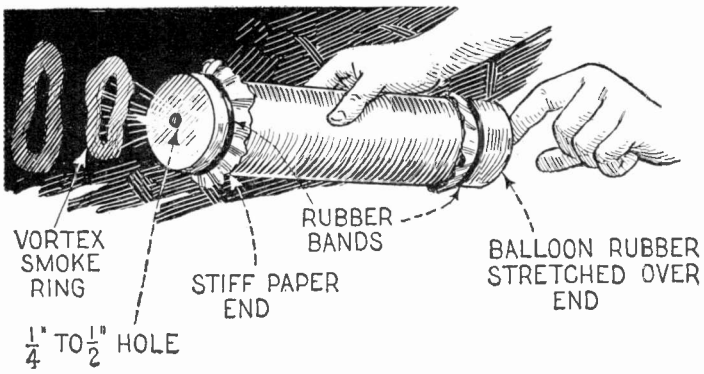
It is possible to concentrate sound by means of a gas lens, just as light is concentrated by a glass lens. This can be demonstrated by means of a balloon inflated with carbonic acid gas and held in the manner shown at the left. A watch is held on the opposite side of the balloon from the ear and by varying the distances A and B, the sound of the watch ticks can be made much louder.

Osmosis Demonstration



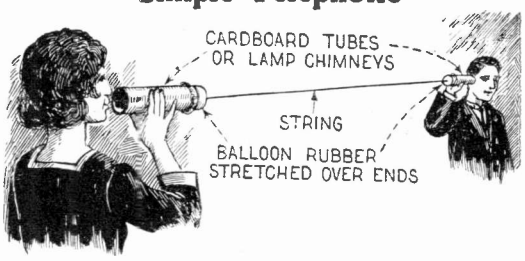
Using a piece of thin rubber, the phenomenon of osmosis can be shown. Stretch the rubber across the large end of a thistle tube as at the right and fill the tube with a strong solution of sugar and water. Place in a container of water and the latter mentioned liquid will pass through the rubber and dilute the sugar solution, causing it to rise in the stem after several days.

Vortex Rings



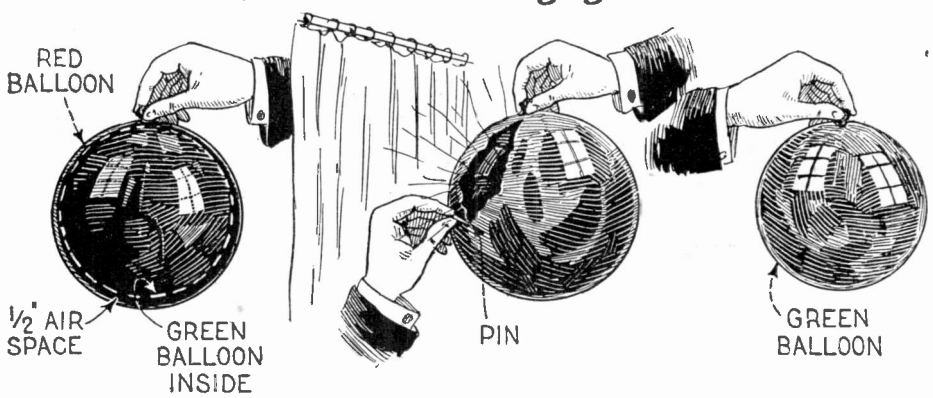
Stretch a piece of balloon rubber over the end of a cardboard tube and a sheet of paper over the other. Cut a hole in the paper end and fill the tube with smoke. Snap the rubber end with the finger and a pronounced ring of smoke will issue from the hole in the opposite end of the tube.

Simple Telephone



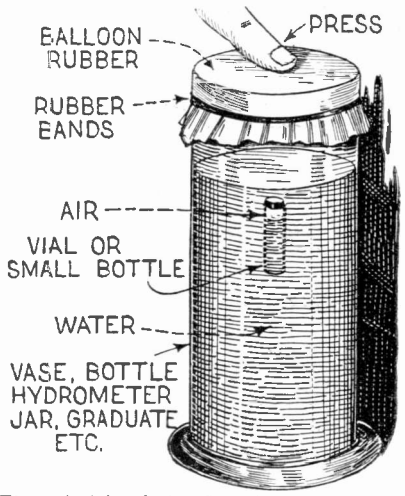
A simple telephone may be constructed as illustrated above. The connecting string must be kept taut.

Balloon Color Changing Trick



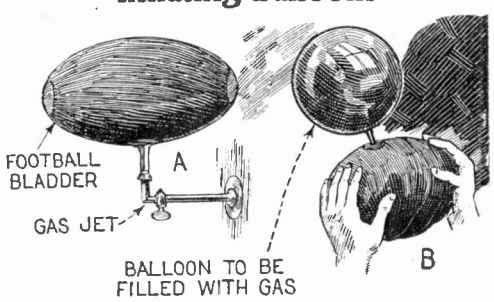
To perform this startling trick, place a green balloon inside a red one, inflate the green balloon and tie it. Inflate the red one slightly larger and exhibit. Cover with a handkerchief, break the outer balloon with a pin and—bang—the color of the balloon appears to change.

Cartesian Diver



The principle of the Cartesian diver can be demonstrated as above. The amount of water in the vial is varied until pressure on the balloon diaphragm causes it to sink. This action is brought about by the pressing of the rubber diaphragm. Doing this makes displacement of the vial smaller and consequently increases the combined weight of the vial and contents. Better results are obtained with an inverted uncorked vial.

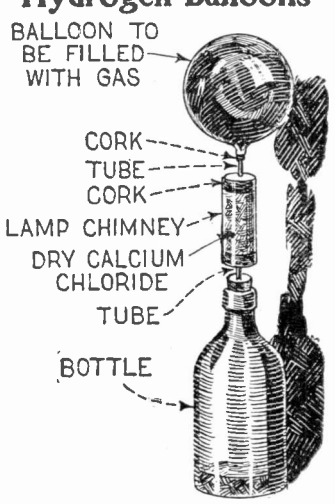
Inflating Balloons



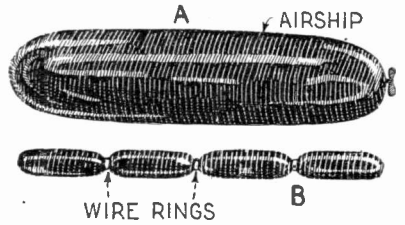
Balloons can be filled with illuminating gas by first filling a football bladder from the source as at A, and then forcing the gas from the bladder into the balloon as at B.

By setting up a gas generator as at right, placing sulphuric acid and zinc in the bottle, balloons can be filled with hydrogen. Let generator run for several minutes before filling the balloons.

Hydrogen Balloons



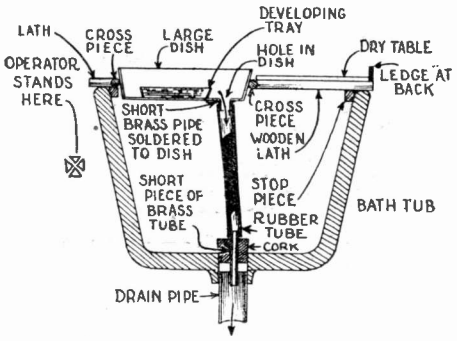
Hot Dogs



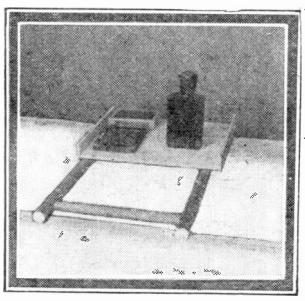
By using large balloons that can be inflated into elongated shapes as at A, model dirigibles can be built. Using several small balloons connected by wire rings as at B, imitation frankfurters are made.

HOW TO MAKE IT

Bath Tub Photographer's Table



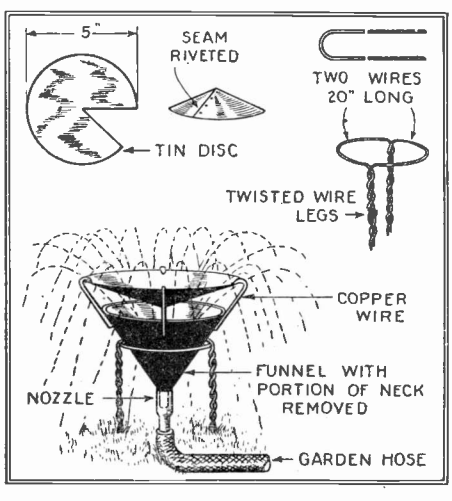
Photographers not fortunate enough to have a room set aside for their developing and printing, will find this new table a great aid to good and quick work. Apart from its convenience, the layout prevents developing solution from coming in contact with the bath itself even if a great deal of solution is spilled. Many developers are poisonous. It will be noted in the diagram above that a tray set into a wooden frame communicates directly with the drain pipe of the tub. The developing tray itself is placed in the larger tray. The layout is easily and quickly removable.



The photograph at the left shows the arrangement of the frame and the dry table at the back.

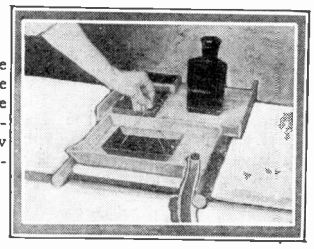
Although in this particular layout round curtain poles were used to build the framework for the dry table and tray, there is no objection to the use of square wooden laths. Cross pieces are arranged to fit the bath tub and they hold the frame securely in place preventing it from sliding off the edge of the tub. The drawing makes this clear.

Lawn Sprinkler



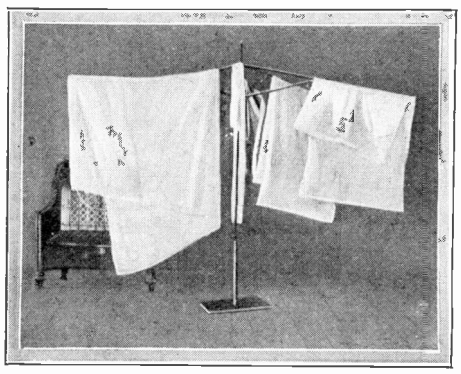
Details and an assembly view of a simple lawn sprinkler are given above. The conical shaped piece over the funnel serves to spread the water outward. —Dale R. Van Horn.

The photo at the right shows the developing table and the tub broken away to show the hose connection.



It is obvious that with the table shown here, spilled developer is carried away directly into the main drain pipe of the bath tub, for all developing is carried on the large enameled steel dish into which developing dishes are placed. The steel dish should be large, at least eight to ten inches across. The drain pipe is a short piece of brass tube soldered to the under side of the dish after the enamel has been chipped away in this part. After the brass tube is soldered in place, a hole is drilled through the dish, and then several coats of enamel are applied to renew the surface.—C. A. Oldroyd, Reporter No. 4433.

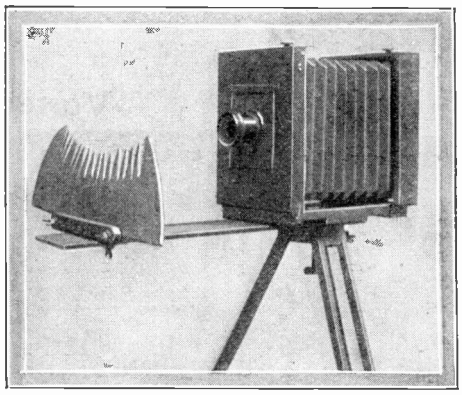
Drying Rack



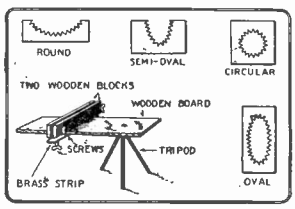
An old umbrella frame fastened to a piece of plank as a base makes an excellent indoor drying rack as shown. The ends of the ribs should be bent upward slightly so as to prevent the pieces from slipping off. —Arthur Flinner.

Photo Diffuser

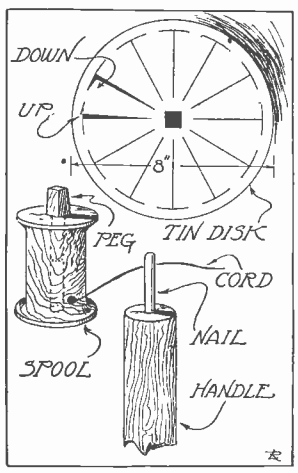
For diffusing the lower half of a portrait or group photograph, an excellent home-made diffuser such as that shown can be employed. It is mounted on an extension base that projects outwardly from the camera and consists of a piece of cardboard cut out to the desired shape, with the edges serrated as shown. By employing different sizes and by regulating the position of the diffuser in relationship to the lens of the camera, varying effects can be obtained. It is quite necessary that the diffuser be not too close or too far away from the lens and the best of results can be determined only by experimenting. A diffuser of this nature lends a very artistic touch to photos, particularly portraits.



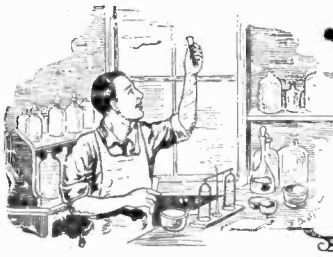
The details of the diffuser support and of various shapes of diffusers are shown at the right. — Ricardo Ludeke.



Winged Whirler



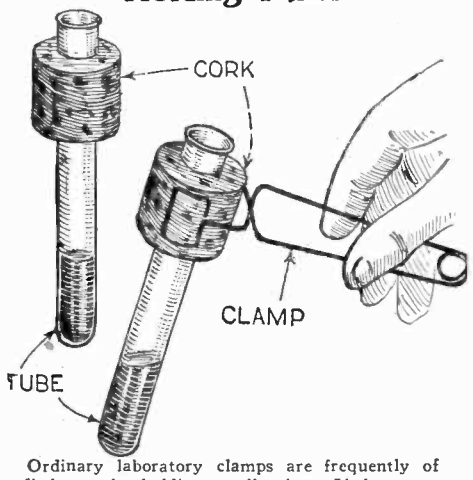
A winged whirler that will rise to great heights when properly constructed can be easily made. First a disk is cut from tin 8 inches in diamter and then a circle is inscribed on this disk 7 inches in diameter. Twelve radii are drawn and cut part way to the center as shown. Alternate ones are bent up and the remainder bent down. A square hole is cut in the center. A spool is then obtained and a peg forced halfway into it, the top of the peg being square as shown. This square peg is to fit loosely in the hole in the disk. If necessary, glue the peg into the spool. Now provide a handle which may be a piece of broomstick and drive a nail in the center as shown, cutting off the nail head. Attach a piece of string to the spool by means of a tack, place the spool on the nail in the handle and wind up the string on the spool. Place the tin disk on the square peg, grasp the handle in one hand and string in the other and pull quickly. The disk will spin and rise to a great height.—L. B. Robbins.



WRINKLES
RECIPES & FORMULAS

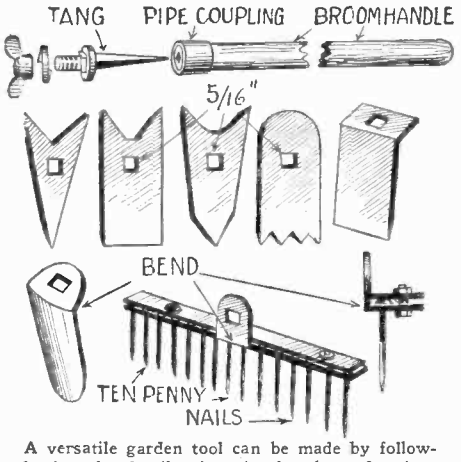
Edited by S. Gernsback

Holding Tubes



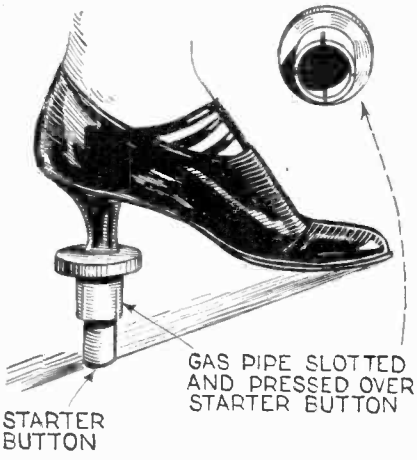
Ordinary laboratory clamps are frequently of little use for holding small tubes. If, however, a tube is placed in a one hole cork, it can be readily held in a clamp as shown in the above illustration. —F. R. Moore, Rep. No. 1993.

Garden Tool



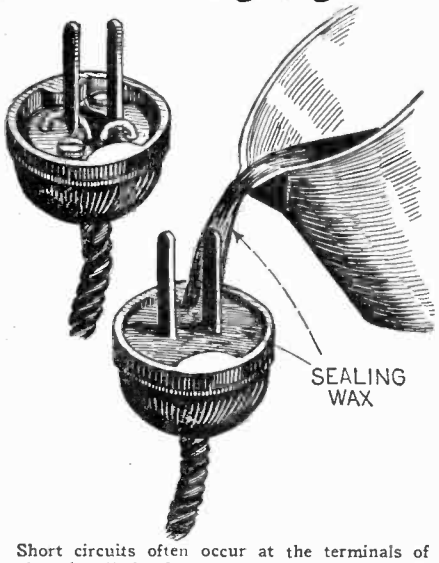
A versatile garden tool can be made by following the details given in the above drawing. A handle is equipped with a tang and several different shaped tools are cut from sheet steel and punched with square holes to fit the tang. A rake is also made. —F. J. Wilhelm.

Starter Button



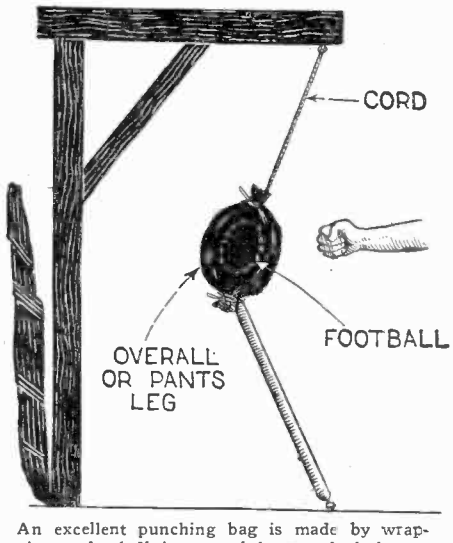
The small starter buttons on cars can be enlarged so as to give ample surface for the heel by placing a cap as shown. A large disk is soldered or welded to the cap which is made with a gas pipe nipple. —F. J. Wilhelm.

Protecting Plugs



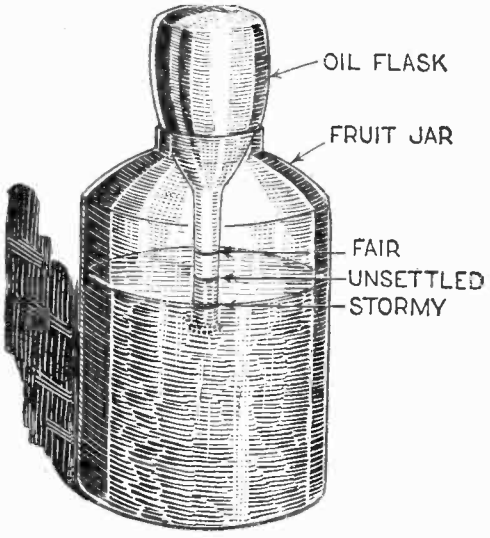
Short circuits often occur at the terminals of plugs but if the depression shown is filled with melted sealing wax, it will be found impossible for such short circuits to take place. —Adolph F. Lonk.

Punching Bag



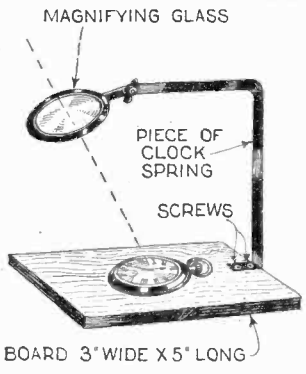
An excellent punching bag is made by wrapping a football in several layers of cloth, encasing the bundle as shown and suspending by means of a stout cord and a length of old inner tubes. —Frank Morella.

Barometer



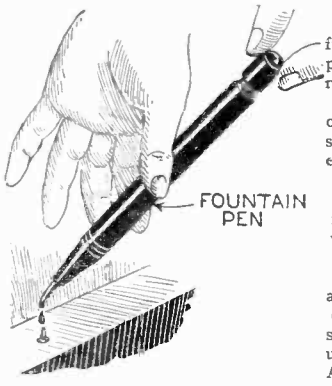
Set up the apparatus as shown above, using any flask that may be at hand and fill the jar half full of water. The higher the level of water in the neck of the flask, the clearer weather may be expected. —K. M. Rice.

Glass Stand



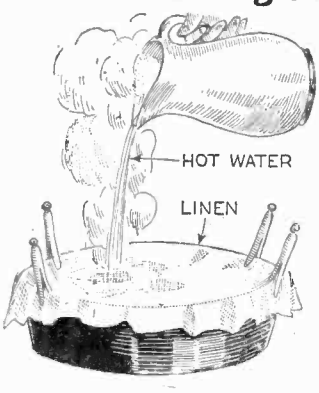
For use when working on watches or other small objects, the magnifying glass stand shown at the left will be found of great value. Any ordinary magnifying glass is supported by a strip of clock spring or other metal at the required height.—J. A. Mahan, Rep. No. 26,609

Oiler



A self-filling fountain pen from which the point has been removed makes an excellent oiler for use on small machinery and in difficult places. The pen is filled with oil which is then conducted to required place and ejected by operating the self-filler in the usual way. —Arthur Moyer.

Removing Stains



Tea, coffee and fruit stains may be removed by placing the stained portion over a bowl as shown above and pouring boiling water over the stain from quite a height. Continue pouring until the stain disappears. If stubborn, use Javelle water. —Nina Jeffers.

Readers Forum

SCIENCE AND INVENTION desires to hear from its readers. It solicits comments of general scientific interest, and will appreciate opinions on science subjects. The arguments pro and con will be aired on this page. This magazine also relishes criticisms, and will present them in both palatable and unpalatable forms. So if you have anything to say, this is the place to say it. Please limit your letters to 500 words and address your letters to Editor—The Readers Forum, c/o Science and Invention Magazine, 53 Park Place, New York City.

MODEL DEPARTMENT

Editor, SCIENCE AND INVENTION:

I have been a happy reader of SCIENCE AND INVENTION Magazine for some time. I just purchased my March copy from the news dealer and was agreeably surprised to note that you have started a Model Department. This is what quite a few of your readers have been waiting for.

I am very anxious to start building a model electric railway for 2½-inch gauge, but not having much experience I am somewhat handicapped. Would appreciate it very much if you would publish some information in your Model Department in your magazine. Quite a few men in Great Britain have given model railways a lot of attention and have produced some fine models. In fact, I understand that there are two firms in England that manufacture model railway material exclusively. Shall we let our English cousins beat us at the model railway game? I'll say not. Hoping to see something real soon in your excellent magazine.

GEORGE H. GASSER,
Pittsburgh, Penna.

(If some of our readers will now send in their locomotives or model electric railways which they have built and enter those models in the SCIENCE AND INVENTION *trophy cup contest, we would be glad to give the details of the construction and print them in* SCIENCE AND INVENTION *Magazine. This magazine also has a Blueprint Department and furnishes the blueprints of all the models illustrated in the pages of the magazine.*

The fact of the matter is that model making interests our many British friends to a greater extent, it would seem, than it does the American populace. We find, however, that there are a great many model makers in the United States; that many of them find model making a wonderful hobby, but inasmuch as they have no official organ there have been no means heretofore for expressing their opinions in books or magazines or giving the details of the models of their construction in any of our publications. It is now up to the readers to demonstrate that the editor's opinion is well founded and that there are model makers in the United States.—EDITOR.)

THE MOON ON THE HORIZON

Editor, SCIENCE AND INVENTION:

I beg to call your attention to the article found in the February number of SCIENCE AND INVENTION Magazine, page 942, concerning the size of the moon. The writer of that article tried to explain why the moon appears larger to us when seen on the horizon than when seen at the zenith. He claims that it is an optical illusion due to an unconscious comparison made by the observer, because when we see the moon along the horizon we can compare it with other objects, whilst such comparison is out of the question when the moon is seen poised in mid-air. I have met this explanation also in several textbooks on physics, *e. g.,* Black and Davis, but I must say that it has never satisfied me.

I have lived for several years out on the Western plains, where I had every opportunity of witnessing the rise of the moon, along a horizon which appeared to be a narrow, bleak line not offset by the smallest object, and yet the moon seemed to be larger. Then again I have seen the moon in cities with their towering skyscrapers. Now although the moon was seen just along the side of a tower or some other huge office building, still it appeared smaller. Although there was every opportunity of making a comparison, the mind obviously did not make it. About a year ago I came across an explanation found in the works of an old Greek Astronomer of two thousand year ago, which seemed far more satisfactory. His name is Posidonius and he lived in the last century before Christ. He explains the optical illusion—because it cannot be anything else—in this way: The so-called dome of the heavens does not appear to us in the form of a perfect hemisphere but as a semispheroid, *i. e.,* the part directly above us seems much nearer to us than parts along the horizon. Now it is a matter of experience that if two objects are seen at the same angle but under the impression that one is farther away, the latter will invariably appear the larger to us. Paradoxical as this may sound, it is perfectly correct. I have tried it out many a time and have found it uniformly correct. Another proof of how far the old Greeks were ahead of us not only in the theoretical principles of the exact sciences but also in their practical application.

SALESIUS SCHNEWEIS,
Teacher of Physics,
St. Lawrence College,
Mt. Calvary, Wis.

(This interesting bit of logic is printed because many of us are very much interested in the apparent increase in size of the moon at the horizon. We wish to thank Mr. Schneweis for his interesting letter.—EDITOR.)

A MODEL CLUB

Editor, SCIENCE AND INVENTION:

I have been very much interested in your Model Department and want to compliment you on the exceptionally well detailed blueprints which this department is furnishing, as well as try to tell you in these few words about the advantages your large sized prints have. Although I have secured blueprints from many concerns which furnish them, I have never seen blueprints as sharp and clear as yours are. Your prints leave nothing to the imagination.

Now that SCIENCE AND INVENTION Magazine has started a Model Department, why not start an International Model Engineering Society? I for one would become an active member. This society should have as one of its requirements a condition that makes it necessary for everyone to build at least one model of any kind whatever, and to submit photographs at least of that particular model, to the society, and on those photographs give the complete details and descriptions, such as stroke and bore of a cylinder, if it happens to be a locomotive, the particular type of locomotive which it represents, and the particular outstanding features which the model may have. The society, for a small fee of let us say, $1.00 to $2.00, could furnish all members with a pin and a certificate of membership. It should be the mouthpiece of the model makers and by means of publishing a small article, questions arising in the mind of one of the members could be answered by the other members who may have overcome the difficulties in a unique way. Such an organization is possible when one considers the circulation of SCIENCE AND INVENTION Magazine. With this publication as its mouthpiece, an International Model Engineering Society would be known throughout the world. I am ready to send my name in immediately, provided that the membership fee including the button and certificate will not cost more than the amounts specified. Who else is with me?

ROBERT J. MALLEY,
Chicago, Ill.

(Now here is an interesting thought, and certainly worthy of further consideration. It would depend entirely upon the appeal a model engineering society of this nature would have as to whether such an organization could be started. The expense of the membership could be very low; the advantages many, and the conditions of the membership should be arranged by the model makers.

Now how many model makers are there who would be interested in such an organization? Let us hear from you.

Let us also have suggestions for the conditions of membership. We think that those conditions outlined in Mr. Malley's letter are very good. They can undoubtedly be improved upon, but inasmuch as more heads are better than one, we shall await information.

By the way, fellow model makers, don't forget the silver cup which is being awarded every month for the best model submitted. The model may be an airplane, a submarine, a steam engine, a locomotive, either electric or steam, a generator, a ship, or what not. —EDITOR.)

OBJECTS TO "READER'S FORUM" POLICY

Editor, SCIENCE AND INVENTION:

About a year ago, I got into an argument in your Readers Forum about Evolution. You wrote an editorial, with which I did not agree, and I wrote you about it, telling you of my opinion. You published this letter of mine and it called forth several answers from various people about the country which you also published. The last one of these in the Editor's note, was a direct challenge to me to have something further to say about it. I gladly accepted the challenge, but it seems that you did not have the nerve to publish what I wrote. I highly approve of your magazine from the scientific standpoint, and think that it is one of the best published, but I do not approve of your Readers Forum, if it is to be run that way. I started the argument by writing you in answer to your editorial, and you gave it a boost by publishing my letter. Then when arguments against me came back in answer to my letter, you published them, and challenged me to have something more to say, but when I said it, you would not give it space. You won the argument, did you not? Of course, you did, by the simple means of publishing your side of it, and refusing space to my side. That shows what kind of a penny scientist you are. Your theory of evolution is correct simply because you will not listen to the other side. That is exactly what I said in my first letter, and you have admitted it by backing down right at the time when the argument began to get a good start, and you realized that you might have a little proving to do on the side if the readers of SCIENCE AND INVENTION Magazine were to think that I got the best of the argument.

Another little matter I would like to remark on. In the last issue of your magazine you wrote an editorial about souls getting together after death. I suppose that you would argue that because you cannot fully explain why grass grows, that it in fact does not grow. That is exactly the way you argue in this article. If you would keep to your science and let things like that alone, you would not make yourself so absurd in the eyes of the public. You are like the dentist that trys to tell me what is wrong with my kidneys or the doctor who tells me about my radio set. You are talking of things that you know nothing about when you get into things like evolution and what happens to souls after death, and you are making a straight monkey of yourself. If you would stick to the things that you know, such as radio, electricity, or in fact, any mechanical science you would be a whiz, as you are apparently well up on those things and know unusually well what you are talking about, but when you get into speculative science and philosophy, you are absurd.

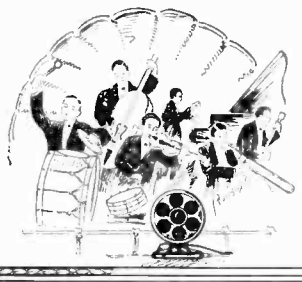
I do not care whether or not you publish this, as it is evident that a fair argument cannot be conducted through the pages of your Readers Forum, so why start one. However, if you have anything to say about what I have said, you will find me more than willing to argue, and to prove anything that I have said.

A. M. RIORDAN.
Flagstaff, Arizona.

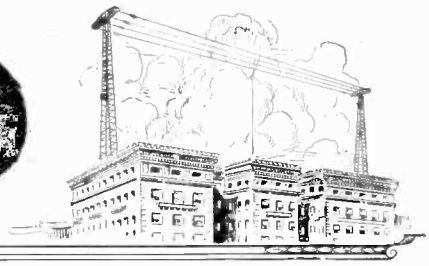
(We have printed Mr. Riordan's letter in its entirety. At the top of this page will be found a box stating that this magazine relishes criticisms and will present them in palatable and unpalatable forms. We do not know which particular form of criticism the above letter represents. Mr. Riordan is correct when he states that we did not publish his answers to the arguments which arose as a result of his letter. There are several reasons for our not publishing them. Many have been answered in textbooks and nothing more remains to be said about those questions if the reader of those textbooks has a knowledge of science.

This department is entirely too small to permit discussion of one subject for a period of a year or more.

Some of our writers probably do not know that an argument can never be won by reflecting on a person's knowledge about a certain subject. The second part of Mr. Riordan's letter presents no argument whatever and consequently requires no answer.—EDITOR).



RADIO



The Future of Radio Broadcasting

By A. P. PECK, Assoc. I.R.E.

THE Radio Department of this magazine has frequently received queries from various interested parties regarding the future of radio broadcasting, and in this article we will outline our idea of just what may take place in the future. Of course, we realize that the system suggested here is of a radical nature and will require many revolutionary changes in various phases of radio before it can possibly be put into use. As stated in an article appearing in the October, 1925, issue of this publication, super-power is undoubtedly going to be one of the solutions of the radio broadcasting problems of the day. When such stations are in use, we will be one step nearer to the universal establishment of a system such as is outlined in this article and illustrated here.

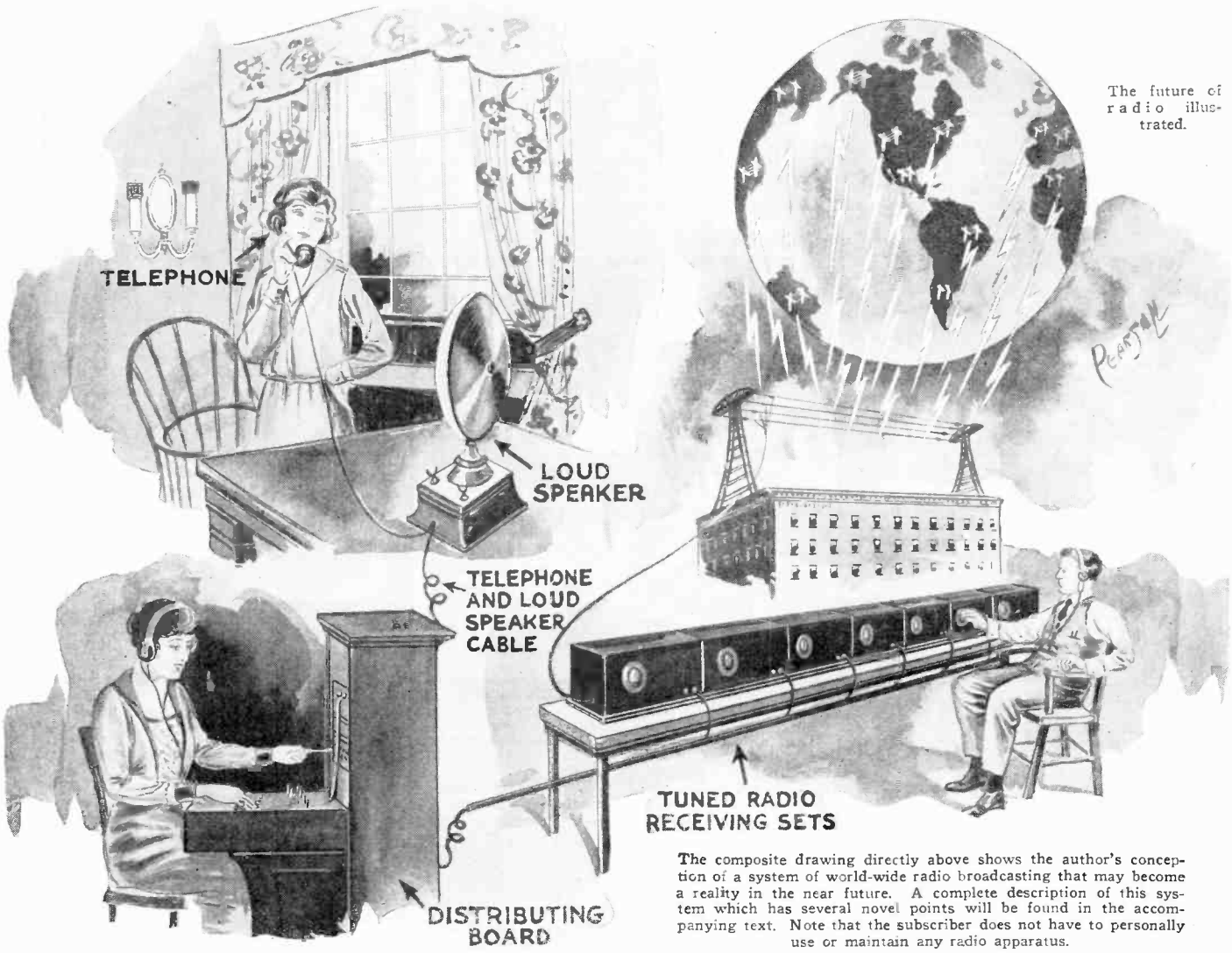
In this discussion of the future of radiophone transmission, we have disregarded the use of radio television. There are so many obstacles to this at the present time that, although we believe that television will eventually become an established fact, still we do not believe that it is worthy of consideration as yet in connection with our entertainment. Radiophone broadcasting has now advanced to such a point that it is an accepted part of the everyday life of millions of people throughout the world. Therefore, we shall deal only with radiophone and will leave the discussion of television to some future date.

When we consider the problem of super-power transmission, it at once becomes obvious that when such stations are erected, this work must be carried through from judiciously selected points throughout the country, so that in no case will any two superpower stations be close enough to each other to cause serious interference. With the advent of the crystal control for broadcasting stations, these stations can be kept to their assigned wave-lengths with such accuracy, that there need be no fear of their straying off their assigned frequencies and so causing trouble. This careful tuning of a transmitter will be an important factor in any such system as the one we speak of.

Although as a general thing monopolies and trusts are considered to be rather bad for industries, still we only have to refer to the excellent record of the telephone companies throughout the world in order to show that a large, powerful and wealthy company can give us the kind of service that we need at a reasonable

(*Continued on page* 182)

The future of radio illustrated.



The composite drawing directly above shows the author's conception of a system of world-wide radio broadcasting that may become a reality in the near future. A complete description of this system which has several novel points will be found in the accompanying text. Note that the subscriber does not have to personally use or maintain any radio apparatus.

A Typical Month at WRNY

By CHARLES D. ISAACSON, Program Director

EACH number on a WRNY program is part of a carefully-balanced whole of cultural and educational values; the continuity being kept up through the year's courses in music, science, sports, body building, the arts, literature, religion, and many other subjects, all dealt with in a comprehensive and systematized manner. Should you leave your receiver tuned in to WRNY, you would find a complete and interesting series of broadcast programs; both entertaining and instructive, in such regular order that your calendar and clock would inform you what to expect. The same artists and lecturers of whom you are told in this article reappear on corresponding evenings each month, or are replaced by others who give later numbers of the same series; for this reason the review of a month at WRNY tells you what is in store for you during the current and coming month.—EDITOR.

IN this article I am going to review the activities of a recent month and tell you some of the outstanding events. The first Sunday included, of course, Dr. Christian F. Reisner, in his "Hour of Religion," who brought with him the Girls' Chorus from the Chelsea Methodist Church, of which he is the pastor; Frederick Hulsmann in one of his "Body Fit" talks; and vocal and instrumental music by the Hulsmann Trio, continuing thereby the ambitions of a program that seeks to supply not only the needs of the soul, but the body as well.

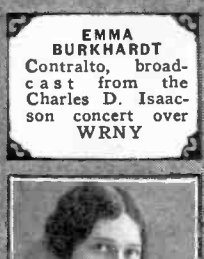
In the evening came one of the greatest of concerts which New York has heard in many a day—the Charles D. Isaacson concert which was given free to the public at De Witt Clinton Hall, and which was broadcast over WRNY. At this concert the master pianist of South America, Juan Reyes was heard, as well as Alberto Terrasi, the opera-

(*Continued on page* 183)

OSCAR SAENGER One of the foremost of the world's music masters, has a series at WRNY.

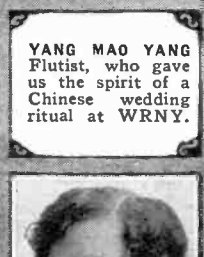
RUTH CONNE Authority on fashions and decorations, who speaks in WRNY's Women's Hour.

SARA BAIR Fine young American soprano who appears frequently on WRNY's programes.



EMMA BURKHARDT Contralto, broadcast from the Charles D. Isaacson concert over WRNY

Lucille Collette French violinist, who has returned to WRNY after a tour of America.



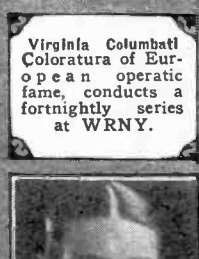
YANG MAO YANG Flutist, who gave us the spirit of a Chinese wedding ritual at WRNY.

Magdeleine Brard Pianiste, now en route to France, who broadcast exclusively through WRNY here.

ALEXIS KUDISCH QUARTETTE Mr. Kudisch, Edward Goorno, Joachim Chassman and Rudolph Simonwitch, who give weekly morning recitals at WRNY. (Left).

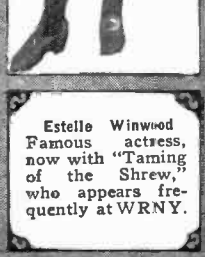
GEORGETTE NYRIELLE WRNY'S ambassador to France, who broadcast songs and an address, from the Eiffel Tower.

ALBERTO TERRASI Baritone, well known throughout the world, as Figaro. He sings operatic selections at WRNY.



Virginia Columbati Coloratura of European operatic fame, conducts a fortnightly series at WRNY.

GLOSS EDWARDS WRNY's new press representative, who will also conduct radio interviews with celebrities.



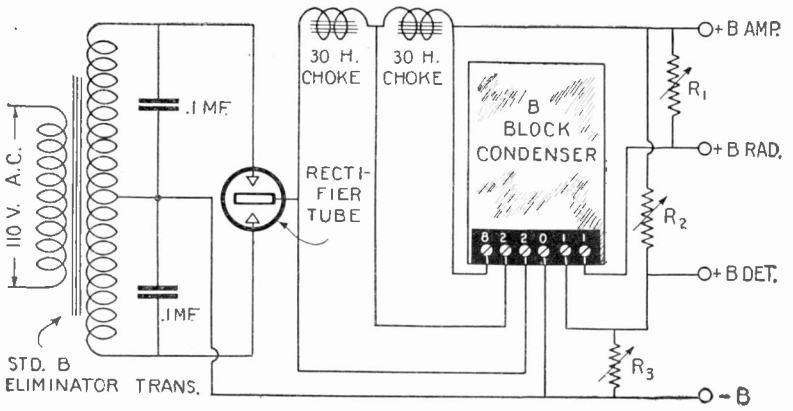
Estelle Winwood Famous actress, now with "Taming of the Shrew," who appears frequently at WRNY.

ROCK FERRIS WRNY's official organist, gives Wednesday night recitals from Temple Emanu-El's organ.

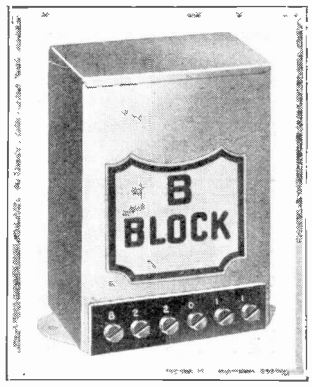
THOMAS FRANCO Directs violin ensembles of his pupils at WRNY, sometimes to the number of twenty-five.

New "B" Eliminator Apparatus

Simplified Parts and Protective Device Aid Construction

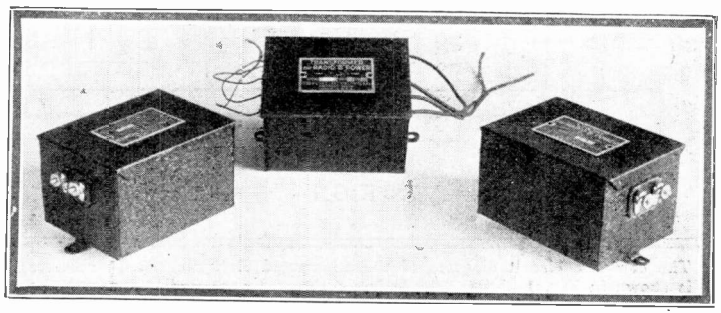


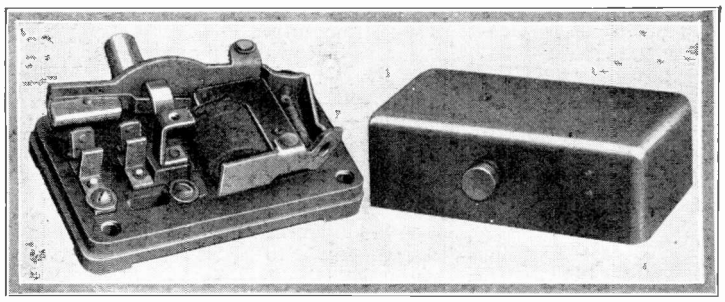
THERE are several different types of transformers and choke coils on the market today that are applicable to "B" eliminator use and one type is shown at the right, whereas others are shown elsewhere on this page. In the illustration at the right, the transformer is shown in the center with flexible leads for input and output. Choke coils are shown on either side of the transformer. Each has sufficient inductance for use in a "B" eliminator and this set of parts will be found quite satisfactory when properly connected with the necessary rectifier tube, filter condensers, and controlling resistors. These units are of small size, yet efficient and lend themselves readily to arrangement in a compact eliminator.—*Photo courtesy Dongan Electric Mfg. Co.*



RIGHT: All of the necessary fixed condensers for the filter circuit of a "B" eliminator are incorporated in a single unit with the necessary terminals as shown. — *Photo courtesy Tobe Deutschmann Co.*

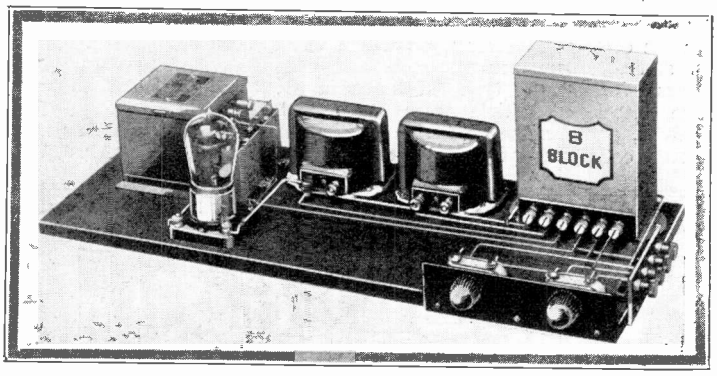
THE drawing at the left shows how the new block of fixed condensers for a "B" eliminator filter circuit is to be hooked up with any standard apparatus. Note that while the condenser block contains all the filter condensers, two other fixed units with a capacity of .1 m.f. each must be employed for connection across the transformer secondary as shown in the illustration. These take care of surges in the secondary when the circuit is closed.

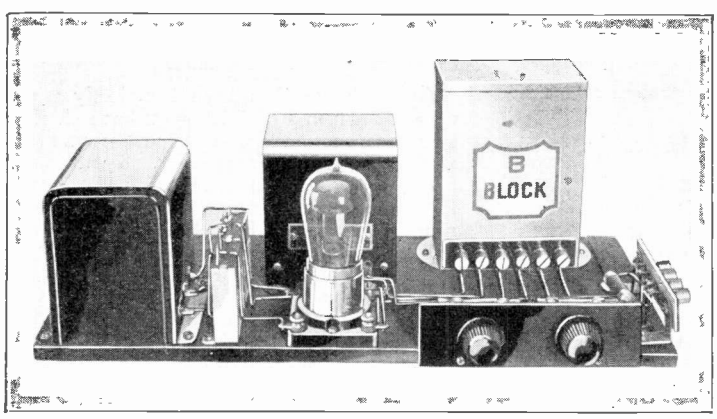




IT must be remembered that a "B" eliminator is a power device and is to be operated on a source of current where a short circuit may prove disastrous. For this reason, a circuit breaker such as that shown at the left should be employed. This device is not only a circuit breaker for use in the 110 volt A.C. lines, but it is also a manually operated switch. Two buttons are placed on it, one for closing the circuit and the other for opening. The electromagnet in this instrument is so designed that if the "B" eliminator is overloaded, the magnet will attract the armature and the switch will snap open, breaking the A.C. circuit. When the trouble is rectified, the circuit breaker can be reset by pressing the red button that rests on the armature.—*Photo courtesy Precise Mfg. Corp.*

IN order to show our readers what a compact layout of a "B" eliminator can be obtained by using up-to-date apparatus, the photo shown at the right is reproduced. It will be immediately noted that the wiring is much simplified over the arrangements used in some of the original "B" eliminators. There are only six terminals on the condenser block and these are very quickly and easily connected to the rest of the circuit. In the older types of instruments, each connection had to be soldered to the condenser lugs. With the block condenser, all of this trouble is done away with and each wire can be tightly clamped in a binding post. Time and trouble are both saved by employing a block condenser of this type and the resulting "B" eliminator unit can be made more compact than with the old style condensers of many separate units. In the complete assembly of the "B" eliminator shown, two separate choke coils are employed and they are housed in separate casings. These are the two 30-henry chokes shown on the diagram at the top of this page.—*Photo courtesy Acme Apparatus Co.*





WHERE "B" Eliminator units are used in which the choke coils are placed in one casing, the wiring of the complete assembly is still further simplified and the eliminator can be placed in about the smallest possible space. In the illustration at the left, it appears that only a single choke coil is employed, but this is not the case as two choke coils are incorporated in the single case shown directly back of the special rectifier tube. This eliminator shown is of exactly the same type as that described in detail in the April, 1926 issue of this magazine. The only difference between this unit and the one heretofore described is that a block condenser is used in the filter circuit and a slightly different arrangement of apparatus is employed. In its techuical aspects, however, the eliminator is exactly the same and the choke coils and transformer are of the same make as used in the other eliminator. Any reader desiring further information on the apparatus described on this page may obtain same upon request to the Radio Editor, inclosing a stamped self-addressed envelope for a reply.—*Photo at left courtesy General Radio Co.—A.P.P.*

The Radio Constructor

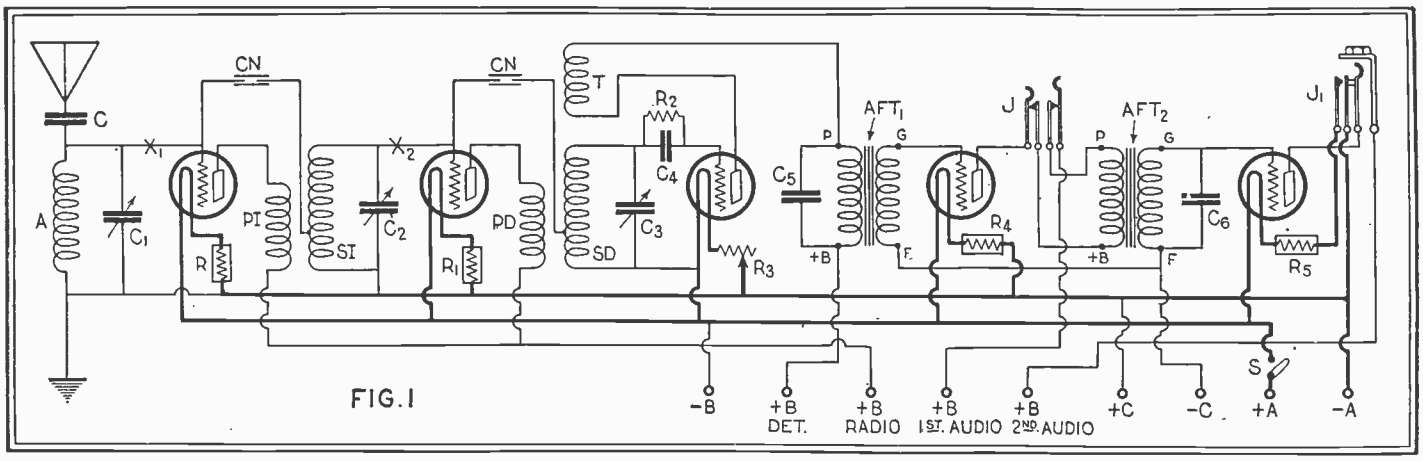
Adding Another Stage of Tuned Radio Frequency Amplification to the Ever Popular Browning-Drake Receiver

By WILLIAM A. VOORHEES

THE Browning-Drake receiver of exactly the same type as that described in the September, 1925, issue of this magazine has been the writer's favorite for a good many months. However, there was just one objection to the original receiver that detracted from its other good qualities. This was caused by the fact that it was not quite as selective as it might be, particularly in the location in which it was used. Only a few miles from WJZ's new super-power station, that station was received on a number of points on the dial and this was annoying to a certain extent. Therefore, the writer conceived the idea of placing an additional stage of tuned radio frequency amplification in this set and so by introducing another tuned filter circuit, increasing the selectivity to a point where there would be absolutely no interference from WJZ and where "DX" stations could be tuned in with greater volume than was possible before.

In the original receiver upon which work was started, manufactured coils and condensers of the same type as shown in the above mentioned article were used, and, therefore, another one of the same kind of detector coils and of condensers was obtained. The tickler coil was removed together with its shaft and supporting brackets. The remaining coil and its condenser was then employed for tuning the grid circuit of the second stage of radio frequency amplification and it was hooked up as shown in the circuit diagram given in Fig. 1 here. You will note that the coils indicated by PI and SI are exactly the same as those lettered PD and SD. The only difference is that the coils in the detector circuit are equipped with a third coil indicated by T and operating as a tickler coil, whereas there is no tickler coil in the instrument located between the first and second R. F. tubes.

After the apparatus was all selected and brought to hand, it was laid out according to the drawing given in Fig. 2. The reason that no photographs are available regarding this set is because the finished receiver did not lend itself very well to photographic purposes. It was hooked up in a hurry so as to quickly find the results that could be obtained with the arrangement.

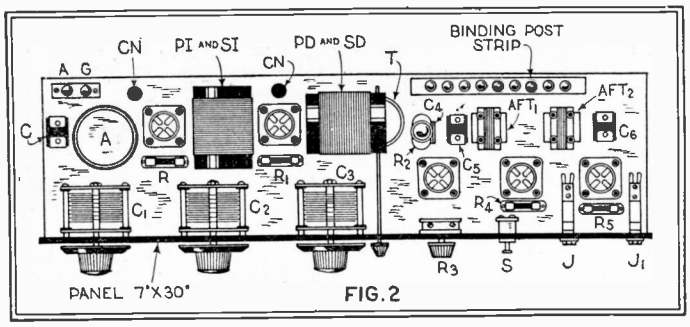


The complete circuit diagram of the augmented Browning-Drake receiver is shown in Fig. 1 above. The letters assigned to the various instruments are used for reference in the text and also in the instrument layout shown in Fig. 2. By following the directions given and by careful adjustment of the neutralization and of the tuning controls, some excellent and unusual results can be obtained from this two stage tuned R.F. receiver.

PARTS USED

For the construction of the coils to be used in a receiver of this nature, we would refer the readers to the September, 1925, issue of this publication. All the necessary data are contained therein and it is only necessary to make an additional detector coil, less the usual tickler for use in tuning between the first and second stages of radio frequency amplification. In case the reader does not desire to make his own coils, these can be obtained ready-made and a letter addressed to the Radio Editor will bring information as to where they can be purchased.

The following parts were used in the construction of this set and the letters given refer to those shown on the drawing in Figs. 1 and 2.



Left: Fig. 2 shows the general layout of the receiver described on this and the following page. The layout of the coils has been determined so as to produce the least amount of interstage coupling and therefore to reduce the possibility of uncontrollable self-oscillation in the R.F. stages.

PARTS

C—.0001 mf. fixed condenser.
C1—.0005 mf. variable condenser.
C2 and C3—.00035 mf. variable condenser.
C4—.00025 mf. grid condenser.
C5—.001 mf. blocking condenser.
C6—.0005 mf. fixed condenser.
A—Antenna coil.
PI—Primary of intermediate T. R. F. coil.
SI—Secondary of intermediate T. R. F. coil.
PD—Primary of detector tuning coil.
SD—Secondary of detector tuning coil.
T—Tickler coil.
AFTI—3 to 1 ratio audio frequency transformer.
AFT2—2 to 1 ratio audio frequency transformer.
CN—Neutralizing condensers.
R, R1, R4 and R5—Fixed filament control resistors.
R2—Variable grid leak.
R3—Standard rheostat.
J—Double circuit jack.
J1—Single circuit filament control jack.
S—Filament switch.
CB—4½- to 6-volt "C" battery.

R.F. AMPLIFIERS

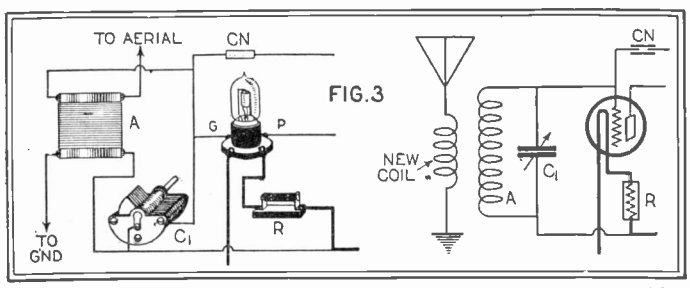
It is generally conceded that the small dry cell types of tubes such as UX-199 make excellent radio frequency amplifiers. If such tubes are employed, they can be used in connection with a 6-volt storage battery by using the correct type of automatic filament-control resistors. In this way the filament current consumption is cut down and very good radio frequency amplification is obtained.

All of the filaments in this receiver can be controlled by automatic resistors with the exception of the detector tube which should have a good type of rheostat in the filament circuit. It is advisable to use storage battery tubes of the UX-201A type for the detector and audio frequency amplifiers as they will invariably give the best satisfaction. However, if it is desired to do so, the smaller tubes of the UX-199 type can be used throughout.

OPERATION

After the set has been completely wired up as shown in Fig. 1 and you have checked every connection for correctness, you are ready to try out this receiver. Turn on the filaments by closing switch S and advance the tickler coil T. The set will invariably squeal. Probably the R. F. tube circuits will also oscillate and this must be controlled by very careful and minute adjustment of the neutralizing condensers, CN. The usual method of neutralization can then be carried through. To do this, remove the resistor, R, from its clip after a fairly loud signal has been tuned in, and you will undoubtedly still be able to hear the station.

Then change the position of the movable part of the first neutralizing condenser until the signal disappears or is heard at its lowest intensity. Then replace the resistor, R, and remove R1. Adjust the second neutralizing condenser for lowest signal intensity and then the set is ready for operation. You can tune in stations on the squeal by advancing the tickler T, until the detector circuit oscillates and then rotating the dials of



If a greater degree of selectivity is desired than is usually obtained with the Browning-Drake receiver, it is quite possible to couple the antenna circuit inductively as shown in the above perspective and schematic diagrams.

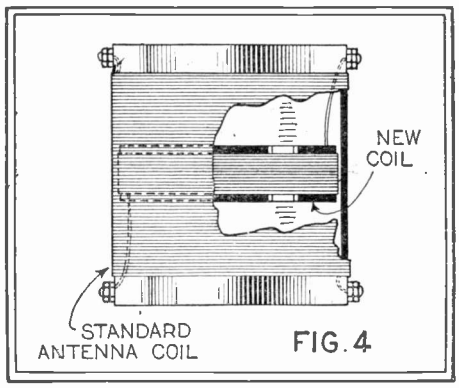
condensers C1, C2 and C3 simultaneously. If the set is correctly constructed you will find that these three dials will read very nearly alike and, therefore, logging of stations will be an easy matter and the tuning should not be difficult.

"B" BATTERY VOLTAGES

When using a set of this nature, it is often found that the "B" battery voltages, particularly for the R. F. amplifier and detector are very critical. It is absolutely necessary that you carefully adjust these voltages until the very best of results are obtained. This will often clear up much trouble found with self-oscillation of the circuits and will make the set much quieter in operation and easier to handle. In case you cannot obtain satisfactory results due to oscillation in the R. F. circuits, it is a very good idea to insert a 100- to 1,000-ohm resistance in series with the radio frequency "B" battery lead as indicated by X in Fig. 1. Changing the value of this resistance will enable you to control very critically the plate voltage applied to the radio frequency tubes.

If after you hook up this receiver you do not obtain perfect results the first time you try it, do not condemn it immediately. It has wonderful possibility for "DX" reception and for sharpness of tuning. It is quite possible that you may not be able to completely neutralize it with the condenser CN. If such is found to occur, you can reduce the possibility of radiation and the consequent interference with nearby receivers by introducing an untuned primary coil in the antenna circuit as shown in Fig. 3. This coil can be constructed as in Fig. 4 and placed within the present antenna coil indicated by A in Fig. 1. This coil may be wound on a smaller tube than that employed by coil A and may consist of about 10 turns of No. 20 D.C.C. wire.

The construction of an antenna coil for use in inductive coupling as shown in the diagram in Fig. 3 is a very simple matter and the exact method of doing this is shown in the diagram at the right. The data are given in the text. The finished coil should be of such a size that it will fit snugly within the standard Browning-Drake antenna coil and so require no additional support.



RESISTANCE NEUTRALIZATION

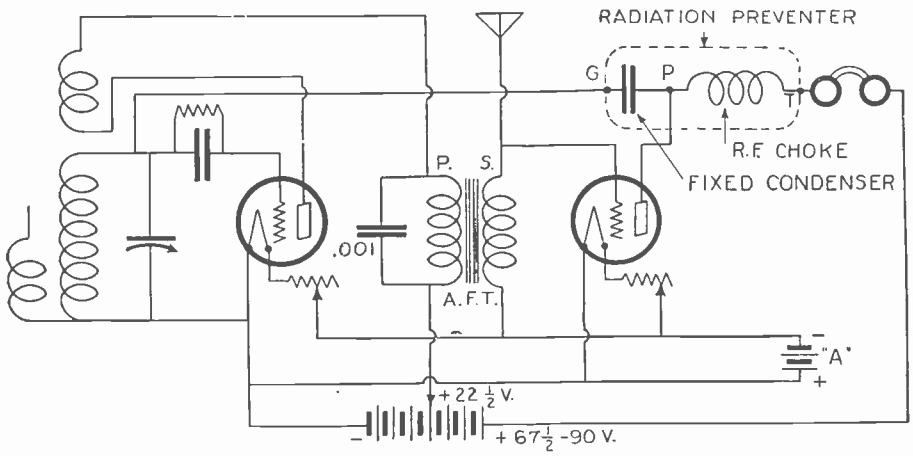
Another system that aids considerably in controlling a receiver of this nature which is inherently unstable and unsatisfactory in operation unless very carefully handled is to use the resistance method of neutralization. There are losses to be found when using this system, but these losses are often compensated for by increased ease of handling and quietness of operation. The method consists of placing a resistance, variable from 100 to

(*Continued on page* 189)

New Device Prevents Radiation

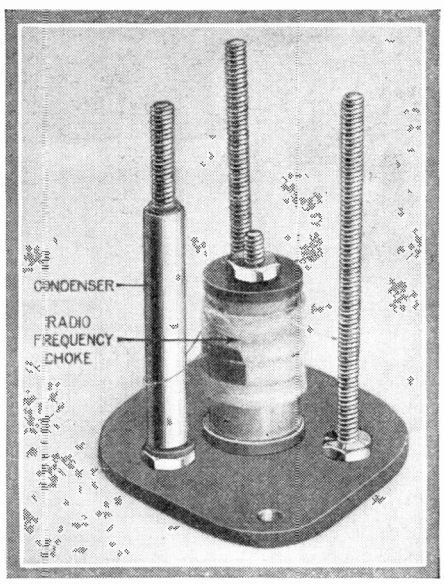
Above: Radiation preventer for use with any regenerative receiver.
Photo courtesy DeForest Radio Co.

EVEN though the battle has been waged for several years against radiation from regenerative receivers still there is a lot of this nuisance still to be found in congested radio districts. It is a very simple matter to prevent radiation to a very great degree and at the same time to increase the range and selectivity of your receiver by employing the little instrument described here. Consisting of an R.F. choke and a small fixed condenser the device, when connected to a standard regenerative receiver as shown, transforms that receiver into one employing an effective stage of radio-frequency amplification in addition to the regular receiver. This is done without the use of any additional tubes by employing a very simple reflex circuit. Furthermore, no radical circuit changes on your regenerative receiver are necessary.



The radiation preventer, hooked to a receiver in the proper manner is shown in the above diagram schematic circuit.

Three binding posts are provided on the top of the radiation preventer as shown and these are connected to the plate of the first A.F. tube, to the grid of the detector and to the phones or second A.F. transformer as the case may be. The ground is connected to the filament circuit in the usual manner.

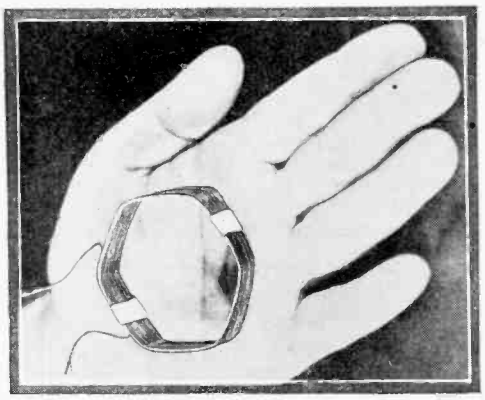


The photograph at the right shows the internal construction of the radiation preventer. The tube over the extreme left-hand machine-screw forms, in connection with that screw, the fixed condenser.

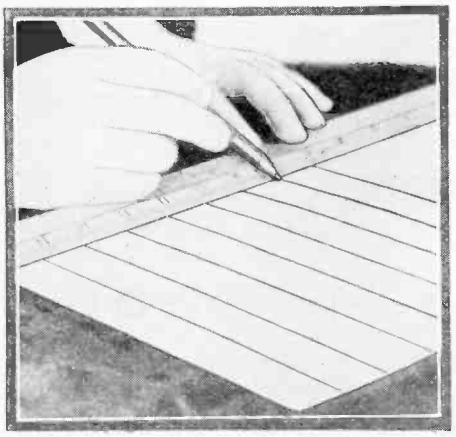
Simple Pickle Bottle Coils

An Easy Method of Making Self-Supporting Coils

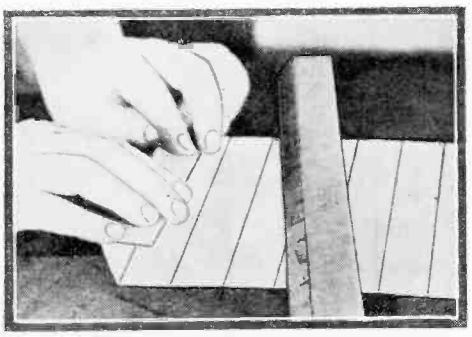
By HERBERT E. HAYDEN



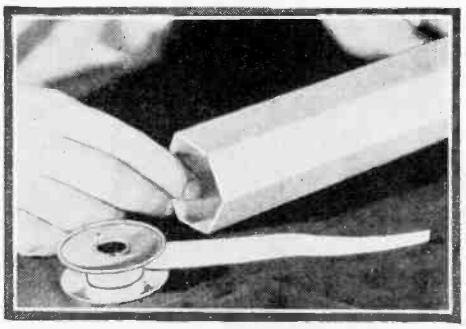
It is acknowledged that one of the most efficient forms of coils is that which does not have any solid material for supporting it. The various photographs on this page show how self-supporting coils of the type illustrated directly above can be readily made on a form that is constructed from heavy paper. For the experimenter who is always trying out different circuits, this system is particularly interesting. If you make up two or three different sizes of winding forms, you will always be ready to make a coil that will suit any particular purpose. By making a long form, any number of turns within reason can be wound.



To make the winding form, rule a sheet of heavy paper as shown above, making the lines about one inch apart. If a larger form is desired, draw these parallel lines at a greater distance from each other. Draw the lines fairly heavily so that they can be easily followed. The length of the winding form will depend upon the coils that the reader desires to make. Make it long enough to afford a good grip while winding.

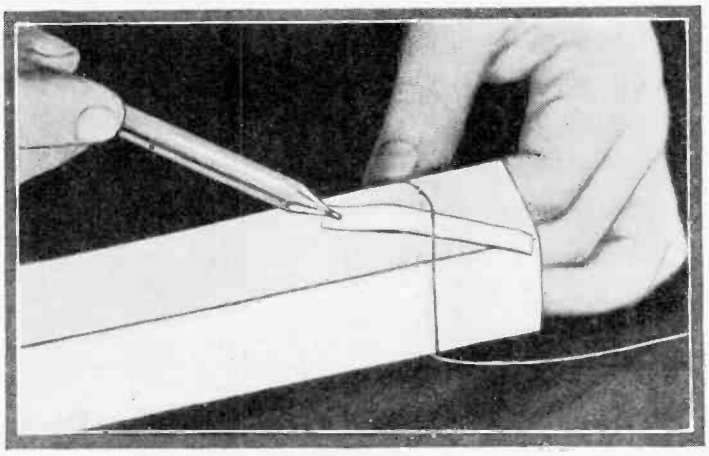


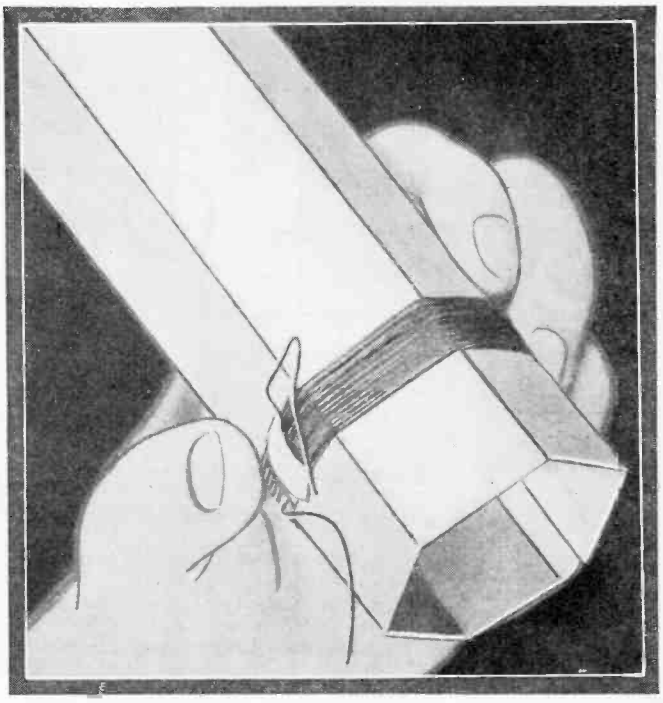
After the paper has been carefully ruled, crease it along each of the ruled lines. After this has been done, the form can be made up with any desired number of sides. The one shown in the other illustrations is of hexagonal shape, although any number of sides from five to ten could just as well be employed. For all around purposes, six or eight sides will be found a most convenient number. After the number of sides has been decided upon, proceed to fasten the form.



Ordinary surgeon's adhesive tape is employed for fastening the winding form together and making it sufficiently rigid to withstand the stresses of winding. The illustration at the immediate left shows the application of the tape to a six-sided form. Be sure that the form is quite strong before you start winding wire upon it.

The start of the winding on a home-made six-sided form is shown at the right. A strip of adhesive tape indicated by the pencil is first laid on the form, sticky side up. This strip of tape is to be twice as long as the finished winding. The winding should start about one-third of the distance from one end of the tape and proceed toward the other end.





In order to make the finished winding quite strong, at least two pieces of adhesive tape should be used and they should be placed upon opposite faces of the form. The winding should be performed very smoothly in order to present a neat appearance and after it is finished, one end of the strip of tape is folded back over the winding. Then the other end is folded over in the same way so that it overlaps the first mentioned end. The result will appear as shown in the illustration at the left. After both adhesive tape strips have been fastened in this way, the winding can be carefully slipped off of the form.

After removing the coil, a thin strip of collodion should be painted lengthwise of the coil at each corner. The application of the collodian with a small brush is shown at the right. Although the coil that is illustrated is quite narrow, still the sizes that can be made are almost unlimited, providing the winding is smooth and even throughout its length. For coils of this nature, the wire used should not be larger than No. 20 D.C.C. or smaller than No. 26 D.C.C. Probably No. 22 D.C.C. will be found to be about the best all around size.

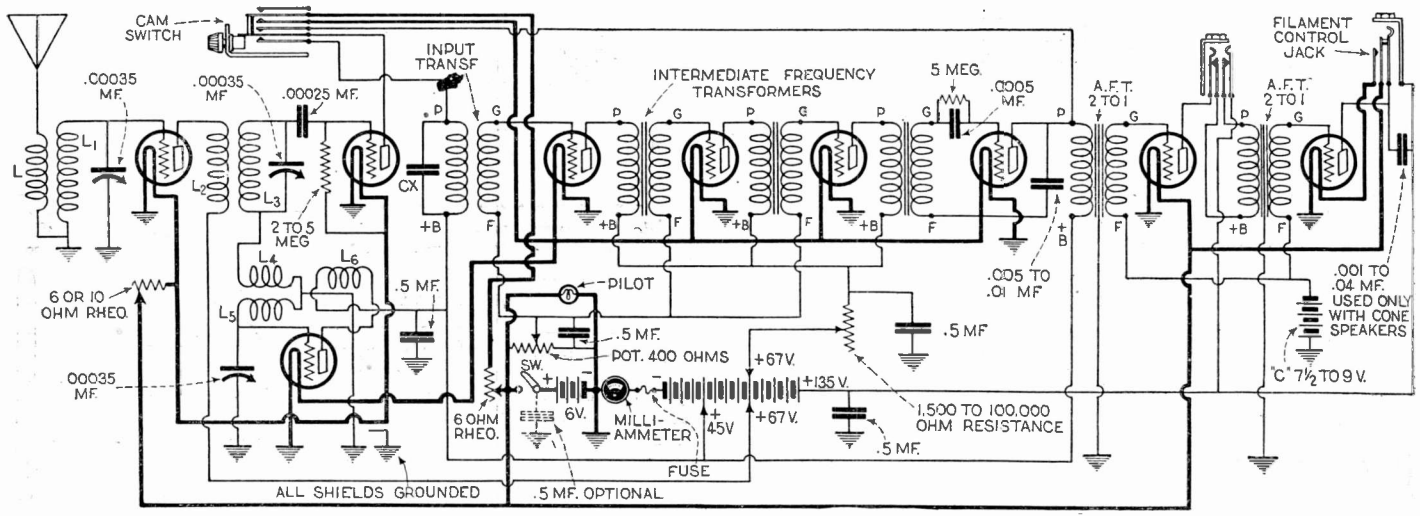
RADIO ORACLE

In this Department we publish questions and answers which we feel are of interest to the novice and amateur. Letters addressed to this department cannot be answered free. A charge of 50c. is made for all questions where a personal answer is desired.

FENWAY SUPER-HET

(468) Q. 1. Samuel Crosley, Memphis, Tenn., asks: Kindly give a circuit diagram and special coil specifications for the so-called Fenway Super-heterodyne, showing how to connect the switch for changing over from four tubes to nine by eliminating the intermediate frequency amplifiers and the second detector.

A. 1. The Fenway Super-heterodyne, the diagram of which is reproduced in these columns and the oscillator condenser can be grounded to their respective shields, but the first detector tuning condenser must be carefully insulated from the metallic parts. The reason for this can be readily seen by referring to the connections given in the diagram. In all cases, keep inductances that are enclosed within shields at least 1½ inches away from the metallic shield. This should be observed not only in connection with this particular set, but in all radio receivers.



The Fenway Super-Heterodyne is the latest set that has captured the attention of radio fans throughout the country and in answer to numerous inquiries received relative to this set, we are showing the complete circuit diagram of it directly above. It is possible to obtain complete blue prints covering this receiver at a nominal charge and all of the necessary parts can also be purchased. A letter addressed to the Radio Editor will bring complete information relative to the obtaining of the blue prints and of the parts, including the necessary shields.

consists of a single stage of tuned radio frequency amplification, placed ahead of an ordinary eight-tube Super-heterodyne employing a local oscillator, two detectors, three intermediate frequency amplifiers and two audio frequency amplifiers. In the diagram given it will be noted that a cam switch is employed for changing over from a four-tube to a nine-tube set, eliminating the intermediate frequency amplifier and the second detector. With this Super-heterodyne, any standard type of intermediate frequency transformers can be employed. The input coil should be the one designed for use with the particular transformers.

The coils L and L1 consist of 84 turns of No. 32 D.C.C. wire on a 2-inch form. This can be tapped at some point along its length, which may be best determined by experimentation, for the ground connection, giving the effect of an auto-transformer as indicated in the diagram. A standard three-circuit tuner with the tickler removed or not used may be connected as the antenna coil. The parallel tuning condenser should then be of the size required for the particular coupler employed.

The coupling coil that is placed between the radio frequency amplifier and the first detector has two parts, a stator and a rotor. The stator is 2¾ inches in diameter and is wound with 63 turns of No. 32 D.C.C. wire. This winding is split in the middle so as to allow the passage of the rotor shaft. The rotor comprises a coil 1¾ inches in diameter by 1 7/16th inches long wound with 24 turns of No. 32 D.C.C. wire. These two coils, the rotor and stator coils, are indicated by L2 and L3 respectively in our diagram.

The oscillator coils are wound as follows. Coil L5 is first wound on a 2½-inch form and consists of 84 turns of No. 32 D.C.C. wire. L6 is wound directly alongside of L5 and is started ⅛th of an inch distant. It consists of 25 turns of No. 32 D.C.C. wire. Directly over the end of L5 that is furthest away from L6, place a strip of empire cloth and over this cloth wind coil L4 which consists of 10 turns of No. 32 D.C.C. wire. All of these coils are wound in the same direction.

It is often found necessary in order to obtain good operation to shield parts of this set. This is accomplished by placing the parts to be protected in 1/32-inch thick copper boxes. The reader can design his own type of boxes with very little trouble. Three of them will be necessary. The first one encloses the first R.F. tube, the antenna coupler, a .5 mf. condenser which may be connected in series with the ground and which is optional and the variable condenser that tunes the antenna coil secondary. The second box shields the first detector tube, its grid leak and condenser, the .5 mf. condenser connected across part of the poteniometer and the tuning condenser for the input circuit of the first detector. The third and last metal box encloses the oscillator tube, the oscillator coils, the .5 mf. condenser connected from + 135 volts to ground and the oscillator tuning condenser. The antenna tuning condenser

GENERATOR FOR TRANSMITTER

(469) Q. 1. H. C. Davidson, Montreal, Canada, asks how a generator may be connected to the transmitter described in the December, 1925, issue of Science and Invention Magazine, said generator to take the place of the rectified A.C. current supply shown.

A. 1. It is merely necessary to connect the terminals of the generator in place of the output of the rectified and filtered A.C. circuit. Connect the positive pole of the generator to the plate through the R.F. choke and connect the negative pole to the filament circuit.

SHARP TUNING WITH CRYSTAL DETECTOR

(470) Q. 1. Lester Delaney, New York City, has a crystal detector set using a fixed coupler for the tuning arrangement. The antenna circuit is untuned, while the secondary is tuned by means of a variable condenser. He asks: Can you tell me how to increase the selectivity of this set?

A. 1. Crystal detector types of receiving sets are inherently broad in tuning, although in some cases it is possible to produce a semblance of sharpness. In your particular instance, we would advise you to increase the coupling between the primary and secondary coils. This will, of course, result in slightly decreased volume, but you will notice an over-all increase in selectivity. This is of particular value in congested districts and will undoubtedly solve your interference problems.

ELECTROLYTIC RECTIFIER

(471) Q. 1. Robert K. Jones, Chicago, Ill., is contemplating the construction of a complete transmitting set using rectified A.C. for supplying the plate voltage to a UX-210 tube. He asks how many cells should be used in his electrolytic rectifier, since this is the type that he desires to use for changing the current from A.C. to pulsating D.C.

A. 1. It is safe to figure about fifty volts per cell in an electrolytic rectifier for transmitting purposes. Presupposing that you use a transformer with the secondary tapped in the center and delivering 550 volts on either side of the center tap, use 11 jars in each of the outside secondary leads or a total of 22 jars in all. The method of connecting an electrolytic rectifier with this type of transformer was clearly shown in The Radio Constructor article appearing in the December, 1925, issue of this magazine. We would suggest that anyone interested in transmitting refer to this article for further information.

"B" ELIMINATOR

(472) Q. 1. Frank Wiesuski, Los Angeles, Calif., built the "B" eliminator described by Max Kuhne in the September, 1925, issue of Science and Invention Magazine and says that he has had some trouble with it due to a reproduced hum. He asks us to give him some advice on this eliminator.

A. 1. We have communicated with the author of the article you mention in your letter of recent date and he has offered several suggestions which may aid you in making your "B" battery eliminator work correctly. In the first place, your "B" eliminator unit may be positioned too close to the receiving set. It should be at least 4 or 5 feet distant therefrom. It is also true that if a perfect ground connection is not employed, a hum will be present. Be sure that your ground wire is securely clamped or soldered to a cold water pipe or to a 7- or 8-foot length of 1-inch iron pipe driven in the ground. Still another suggestion is that you connect another capacity from the positive detector post to the negative "B." Use a ¼- or ½-mfd. condenser between these two points. If there is a by-pass condenser from the negative "A" to the positive "B" binding post in the receiving set itself, take it out as it is not necessary and may be causing some trouble. Then again, if there is no connection between your filament circuit and the ground, one should be placed in the circuit for otherwise the eliminator will not operate correctly. We are quite sure that one of these points will be the solution to your trouble.

FOUR TUBE SET

(473) Q. 1. Horace Potter, East Orange, N. J., says that his radio set gives plenty of volume but the reproduced tones are not clear. He lists the apparatus employed and asks us to help him in locating his troubles.

A. 1. Probably the addition of a 3- to 4½-volt "C" battery to your radio set would aid in clearing up your trouble. Also there is a possibility that one or another of your tubes is poor and does not function properly. Changing tubes around in the set might help you out as might also the addition of a good variable grid leak, properly adjusted.

T. R. F.

(474) Q. 1. George Rayner, Newark, N. J., wants to know: Do you consider a variometer to be superior to an inductance coil and variable condenser for use in a tuned radio frequency receiver, where one or the other of the instruments are to be used as the tuned radio frequency transformer?

A. 1. No, we do not. A tuned radio frequency receiver employing single layer inductance coils and variable condensers for tuning them will usually be found far superior in many ways to a similar type of receiver using variometers for the variable tuning units. The variometer set will be found to be much broader in tuning than the other type.

RESISTANCE VERSUS TRANSFORMER

(475) Q. 1. F. G. Nicholas, McCleary, Wash., asks us to compare a three-stage resistance coupled audio frequency amplifier with a two-stage transformer coupled unit.

A. 1. While a three-stage resistance coupled amplifier will give clarity far excelling the ordinary two-stage transformer coupled audio frequency amplifier, their volumes will be about equal one to the other.

Scientific Humor

HEATED ARGUMENT

"Mandy, why don' y'u gib me mo' 'lectrical treatment fo' mah rheumatics?"

"Go 'long, Niggah, Ah done offe'ed to gib y'u mo' 'lectrics, an' y' 'fused."

"Listen heah, Mandy, y'u made me hot; coa'se ah 'fused!"—(*Miss*) *Ruth E. Millard.*

FOR LIGHT-HEADED STUDENTS

READER: "Have you some good light reading?"

LIBRARIAN: "We have several books on the gas industry and some on ballooning. Which would you prefer?"—*John H. Spicer.*

DON'T LIKE THE PESKY THINGS

VISITOR: "Ah, this is the place for bookworms."

"LIBRARY JANITOR: "Well, you'll not find any here. We fumigate regularly."—*John H. Spicer.*

USE A SPIKE AS A NEEDLE

MAGISTRATE: "Are you sure he was drunk?"

MINION OF THE LAW: "Well, his wife said he brought home a manhole cover and tried to play it on the Gramophone. —*Herman Splett.*

I WANNA KNOW

RADIO EXPERT (just awakened by loud noise from telephone): "Radio Shop."

"Hello, we're holding a dance to radio music on that set I bought of you last week."

"Well?"

"I want to know which dial to turn to make it play faster."

"Ding-a-ling!!!!"—*J. G. Villepigue, Rep. No.* 23127.

USE THEM FOR LOUD SPEAKERS

"Gimme a shoehorn."

"Ya don't need a shoehorn, anyone can hear your shoes coming."—*Clement Donnelly, Rep. No.* 25786.

THE SIXTH SENSE

A dog can bark and a rooster crow
Because they are built that way, you know.
My set can't see, smell, taste or feel
So why in thunder does it squeal?—*Normal I. Schiller.*

DOES HE WANT TO RECOVER THE PRICE?

FARMER (who had bought a tire cover a few days before): " Looky har! I want my money back."

SALESMAN: "What is wrong with the tire cover?"

FARMER: "Why, I hadn't driv more than twenty miles on it before it wore out. And another thing, it didn't pertect that thar tire a bit."—*Billy Runyon.*

IT IS DONE FOR TIDINESS

A little boy standing on the beach watching the tide go out exclaimed to his mother who was beside him, "Oh, mama, who pulls the plug out of the ocean?"—*Miss Gladys Rose.*

First Prize $3.00

YES, THEY BROADCAST EVERYTHING

A young boy, who has been forbidden to smoke, is "listening in" to station WRNY and smoking a cigarette. Hearing his father coming, he quickly throws the cigarette in the loud speaker.

FATHER: "Son, look! the radio is on fire!"

SON: "Oh, no, father, don't worry. That's Station WRNY broadcasting a big fire in New York."—*Gerald Douglass.*

WE receive daily from one to two hundred contributions to this department. Of these only one or two are available. We desire to publish only scientific humor and all contributions should be original if possible. Do not copy jokes from old books or other publications as they have little or no chance here. By scientific humor we mean only such jokes as contain something of a scientific nature. Note our prize winners. Write each joke on a separate sheet and sign your name and address to it. Write only on one side of sheet. We cannot return unaccepted jokes. Please do not enclose return postage.

All jokes published here are paid for at the rate of one dollar each, besides the first prize of three dollars for the best joke submitted each month. In the event that two people send in the same joke so as to tie for the prize, then the sum of three dollars in cash will be paid to each one.

WHERE CHEMISTRY IS NEEDED

PROFESSOR: "I'd like to know the names of a few good reducing agents."

SIX CO-EDS (in chorus): "So would we!" —*Julius Schreiber.*

ARE THEY CELIBATES?

"How do bees dispose of their honey?"

"They cell it."—*H. E. Hudec, Rep. No.* 23475.

PHYSICAL SCIENCE

"I am beginning to get a lot out of chemistry," said the student, as he walked out of the laboratory with ten dollars worth of laboratory apparatus.—*Hymen Bushlowitz.*

BUY A STERILIZER

GOSSIP: "My husband thinks kissing transmits germs. Does yours?"

NEIGHBOR: "No, my husband thinks that germs are mostly transmitted by money, and he's very careful not to hand me any."—*Alice Bushlowitz.*

WHY NOT?

PROFESSOR: "I take pleasure in giving you 81 in mathematics."

STUDENT: "Make it 100, sir, and thoroughly enjoy yourself."—*Elwyn Hudec.*

IT WILL BE WOUND DOWN WHEN HE GETS IT

SISTER: "Jim, go upstairs and get my watch."

JIM: "Aw wait awhile and it'll run down itself."

SISTER: "Yes, but you know ours is a winding staircase."—*Richard Buchanan.*

BAD MANNERS

SCIENCE: "I see you sold your car."

RA-D-O-NEWS: "Yes, it smoked every time I used tobacco'r (to back her).—*F. J. Wilhelm.*

MAYBE HE ATE IT,

DAFFY: "Talk about nightmares. Last night I dreamed I was eating Shreaded Wheat Biscuits and when I woke up about half of the mattress was gone.—*Lee Warren, Rep. No.* 25986.

NOT SUN-SPOTS

TEACHER: "Where else is iron found, James?"

JAMES: "Well, I know there is some iron in our bodies."

WILLIE (out loud): "Now I know what those things are on Johnny's face. He must have forgotten to wipe his face dry and the iron rusted."—*H. Feinstein.*

SOME ARE AS INTELLIGENT

1ST RADIO BUG: "I thought I had China on my radio last night but I was mistaken."

2ND RADIO BUG: "How so?"

1ST RADIO BUG: "I found out it was my son practicing some new college yells."—*Chester Kennedy.*

DONE ON THE WRONG SIDE

WHITE: "Smith was as mad as hops last night!"

BLACK: "How come?"

WHITE: "He slept in one of those new-fangled beds that wash your face, comb your hair, shine your shoes, and give you a cup of hot coffee."

BLACK: "What of it?"

WHITE: "He got in the wrong way; and it poured the coffee down his pants, washed and combed his shoes, and blacked his face." —*Henry Huff.*

READY FOR THE BLOW OFF

DUPLEX: "How do you know he intends to get you lit up tonight?"

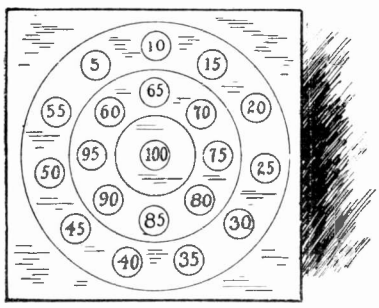
BUNGALOW: "He wired me today."—*James Clyde Bailey.*

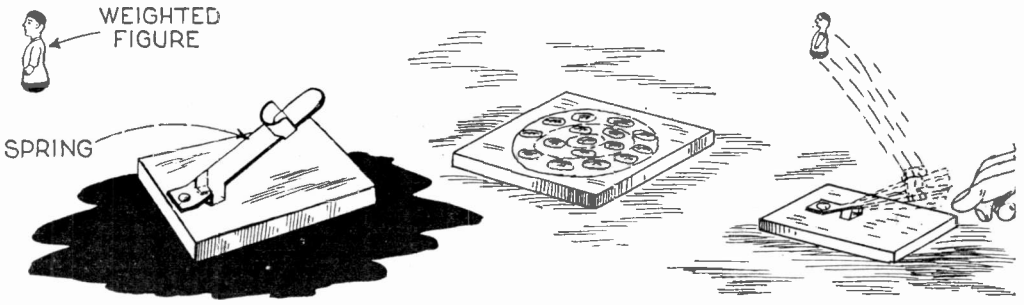
A BACK BREAKER

A man walking along a highway was overtaken by a storm and sought refuge under a bridge. While under the bridge the storm wrecked it killing the man. After the body was removed the coroner viewed it and sent in this report: "Death due to fallen arches." —*Frederick Schneider.*

LATEST PATENTS

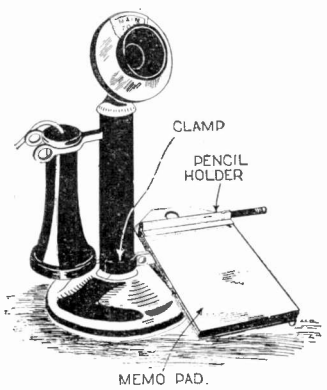
NEW GAME INVOLVES SKILL AND CHANCE





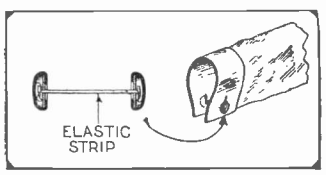
No. 1,576,515 issued to Robert L. Kinney protects a game that consists of three essential parts, namely a target, a weighted figure of a man and a projecting device. The purpose of the game is to throw the weighted figure from the spring-actuated catapult toward the target placed some distance away, whereupon the player scores according to the number assigned to the depression in which the man lands upright. The success of the system depends upon the weight placed on the base of the figure which keeps it in an upright position at all times.

MEMO PAD



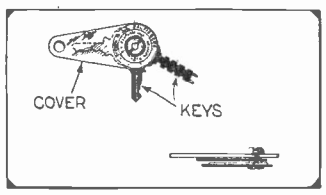
No. 1,570,430 issued to Clyde L. Bowers describes the telephone memorandum equipment illustrated. The memo pad is fastened to a metallic support which in turn is clamped to the telephone stand. A pencil receptacle is provided for that easily lost implement.

CUFF LINK



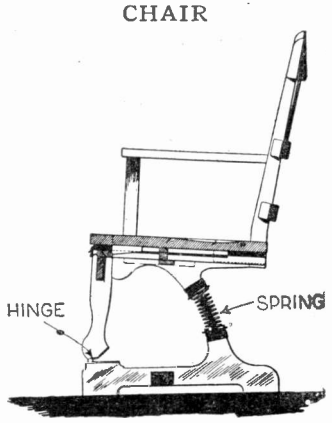
No. 1,574,431 issued to Walter E. Lena was allowed on the elastic cuff link shown above. The essential part of this invention lies in the method of fastening the elastic strip to the end buttons by means of a folded metallic member that grips the elastic band tightly and prevents it from being pulled out of the button.

KEY CARRIER



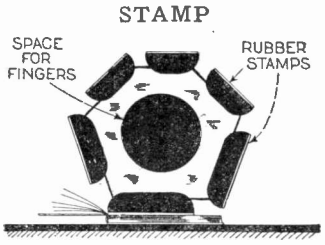
No. 1,577,367 issued to Leroy L. Salfisberg protects the type of key carrier shown above wherein the keys are fastened to a metallic strip by means of a removable machine screw, the strip protecting the keys and the entire assembly providing ready access to any one of the keys.

CHAIR



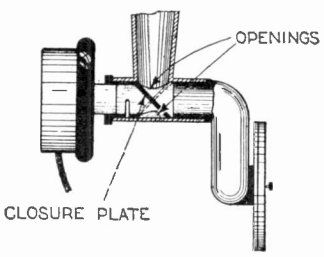
No. 1,570,096 issued to S. Stransky describes a novel type of tilting chair wherein the front part is pivoted on a hinge and the tilting is controlled by a coil spring. Other controlling methods are described in more detail in the patent specifications. The essential idea is shown in the above illustration.

STAMP



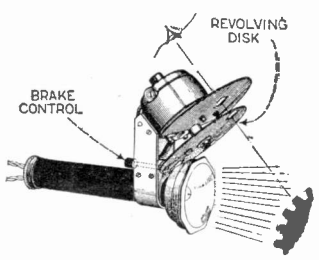
No. 1,576,778 issued to Harold P. Morton relates to the mounting of a multiplicity of rubber stamps on a single member so that each stamp will be available for instant use. The details of the system will be easily grasped by reference to the above illustration.

PHONOGRAPH TONE ARM



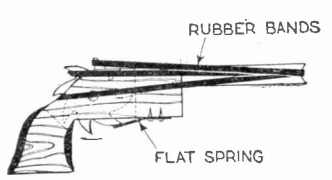
No. 1,570,308 issued to John Koranek relates to a head for a phonograph tone arm that enables the user to employ the phonograph horn for both radio and phonograph record reproduction. This is accomplished by means of a system such as that shown above wherein a rotatable closure plate opens the tone arm into the curved arm connecting to the sound box or into the radio reproducing unit. This is accomplished merely by turning the radio reproducing unit through 180° in the desired direction.

SYNCHRONIZING DEVICE



No. 1,566,124 issued to Robert H. Rogers protects a small portable device by means of which it is possible to examine any desired part of a rapidly moving object. Light is thrown upon the object by means of the projection lamp and the revolving disk is driven by the motor, its speed being regulated by the brake. When the revolving disk is traveling at the correct speed, observation of the moving object along the line of sight shown will reveal the moving object as apparently standing still. Valuable records can thus be made.

TOY GUN



No. 1,572,350 issued to Fred C. Ecker presents a novel repeating toy gun for shooting elastic bands. The bands are held by the notches as shown and by pulling on the lower projection as on a trigger, the band is released and projected. The repeating feature is obvious.

NOTICE TO READERS. The above illustrated and described devices have recently been issued patent protection but are not as yet to our knowledge available on the market. We regret to advise that it is impossible to supply the names and addresses of inventors of the above devices to any of our readers. The only records available, and they are at the Patent Office at Washington, D. C., give only the addresses of the inventors at the time of application for a patent. Many months have elapsed since that time, and those records are necessarily inaccurate. Therefore, kindly do not request such information.

—EDITOR.

THE ORACLE

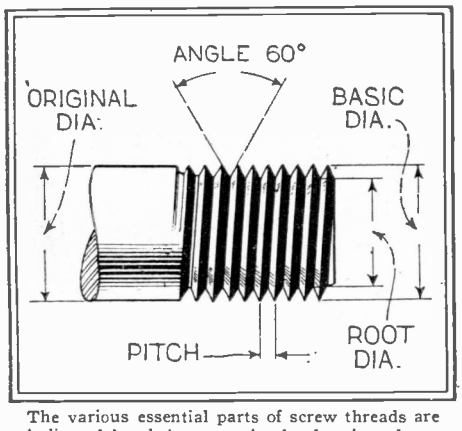
The "Oracle" is for the sole benefit of all scientific students. Questions will be answered here for the benefit of all but only matter of sufficient interest will be published. Rules under which questions will be answered:

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 addressed to this department cannot he answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 50 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.

SCREW THREADS

(2055) Q. 1. Leonard Abelson, Bronx, N. Y., asks us to show in an illustration the various terms applied to screw threads.

A. 1. The drawing in these columns shows all the required information. This screw thread is a U. S. standard known as the sharp V-thread. As will be noticed, the original diameter indicates the size of the stock upon which the thread is cut, the basic diameter is the outside diameter of the threads, and the root diameter is that measured between the bases of the threads.



The various essential parts of screw threads are indicated by their names in the drawing above. This is a U. S. standard V thread.

CAUSES OF HALITOSIS

(2056) Q. 1. R. B. Marcy, Los Angeles, Calif., asks: What may halitosis be due to?

A. 1. The Reference Handbook of Medical Sciences gives the following possible causes for halitosis:

Transient—
Mental disturbance. Various ingesta, medicinal and alimentary. The menstrual period.

Systemic—
Fevers. Diabetes mellitus. Uremia. Pyemia. Glaucoma (?). Burns. Migraine. Tuberculosis. Pernicious anemia. Pseudoleucemia. Interstitial nephritis.

Toxic—
Antimony. Arsenic. Lead. Mercury. Phosphorus. Sulphur. Alcohol. Tobacco.

Digestive—
Gastritis. Dyspepsia. Cancer of stomach or liver. Constipation. Hepatic disorders. Enteritis. Intestinal worms, particularly ascarides in children. Dental caries.

Buccal—
Gingivitis. Stomatitis. Pyorrhea alveolaris. Lingual catarrh. Necrosis of jaw. Carcinoma of tongue and other parts. Cancrum oris. Lack of cleanliness.

Nasal—
Polypi. Ozena.

Faucial—
Fellicular tonsillitis. Follicular pharyngitis. Syphilitic ulceration. Diphtheria. Putrid sore throat.

Laryngeal—
Carcinoma. Ulceration.

Pulmonary—
Bronchiectasis. Putrid bronchitis. Tuberculous ulceration, (cavities). Gangrene. Abscess. Cacinoma.

Idiopathic—

Q. 2. How can I get rid of this condition?

A. 2. The thing to do is to find the cause and then remove it. As is evidenced on the above list the conditions which may produce halitosis or bad breath are numerous. Most of them lend themselves to ready treatment.

SPECIFIC GRAVITY

(2057) Q. 1. Edward Tyler, Pasadena, Calif., wants to know: What is specific gravity?

A. 1. Specific gravity may be defined as the relative density of a substance as compared with a standard.

REMOVAL OF SCAR

(2058) Q. 1. Miss C. B. McCawley, New York City, says: I am twenty-one years old and considered good looking except for a scar on the side of my neck and face produced by a burn received in infancy. Can this be removed?

A. 1. Yes.

Q. 2. What method is advisable?

A. 2. This depends entirely upon the nature of the scar and its formation. Plastic surgery, X-rays or radium may be used separately or in combinaton.

Q. 3. Do you advise that I have this done?

A. 3. That depends entirely upon yourself. The scar according to you is not giving you any distress. Nevertheless you seem to object to its marring your appearance and the usual procedure is to remove an eyesore if it is in your power to do so. We therefore suggest that you consult your physician or take the matter up with the physicians and surgeons at your local hospital.

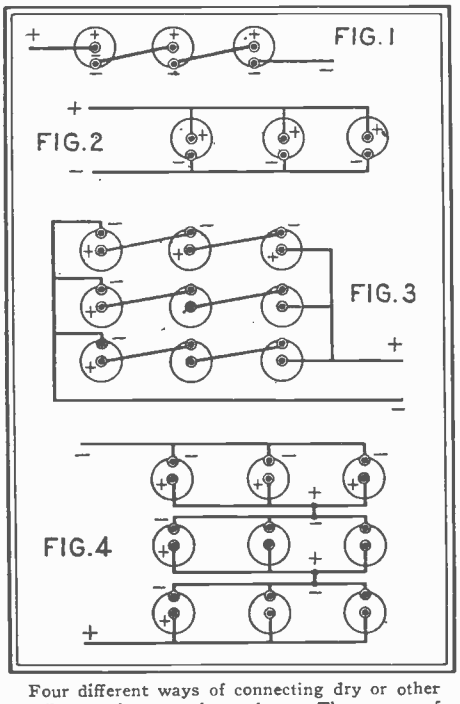
BRAINS

(2059) Q. 1. Benjamin Schneider, Atlanta, Ga., asks: What is the chief difference between the brain of a man and that of an ape?

A. 1. The ability to reason is the chief differentiation between the two species. The ape can be taught to mimic certain actions and in some cases to perform useful work, but he cannot be taught the reasons for doing certain things and cannot figure out for himself just how a certain action must be accomplished. It is the quality of reasoning that makes man superior to the lower animals.

CELL CONNECTIONS

(2060) Q. 1. Rudolph Fincke, Rochester, N. Y., says: I have been told that there are four methods of connecting dry cells or storage cells to each other, but I only know of two, namely series and parallel. What are the other two methods?



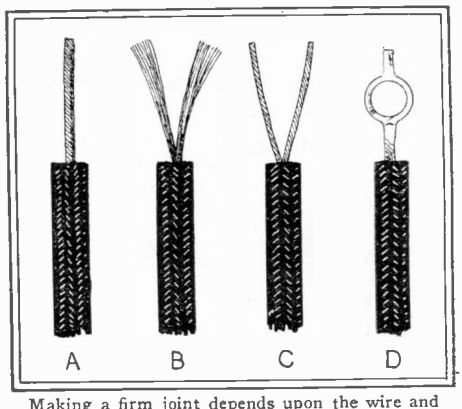
Four different ways of connecting dry or other cells together are shown here. The names of these connections are given in the text.

A. 1. The four methods of connecting cells are shown in these columns. Fig. 1 shows three cells connected in series. Fig. 2 shows cells connected in parallel. Fig. 3 shows what is known as a parallel bank of series connected cells, whereas Fig. 4 shows a series bank of parallel connected cells. Reference to the well known methods of determining the voltage and amperage obtainable from a series or parallel bank of cells will quickly show how the same units are determined for the last two of the illustrated methods of connections.

WIRE TERMINALS

(2061) Q. 1. Milton Singer, Brooklyn, N. Y., asks: What is the best way to fasten stranded wires under binding posts so that they will not work loose?

A. 1. The illustration here shows one of the best methods of performing this work. First, the insulation is removed from the stranded cable and the exposed bare wire is carefully cleaned. This



Making a firm joint depends upon the wire and if the wire is looped as above, best results will be obtained.

gives the result shown at A. Then the twisted wires are separated into two groups as at B and are twisted together as at C. A loop is then formed as at D and well tinned with solder. The result will make very nearly perfect connection when placed under an ordinary binding post such as is found on the tops of dry cells.

GNOME ENGINE

(2062) Q. 1. Victor H. Beck, Stockton, Calif., asks: Is the Gnome engine with radial rotating cylinders of the two-cycle or four-cycle type?

A. 1. This engine operates on the four-cycle principle, although it has only one valve and takes in the charge of gas from the crankcase. The action is as follows, starting with the ignition of the mixture in the cylinder. The firing takes place at about 15 degrees before top dead-center and as the piston is moved down on the firing stroke, the single valve opens at about 85 degrees after top dead-center. The exhaust continues until the piston returns to dead-center in the upper end of the cylinder. The exhaust valve is still open and as the piston descends, pure air enters through the valve and continues to flow until the closing of the valve which takes place at about 65 degrees below top dead-center. The piston continues to descend, forming a partial vacuum until at about 2 degrees before dead-center the piston opens the ports to the crank case and an exceedingly rich mixture of gas enters the cylinder, mixes with the air and forms a combustible mixture. On the next upward stroke, the ports are closed and compresson takes place. The gaseous mixture is introduced into the crank case through a hollow shaft.

HYDROGEN

(2063) Q. 1. Nathan Putney, Miami, Fla., inquires: What is the heat developed by the combustion of hydrogen gas?

A. 1. 34,500 calories of heat are developed by the combustion of a gram of hydrogen gas.

REMOVING CONNECTORS

(2064) Q. 1. L. R. Simpson, Herrick, Ill., asks: How are the connecting strips used on automobile storage batteries removed from their positions?

A. 1. In general, the method is to bore into the connector with a wood bit. Start the hole directly over the center of the cylindrical protuberance to which the connecting strap is fastened. Drill to a depth of about 3/16 of an inch, whereupon by prying upward carefully with a screw driver, the connecting strap can be removed.

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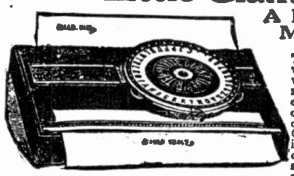

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Hold the **MAGIC INDICATOR** over a man's hand—instantly it moves in a straight line, backward and forward. Hold it over a woman's hand and it describes a complete and continuous circle. The same action can be obtained over a letter written by a man or woman, etc. It is fascinating; baffling. We have never been able to figure out how it's done—but we've never seen it fail. Many novel and entertaining feats may be performed with the Sex Indicator. For example, similar results can be obtained with animals, cats, dogs, rabbits, over birds, chickens, canaries, etc. Also used to predetermine the sex of chickens and birds, etc., in fact it is sold as a patented egg tester in Europe. **Price 25c, or 3 for 65c, postpaid.**

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Exploding Cigarettes

JUST LIKE ORDINARY CIGARETTES. BUT SUCH REAL STARTLERS! The box contains ten genuine cigarettes of excellent quality. They appear so real, but when each cigarette is about one-third smoked, the victim gets a very great surprise as it goes off with a loud **BANG!** A great mirth provoker yet entirely harmless. **Price 25c per box.**

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CIGARETTE MAKER

Roll your own and save money. Makes them better and quicker besides saving more than half. Use your favorite brand of tobacco. Neat, useful and handy. Pocket size, weighs ½ oz. Made entirely of metal, nickel-plated. **Price 25c postpaid.**

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Wonderfully Sweet Toned and Musical

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This Magic Flute, or Humanatone, is a unique and novel musical instrument that is played with nose and mouth combined. There is just a little knack in playing it which, when once acquired after a little practice will enable you to produce very sweet music that somewhat resembles a flute. There is no fingering, and once you have mastered it you can play all kinds of music with facility and ease. When played as an accompaniment to a piano or any other musical instrument, the effect is as charming as it is surprising.

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Two very novel metal badges, nickel plated, that you can wear, giving you fun of all proportion to their trifling cost. **10c, each badge, 3 for 25c, or 75c per doz. p.pd.**

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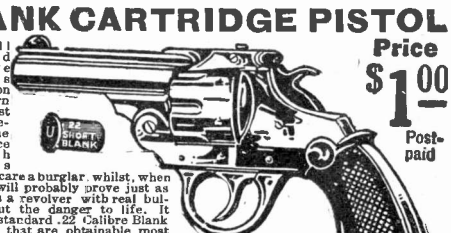

This well made and effective Pistol is modelled on the pattern of the latest type of Revolver, the appearance of which alone is enough to scare a burglar, whilst, when loaded, it will probably prove just as effective as a revolver with real bullets, without the danger to life. It takes the standard .22 Calibre Blank Cartridges, that are obtainable most everywhere. Even the most timid women can use it with perfect safety and frighten a thief without risk to herself or anyone else. **A Great Protection Against Burglars, Tramps and Dogs.** You can have it lying about without the danger attached to other revolvers. We sell large numbers around the 4th of July. Well made of solid Metal. **PRICE ONLY $1.00 Postpaid. Blank Cartridges 22-cal. shipped by express only, 50c per 100. Johnson Smith & Co., Dept. 345 Racine, Wis.**

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Place a very small amount of this powder on the back of your hand and blow it into the air and everyone in the room or car will begin to sneeze without knowing the reason why. It is most amusing to hear their remarks, as they never suspect the real source, but think they have caught it one from the other. Between the laughing and sneezing you yourself will be having the time of your life. For **parties, political meetings, car rides,** or any place at all where there is a gathering of people, it is the **greatest joke out. Price 10c or 3 for 25c**

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Serpent's Eggs

Box contains 12 eggs. When lit with a match, each one gradually hatches itself into a snake several feet long, which curls and twists about in a most lifelike manner. **Price per box 10c ppd.**

Microphone Transmitter Button

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You can easily make a highly sensitive detectophone by using this Transmitter Button to collect the sound waves. You can build your own outfit without buying expensive equipment. It is simple and inexpensive. You can install an outfit in your home and hear conversations being held all over the house. You can connect up different rooms of a hotel. This outfit was used by secret service operatives during the war. It is being used on the stage. It is ultra-sensitive and is the greatest invention in micro-phones. You can conceal the Button almost anywhere—card board boxes, stove pipes, stiff calendars, on the wall behind a picture frame, etc. Button is so light and small it cannot be detected. Persons can be overheard without suspecting it. You can listen in on conversations in another room. A deaf person in the audience can hear the speaker. Connected to phonograph, piano or other musical instrument, music can be heard hundreds of feet away. Button may be used to renew telephone transmitters; often makes an old line "talk-up" when nothing else will. The ideal microphone for radio use; carries heavy current and is extremely sensitive. Amplifies radio signals. Countless other similar uses will suggest themselves. Experimenters find the Button useful for hundreds of experiments along the lines of telephones, amplifiers, loud speakers, etc. Many fascinating stunts may be devised, such as holding the button against the throat or chest to reproduce speech without sound waves. $5.00 is given to anyone who sends in a new suggestion for the use of the Button providing the manufacturers find it suitable for use in their literature. **PRICE $1.00 POSTPAID ANYWHERE.**

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ITCHING POWDER

This is another good practical joke; the intense discomfiture of your victims to everyone but themselves is thoroughly enjoyable. All that is necessary to start the ball rolling is to deposit a little of the powder on a person's hand and the powder can be relied upon to do the rest. The result is a vigorous scratch, then some more scratch, and still some more. **10c box, 3 boxes for 25c or 75c** per doz boxes postpaid.

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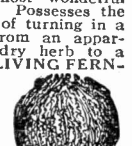
RESURRECTION PLANT

One of the most wonderful plants known. Possesses the strange power of turning in a few minutes from an apparently lifeless, dry herb to a BEAUTIFUL LIVING FERN-LIKE PLANT of a dark green color. Simply place the plant in saucer of water, it will open up and start to grow in 20 minutes. When taken out it will dry up and go to sleep until placed in water again. Fine house plant—summer or winter. **10 cents each or 3 for 25c,** postpaid.



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White Ants Destroy Buildings

By HELEN HOFFMAN

(*Continued from page* 105)

of the pests will eat the heart out of a book in the course of a few days' engagement. So to the experts who know the ways of the ant it was not astonishing to find recently in the file-room of the Congressional Library pamphlets and records eaten through from cover to cover.

Almost at the same time the loss of a large number of revenue stamps was reported. An investigation was started. The culprit proved to be the fast working termite.

In India where the ravages of this small pest exceed the damage done in any other country, it is plain to be seen that the tropics or semi-tropical countries are by their very nature likely to be the greatest sufferers from the termite. The moisture of the tropical and semi-tropical countries favor not only the reproduction of the ant in swarms of millions and even billions, but the climatic conditions and the soil create an ideal state in which the white ant thrives on his destructive methods of living.

Photographs taken by scientists who have made extended investigations into the destruction wrought by the termite in various parts of India show the sad-eyed natives taking leave of their bamboo homes practically ruined by this hard working army.

One of the greatest experts on the subject is the Rev. Joseph Assmuth, S. J., for many years Professor of Biology at Bombay University, now with St. John's University, Fordham, New York City. He, with scientific men of other countries, is watching the work of the U. S. government with great interest, due to the fact that no country as yet has found means of coping with the problem. In Bombay, he says, the ants boring from within, destroyed the pipes in the great organ of its finest church. Most desperate of all, he says are the railroad owners, who suffer tremendous losses. From Krachi to Lahore, a distance of some 700 odd miles, the ants destroyed in a period of about three years something like 75,000 wooden railroad ties.

In various parts of South Africa and Rhodesia vast stretches of wasteland are to be found dotted with good-sized mounds erected by the termites. The ants bore into the moist soil with the energy of a subway digger, throwing up the earth as they dig. The workers, as a certain group of the ants are known, emit a saliva which they utilize in fashioning the mounds. When completed these resemble a first-class cement.

The ant, it has been found, destroys the hardest of woods with as much ease as he destroys rubber, leather shoes and paper.

Termites, or *white ants*, as they are known, are not, strictly speaking, the government points out, ants as the public knows them. The termite, it says, is related to the roach family. Forty-three of the 1,500 species or kinds in the world are known in this country and on the Panama Canal Zone. The almost incredible damage done by this *international army*, is made possible by the fine equipment furnished them by Nature in a powerful set of saw-fashioned teeth, set on either side of the jaw.

[Those interested in the "Biology of the Termites of the Eastern United States. With Preventive and Remedial Measures", can obtain a book bearing the above title written by Thomas E. Snyder of the U. S. Department of Agriculture, by communicating with the Government Printing Office at Washington, D. C. The price of this book is twenty cents, including postage. A small booklet also edited by the U. S. Department of Agriculture and available from that Government Department at Washington, D. C., is entitled. "White Ants As Pests in the United States and Methods of Preventing Their Damage."—*Editor.*]

Experimental Spinthariscopes

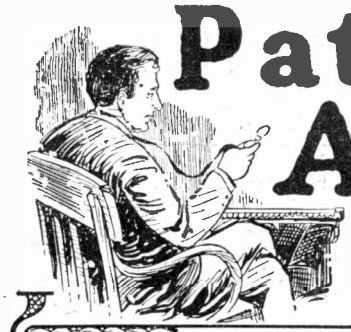
By CHARLES K. FULGHUM

(*Continued from page* 144)

and screen are assembled, it should be screwed in place on the jar, and a mark made on the side of the jar about 1 cm. below the screen. The assembly of the complete radioscope is shown in Fig. 3.

In using the instrument, a small quantity of the ore to be tested is ground to a coarser powder and placed in the jar. The jar is then filled with water to the mark on the side of the jar, and then corked with a rubber cork and shaken vigorously. The cork is then removed, and the metal cap placed on the jar. If scintillations are observed when the lens is focused on the screen, one can be certain that the ore in the jar contains radio-active material. All of the operations described should be carried on in a dark place, and the cap with the screen should be kept in a dark place previous to the experiment. Otherwise, under the action of light, the screen will become phosphorescent and the scintillations produced by the *alpha* particles released from the radio-active material in the jar will not be visible.

Patent Advice



Edited By
A. P. PECK

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 addressed to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are published here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

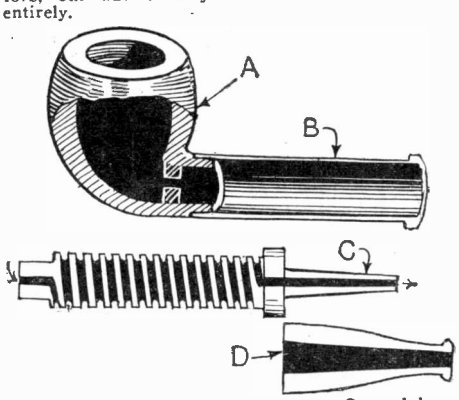
Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

NOTE:—Before mailing your letter to this department, see to it that your name and address are upon the letter and envelope as well. Many letters are returned to us because either the name of the inquirer or his address is incorrectly given.

PIPE

(938) Q. 1. O. Bares, Wilmar, Calif., has designed a tobacco pipe of the type that is shown in the accompanying illustration, wherein A is a standard wooden pipe bowl, B is a metal sleeve, C is an insert provided with a spiral groove and D is the stem. The purpose of this design is to produce a cool smoking pipe. This is supposedly achieved by causing the smoke to travel around the long spiral and, becoming cool in the operation.

A. 1. The idea is very old indeed. In fact, there has been at least one pipe similar to this placed on the market and marketed to a very great extent, but without really successful results. The design of this other smoking pipe was so similar to the one that you have forwarded to us that we believe you would encounter interference in attempting to obtain a patent and, therefore, our advice to you is to drop the matter entirely.



Pipe design suggested for patent. Our advice appears above.

TRANSMISSION

(939) Q. 1. James Noble, Jr., Mount Morris, N. Y., has devised a transmission for automobiles that provides continuously variable speeds and that is designed to be placed between a conventional automobile clutch and the rear end or differential mechanism. He asks our advice as to the practicability of such a device.

A. 1. We do not see anything whatsoever that could be considered as being new or novel in connection with your proposed automobile transmission. In the first place, the fundamental principle upon which it operates is very old and has been known to the automobile world for many years. In fact, automobiles and even motorcycles have been placed on the market equipped with a transmission very similar to yours but there are so many defects to be found in a system of this nature that these vehicles have never become popular. In view of preceding claims to the design of a transmission of this type, we do not believe that it would be profitable for you to proceed further with yours.

CHIROPRACTIC DEVICE

(940) Q. 1. Thomas Gullano, Brooklyn, N. Y., has invented a belt that has been designed with the purpose in mind of allowing a person to give himself chiropractic adjustments of the spinal vertebrae. He asks our opinion upon it.

A. 1. We do not favor your device in any way whatsoever. In the first place, chiropractic adjustments often require the exertion of much force and this force must be applied in a very exact manner as otherwise harm may result. A person unversed in the art is not certain and perhaps incapable of producing a satisfactory adjustment with a belt of the type that you have designed, and we would, therefore, certainly not advise you to proceed further in the attempt to commercialize this device.

STOP SIGN

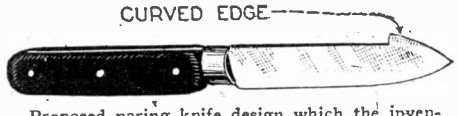
(941) Q. 1. Edwin M. Love, Alhambra, Calif., submits a design of a type of "stop" signs to be used on automobiles or trucks not equipped with electric lighting systems. The sign consists of a small flap arranged with a spring and so connected that when the brake pedal of the vehicles is depressed, the flap will assume a perpendicular position at the rear of the vehicle and will display the word "stop." He wants to know what we think of his idea.

A. 1. Frankly, we do not think very much of it. In the first place, the idea is old. Similar home-made systems have been described in the pages of various periodicals in the past and we believe that applications for patents have been made upon some of them. In any event, we are very much of the opinion that you are entirely too late with your idea and we would not advise you to attempt to obtain a patent upon it. We are sure that even though such a patent might be issued, you would have very little chance of commercializing the system.

KNIFE

(942) Q. 1. Marion R. Maybaugh, Bowling Green, Ind., submits a design for a paring knife to be used for removing the cores of apples and the eyes from potatoes and the design of the same is shown in these columns. The end of the knife is slightly curved as indicated so as to facilitate the work mentioned. He asks our opinion upon it.

A. 1. Your particular design for a paring knife is not at all new and we are very much of the opinion that it does not constitute patentable material. If you will thoroughly search the various department stores and others carrying kitchen utensils, you will undoubtedly find several knives constructed along lines very similar to the one you have designed. We do not believe that you would be able to obtain a mechanical patent upon this knife and would not advise you to invest any further time or money in the proposition.



Proposed paring knife design which the inventor wants to patent. Our advice is given in the answer herewith.

Tarrano the Conqueror

By RAY CUMMINGS

(*Continued from page* 133)

pacing the room. "Tarrano the weakling! To what depths has Tarrano fallen!"

He stopped before her. "I ask your pardon, Lady Elza. This has been madness. Forget my words—all madness."

His tone was crisp. "Human weakness to which I did not realize I was so prone made me talk like a fool. Desire you above the conquest of the Universe? Absurd! Lies that men whisper into women's ears! All lies!"

Was he telling the real truth now? Or was this a mood of recrimination? Bitterness that his love was scorned. Again his gaze held her, but in it now she could see nothing but a cruel inflexible purpose.

"Tarrano in defeat! That is impossible, Lady Elza. You will very shortly realize that, for I am going to show you how, sin-

A grotesque naked monstrosity almost in human form. A travesty—gruesome mockery of mankind. A face, three-eyed . . .

gle-handed, I can make it impossible. Show you with your own eyes. It was my purpose in coming to waken you—my purpose, when your beauty led me into weakness incredible . . . Get up, Lady Elza."

She stared. With folded arms he stood emotionless regarding her.

"Get up, I tell you. Put on those garments you wore when we arrived. We are going travelling again."

He stood waiting; and beneath his gaze she shrank back, drawing the fur rug over her.

A smile of contempt parted his lips. "You hesitate? You think I am still a weakling? You over-rate your beauty, Lady Elza . . . Make haste, I command you. We must start very soon."

She summoned her voice. "Start? Where? What are you—"

"No questions, Lady Elza. Not now. Make haste—"

He jerked from her the fur covering, flung it across the room, and with the same gesture turned away impersonally. Trembling, she rose from the couch and donned the garments he had indicated, while he stood brooding by the window, gazing through its transparent pane at the glistening frozen city which was all that remained of his Empire.

CHAPTER XXVIII

THE THING IN THE FOREST

"All in good time, Lady Elza, you will know where we are."

Alone, unnoticed, they had departed from the City of Ice on a small flying platform similar to the one they had used before. The night had passed; day, with a new warmth to the sun, came again. Flying low, with Tarrano in a grim, moody silence, and Elza staring downward.

The aural lights were overhead when at the last Tarrano brought the platform to rest. A thick, luxuriant forest. Huge trees with rope-like roots and heavy vines. Others with leaves like the ears of an elephant. And the ground hidden by almost impenetrable underbrush.

They had landed in a tiny glade beside a dank marsh of water, where ferns shoulder high were embanked. It was dark, the stars and the tints of the auroral lights were barely distinguishable through the mass of foliage overhead. Elza gazed around her fearsomely. The air was heavy, oppressive. Redolent with the perfume of wild flowers and the smell of mouldering, steaming earth.

"All in good time, Lady Elza," Tarrano repeated. "You will know where we are presently; we are closer to human habitation than you would think."

Elza's heart pounded. As they were descending she had noticed a glow of light in the sky ahead. As though by intuition now,

she seemed to realize that they were not far from the Great City. Her thoughts leaped to me—Jac Hallen—there in Maida's palace. Tarrano's grim, sinister purpose was as yet unknown to her. But she guessed that in it, danger impended for me—for all of us in the Great City.

"Jac! Danger! Jac! Danger!"

Her thoughts instinctively reiterated the two words uppermost in her mind. And I think that it was just about then when they awakened me.

Leaving the vehicle, Tarrano commanded Elza to follow him; and he began picking his way through the jungle. A light was in his hand; it penetrated but a short distance. A quivering beam of yellow light; then Elza saw that upon occasion, as Tarrano's finger slid a lever, the beam narrowed, intensified to a bright lavender. And now where it struck, the vegetation withered. Blackened, sometimes burst into tiny flame, and parted thus before them as they advanced.

The jungle was silent; yet, as Elza listened, beneath the crackle of the burning twigs she could hear the tiny myriad voices of insect life. Startled voices as the heat of Tarrano's beam struck them. Rustling leaves; breaking twigs; things scurrying and sliding away, unseen in the darkness.

Once or twice a crashing—some monster disturbed in his rest plunging away. Again, a slithering bulk of something, undulating its path through the thickets. All unseen. Save once. Looking upward, Elza caught a gleam

of green eyes overhead. A triangle of three baleful spots of phosphorescent green. Her murmur of fright caused Tarrano to glance upward. His lavender beam, grown suddenly larger, swung there with a hiss. Falling from above came a pink body. A bloated body, square, with squat, twisted legs; a thing larger than a man. A grotesque naked monstrosity almost in human form. A travesty—gruesome mockery of mankind. A face, three-eyed. . .

The thing lay writhing in the underbrush, mouthing, mumbling and then screaming—the shrill scream of death agony. And the horrible smell of burning flesh as Tarrano's light played upon it . . .

"Come away, Lady Elza. I'm sorry. I had hoped to avoid an affair such as this."

Sickened, shuddering, Elza clung close to Tarrano as he led her onward.

An hour or more; and now Elza could see in the distance the lights of the Great City.

"Jac! Danger! Jac! Danger!"

The idea of thought-transference had come to her. With all the power of her mind she was thinking her warning to me, praying that it might reach me.

"Single-handed, Lady Elza. You shall see now how, single-handed, I make impossible any attack upon Tarrano."

Stumbling through a tangle of low growth—a black thicket which tore at my garments and scratched my flesh—I was transfixed by a woman's scream. It came through the darkness from near at hand.

In her abstraction Elza had almost forgotten herself and Tarrano; his voice reached her—his voice grim and with a gloating, sinister triumph in it. He was bending to the ground. Elza saw that they had come to an open space—an eminence rising above the forest. Underfoot was a stony soil; in places, bare black rock with an outcropping of red, like the cinnabar from which on Earth we melt the *Heavy-metal.**

Tarrano faced her. "Nature, my Lady Elza, is fair to my purpose. I knew I would find some such deposit as this." He turned his face to one side attentively, and darted his light—harmlessly yellow now—to where a lone tree showed its great leaves beginning to waver in a night breeze.

"Nature is with us! See there, my Elza! A wind is coming—a wind from us to—them!"

The breeze grew—a breeze blowing directly over the forest to where in the distance the lights of the Great City showed plainly. Tarrano added:

"I had thought to create the wind." He tapped his belt. "Create the wind to carry our onslaught. But you see, it is unnecessary. Nature is kind, and far more efficacious than our man-made devices."

"Jac! Danger!" She stood there in the

* *Quicksilver.*

breeze, watching Tarrano—his purpose as yet no more than guessed—praying that I might receive her warning.

Tarrano selected his spot—a tiny little cone of rock no bigger than his thumb. He beckoned Elza.

"Stand close, and watch. You shall see how from the merest spark, a conflagration may ensue."

The cylinder in his hand darted forth a needle-like shaft—a light of intense purple. It touched the tiny cone of rock, and he held it there.

"A moment. Be patient, my Elza."

The point of rock seemed presently to melt. Like a tiny volcano, at their feet, lava from it was flowing down. A little stream of melted rock, viscous, bubbling a trifle; red at the edges, white within, and with wisps of smoke curling up from it.

Elza stared with the fascination of horror, for now tiny tongues of flame were licking about. Blue tongues, licking the air, vanishing into wisps of black smoke.

Tarrano snapped off his ray. But the tongues of flame stayed alive. Spreading slowly, soundlessly, their heat now melting the ground.

A breath of the smoke touched Elza's face. Pungent, acrid. It stopped her breathing. She choked, coughed heavily to expel it.

"Come away, Lady Elza. Let us watch from a safer distance."

He led her from the hillock, up the wind to where at the edge of the forest they stood gazing.

The blue fire had spread over a distance of several feet. A sluggish, boiling, bubbling area of flame. Tongues now the height of a man. And from them, rolling upward, a heavy black cloud—deadly fumes thick, blacker than the night, spreading out, welling forward over the forest toward the Great City slumbering in its falsely peaceful security.

At last Elza knew. Stood there, cold, shuddering; thinking with all the power of her mind and being:

"Death, Jac! Death to all the City! The black cloud of death!"

Oblivious to Tarrano she stood until at last the rocky eminence was one great mass of the surging blue fire. And the black cloud, compact as a thunder-head, rolled onward.

"You can see it coming! Death Jac! Death to all the City!"

A sudden madness descended upon Elza. She felt abruptly that her warning was futile, felt an overpowering desire to run. Run somewhere—anywhere, away from the

lurid sight she was facing. Or run perhaps, to the Great City; to race with that black cloud of death; to run fast and far, and burst into our palace to warn us.

Tarrano, himself lost in triumphant contemplation of what he had done, for the moment was heedless of Elza's presence. With white face upon which the blue glare had settled like a mask of death, Elza turned silently from him. Forgetful of that horrible thing they had encountered—others of its kind which might be lurking about—she turned silently and plunged into the black depths of the forest.

CHAPTER XXIX
A WOMAN'S SCREAM

"The Black Cloud of Death!"

We stood there at the casement of the palace, gazing with a growing terror at the visible evidence of the tragedy which threatened. A black cloud off there in the distance, spreading out, rolling inexorably toward us. And then came the wind, and with it a breath of the black monster—a choking, horrible suggestion of the death rolling already over the city.

$5,000 for Perpetual Motion

When SCIENCE AND INVENTION Magazine was still in its infancy, the editors denied the possibility of constructing a perpetual motion machine using those forces of nature as we now know them.

Since that time the editors have received thousands of different designs for perpetual motion devices, and have received hundreds of circular letters soliciting finances for the building of perpetual motion machines.

The editors know that if they receive these letters, there are thousands of others in this country who get similar letters and who fall for the claims made in the numerous prospectuses giving the earning capacities of the various machines.

Most of the shares of stock for these perpetual motion machines are being sold at a rate of $1.00 per share, although some inventors are trying to sell shares of stock at $100.00 per share.

Therefore the editors of this publication say, "Just come in and show us—merely SHOW us—a working model of a perpetual motion machine and we will give you $5,000.-00. But the machine must not be made to operate by tides, winds, waterpower, natural evaporation or humidity. It must be perpetual motion."

We must have been fascinated at the casement for some considerable time. Elza's thought messages had ceased. Abruptly I came to myself.

"The Black Cloud of Death!" I turned to Georg and Maida. "Alarm the city! Arouse them all! Alarm—"

Maida's face was white: she flung off Georg's arm which had been protectingly around her. "The siren—"

Terrible moments, those that followed. Confusion; panic; death!

The public siren in the tower by the lagoon entrance shrilled its warning. The danger lights blazed out. The city came to life. Lights sprang up everywhere. People—with the daze of sleep still upon them—appeared at the casements; on the roof-tops; on the canal steps they appeared, fumbling with their boats. Panic!

A pandemonium. Aircraft, such as could so hastily be mustered, swept overhead. A glare of lights everywhere. The shrill voice of the siren stilled, to make audible the broadcast warnings—stentorian tones screaming: "The Black Cloud of Death! Escape from the city! Escape to Industriana!"

Warning, advice, command! But over it all, the breath of the black cloud now lay heavy. The lights were dimmed by it. Everywhere—to every deepest recess of the city—to every inner room where to escape it many had fled—its deadly choking breath was penetrating.

Within the palace was turmoil. We had an air-vehicle on a landing-stage nearby; but Georg and Maida would not leave at once. Rulers of the Central State, as a Director might stick to his crumbling Tower, they stayed now in the Great City. Encouraging the people. Maida's voice, futily attempting to broadcast over the uproar. Georg commanding the official air-vessels to load with refugees; himself struggling to direct the jam of boats toward the embarking stages.

We were in the instrument room of the palace. The air was pale-blue, though I had closed every casement. Ourselves, choking already; then gasping; and with no time or thought to procure a mask. The chemical room, from whence we might have secured apparatus to purify our air, had been abandoned before we thought to seek it out. I dashed into it, my breath held. Its casements were open; its air thick-blue with the fumes; its staff long since fled. I ran back to Georg and Maida, gasping, my lungs on fire, my head roaring.

"No use! Abandoned!"

The department of weather control where —had we been forewarned—we might have found means to divert the wind by another of our own creation—was deserted by its staff at the first alarm.

"No use! Georg—Maida—let us go!"

The mirrors all about us in the instrument room were going dark; the horrible scenes of death throughout the city which they pictured were vanishing. The public lights were going out; the broadcast voices were ceasing.

The city now was out of control. But still the lagoon outside was packed with boats—overloaded boats . . . . Screams of terror, choked into silence . . . . boats with frenzied occupants leaping into the water to find a quicker, happier death. . . . a woman with a babe in her arms on a housetop across the lagoon—the infant already dead; the crazed mother flinging it down into the water, herself following with a long, gasping scream . . .

At last Georg pulled at me—no longer could we speak—pulled at me, and with Maida between us, we fled. The air outside was worse. In the dimness, our landing stage seemed *helans* away. The flagged area between us and the stage—a space of square-cut metal flagging, bordering the lagoon—was littered with bodies. Dead—or dying. People even now staggering from landed boats—staggering blindly, stumbling over bodies, falling and lying always where they had fallen.

With our own senses fading, we groped our way forward. Soon we were separated. I saw Maida fall and Georg pick her up, but I was powerless to reach them.

The landing stage seemed so far away. The dead and dying beneath my feet obstructed me as I staggered over them. A woman, reeling toward me, flung her arms about my neck with an iron grip of despair. I stared into her face, purple almost with its congested blood, her mouth gaping, her blood-shot eyes bulging; and even with the terror distorting them, I saw beneath it their look of despairing appeal . . .

Her arms clinging to me desperately; but with a curse I flung her to the ground and reeled onward.

Without knowing it, I had come to the brink of the water's edge. The flagging seemed to drop away. I fell. Dimly I heard the splash as I struck the water; and felt a grateful cooling sense as it closed over me.

I am a strong, instinctive swimmer. I did not breathe, and when I rose to the sur-

face, the single swift breath I took was purer than any I had had for half an hour past. My head cleared a little; swimming instinctively, and with cautious breaths, I found that I was able to go on.

I know now that by some vagary of chance—of fate if you will—I had struck a surface area where breathable air still remained. I swam, striving to plan, to think where I might be swimming. Yet it was all a phantasmagoria, with only the strength of my muscles and the instinct to preserve my life remaining to direct me. Swimming endlessly . . . swimming . . . taking a half-gasp of breath . . . swimming . . . trying to think . . . or dreaming . . . was it all a dream? . . .

When I came to myself I was lying upon a bank of ferns in the outskirts of the city. It was still night; the black cloud of death had passed on; the air was pure. Like a man for days bereft of water, I lay and drank in the air, pure at last, as the Almighty distills it for us.

Bodies were lying around me on the bank. A dark, silent house stood nearby; and a deserted boat. All darkness and silence—the brooding silence of death. I was still dazed.

Maida—Georg; they seemed like people in a dream long faded. Industriana! They were going to the Rhaal City of Industriana. *I* had been trying to get there. I must get there now—join them. I climbed to my feet; the edge of a forest was nearby and with wavering steps I started toward it.

Looking back on it now I realize that I was even then half crazed. In a daze I must have stumbled through the forest for hours. Unreasoning, with only that one idea—to get to Industriana; and in the background of my consciousness the vague belief that Elza would be there to greet me. Into the depths of the untrameled forest with unguided steps I wandered.

At last I found myself wondering if the dawn were coming; the tri-night hour was long since passed; the auroral lights as I could sometimes see them through the tangle of vegetation overhead, were low in the sky. Insects—and sometimes larger beings—leaped and slithered unseen before my advance. But I did not heed them. Eyes may have peered at me as I stumbled through the blackness of the undergrowth; but if they did, I did not notice them.

And then at last I was brought abruptly to full rationality and consciousness. Stumbling through a tangle of low growth—a black thicket which tore at my garments and scratched my flesh—I was transfixed by a woman's scream. It came through the darkness from near at hand. A crashing of the underbrush, and a woman's scream of terror. It stopped my breath, turned me cold.

Elza!

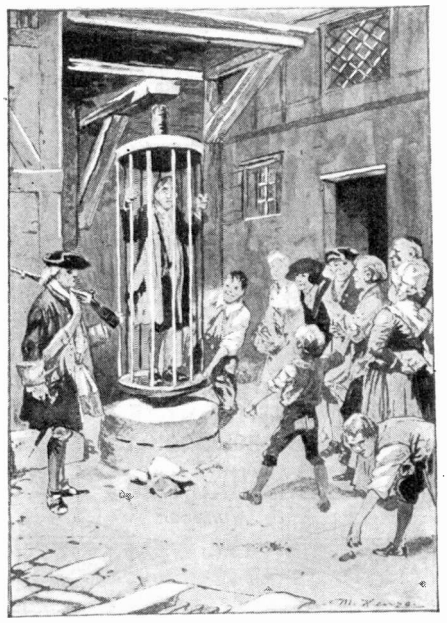
(Continued in next issue)

Ancient Torture Methods

By T. O'CONOR SLOANE, Ph. D. LL.D

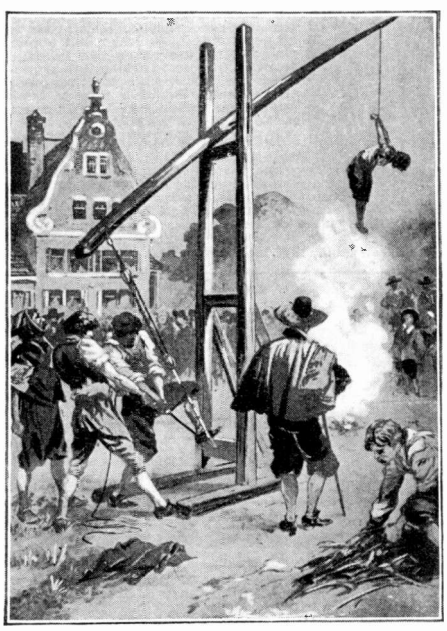
(*Continued from page* 115)

we find that torture was most generally applied for the purpose of making witnesses testify, or for extracting confession to determine guilt, rather than as a mode of punishment.



Here a victim is exposed in a circular cage mounted on pivots so as to be readily rotated.

It seems rather a hard fate for an unfortunate slave to be used as a witness against his will, in a lawsuit, and be put upon the rack in order to be made to give the required testimony. There is no doubt, judging from the accounts of the law and its administration from the earliest day, that testimony thus secured was considered most reliable. A Roman citizen, though he might be decidedly inferior to the slave in learning and culture, was exempt from torture. But that rule did not always hold. St. Paul, a Roman citizen, claimed the exemption and was granted his claim. But, Cicero tells us in one of his orations, of Verreas submitting a Roman citizen to torture despite his affirmation of Roman citizenry.



In the sweep-gallows illustrated above the rope is released for ten feet or more and fetched up suddenly. A jerk causes extreme torture. The fire is also applied.

How to Make Your Own

SPEECH AMPLIFIER

MICROPHONE Transmitter Buttons have been used for a number of years to make powerful sound transmitting elements. These very sensitive amplifiers offer every "Radio Fan" the means of building his own powerful speech amplifier. We offer herewith to the constructor these special *Amplifier Units.*

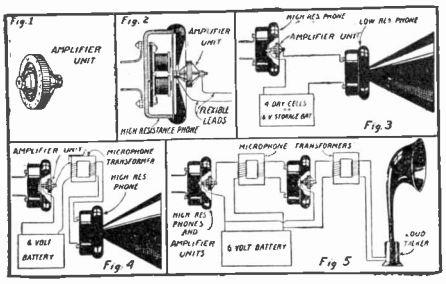


Fig. 1 shows the amplifier unit.

Fig. 2 shows how the unit is attached to a telephone receiver. The first procedure is to mount the unit on the diaphragm of a telephone receiver, which usually is a high resistance telephone, either 1,000 or 1,500 ohms.

Next we select the loud speaking telephone. If a low resistance telephone is available, it should have for maximum efficiency an impedance equal to the resistance of the amplifier unit, or about 10 ohms; it is connected up as shown in Figure 3. A 5 ohm telephone receiver is used in this circuit with a 6-volt storage battery.

Two telephones taken from a good double headset of 2,000 to 3,000 ohms which do not rattle on strong currents, are employed in Fig. 4, one at the receiving end, the other as loud talker. In this hook-up there is one instrument which must absolutely be used with this combination, the transformer. As stated before in connection with Fig. 3, the impedance of the telephone, if used in direct connection, should equal the resistance of the unit. But as the impedance of the telephone in Fig. 4 is much higher than the resistance of the unit, it may be 200 times as great, a transformer having a step-up ratio is used to match up the resistance of the unit with the impedance of the loud speaking telephone. In other words, the primary coil of the transformer should have an impedance (which is sometimes called "A. C. resistance") equal to the resistance of the unit, or about 10 ohms, and the secondary coil should have an impedance equal to the impedance of the high resistance telephone. This transformer may be purchased in any Radio Store and is called a microphone transformer or modulation transformer, designed primarily to use in radio transmitting sets. A 6-volt battery gives the best results. The current passing through the unit will vary from .1 to .25 ampere.

Fig. 5 shows a circuit for further increasing the volume of sound. This is simply two of the circuits, such as shown in Fig. 4, linked together. This arrangement is highly sensitive and the telephones on which the units are mounted should be packed in a box of cotton, as the slightest vibration or sound in the room will be picked up and heard in the loud talker. Any sensitive radio loud talker may be used in this particular circuit.

THESE and innumerable other interesting experiments are possible with these amplifiers. Every amateur should have at least one or two in his "Lab" or workshop. A four-page instruction pamphlet is sent with every unit.

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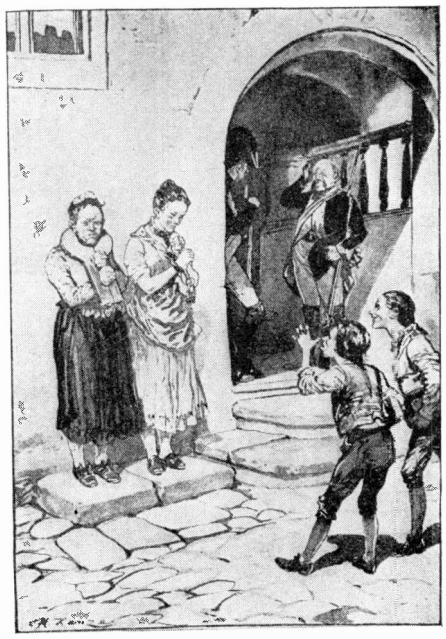
Thumb-screws, a well-known instrument of torture, were used by the English. It is told that one of the English kings had the instrument applied to his own thumbs. At the first suggestion of pain, he ordered the tightening to be stopped and admitted that another turn of the screw would make him



Here we see two women, one with a wooden and one with a metal collar, a variation on the pillory and standing on the penitential stone.

confess anything. It seems perfectly obvious that the vast majority of "confessions" thus obtained were confessions made by innocent people who could stand no more of the particular form of torture applied.

Illustrations of some instruments of torture are given with this article. In the following articles, more will be said of the various innovations and new inventions of instruments of torture—each more painful than the other—which showed a certain degree of ingenuity of what may be termed, the diabolical order; and something will be said of the evolution of torture to our own methods now employed to open the mouths of the silent and to gain admissions—our famous "third degree."

This illustrates the strappado. The victim was drawn up by the wrists which were tied behind the body. Varying weights were applied to his feet to increase the torture. Part of the torture was to raise him up and then drop him a certain distance without letting him touch the ground so as to jerk the arms out of the sockets.

How to Know the Value of Patents

By LEO T. PARKER

(*Continued from page* 111)

quires an explanation entirely too lengthy for this space, but suffice it to say that it means practically what the average person might believe the word expresses.

During the court proceedings or litigation in which infringement of a patent is involved, the defendant's attorney in making every effort to invalidate the patent simply strengthens it, provided, of course, its validity is upheld and an adverse decision is rendered against the party being sued for the infringement. The validity of a patent during the infringement litigations may be passed upon first, by the District United States Court, then by the Circuit Court of Appeals of the United States, and later, under certain conditions, by the Supreme Court of the United States.

So, therefore, if a patent is adjudicated in all three of these courts its validity is assured. If, however, its validity is upheld only in a District Court of the United States, there is a chance that the decision may later be reversed in either the Circuit Court of Appeals or the Supreme Court.

For these reasons the value of a patent is determined to a great extent, by the number of courts through which it has passed.

But if a patent is not adjudicated and has not passed through court litigation, then its value may not be so accurately determined. In other words an unadjudicated patent may be worth thousands of dollars or it may prove a liability. For example, if after an infringement suit is instituted on a patent and during the litigation the patent is declared invalid, then of course, the patent is valueless and the money spent in prosecuting it is lost.

It is true that some investments are much safer than others. And so it is with patent investments. If a patent is not adjudicated, it is advisable to place it in the hands of a reliable patent attorney to receive his opinion of the broadness of its scope or strength. By this plan a person may be reasonably certain whether or not a patent is sufficiently strong

$11,000 for Spirits

More than two years ago SCIENCE AND INVENTION Magazine offered a prize of $11,000.00 to anyone who could demonstrate his or her ability to communicate with the spirits or to give some definite form of a psychical demonstration which in itself was not trickery.

The result has been that mediums and spiritual organizations have been afraid to place proofs before us. Those weak attempts which have been made to demonstrate psychical phenomena were almost instantly proven fraudulent, and no medium has dared to contradict our findings.

In view of these facts, should we not consider all mediums fraudulent? Should we not consider every psychical manifestation as being trickery pure and simple, intended primarily to fleece those who visit the circle and who find solace in the words from the worst forms of charlatans, namely those who are being permitted to practise upon the poor, seeking words from loved ones?

We have $11,000.00 offered by this publication and Joseph F. Rinn which will be awarded wholly or in part to the one producing a phenomenon devoid of trickery.

to prevent other persons or firms from manufacturing a competing product. Also, fairly reliable information can be had as to the likelihood of other previously issued patents being so broad in scope as to cover the patent in question. All of this information can be had from a reliable patent attorney who may base his opinion on data gained from the patent application, searches of the Patent Office records, etc. If the opinion is to the effect that the patent is valid and strong, then, of course, the odds are in favor of the inventor, providing the patented article meets with popular public demand.

The likelihood of an article proving a popular and profitable selling item may be based, to a great extent, upon the past success of other articles which are used for the same purpose. If the patented product is already marketed, the available records may be resorted to for the purpose of determining the average selling cost, average profit, sales distribution, etc.

A particular advantage of having an article patented is that the inventor is given 17 years in which to exclusively make, sell and use the invention. The inventor, therefore, has an absolute monopoly on the patented product and is privileged to set any selling price on it as he may see fit.

The real value of a patent lies in the fact that the manufacturer may sell articles at a much higher price, and thereby earn considerably increased profits, than when the same articles are manufactured and sold by competing firms. A striking example of the price control advantage of manufacturing a patented article is offered by a very popular and universally used safety razor which sold throughout the country at a standard price of $5.00, during the entire life of the patent. However, within two months after the patent expired, and at the present time, competing firms offer the same type of safety razor as low as thirty-nine cents each. It is, therefore, apparent that in consideration of the abnormal profit at which a patented article may be sold, the actual value of a patent can be figured as being the difference between the patented article's selling price less the price which may be necessary to establish in the face of competition, and then multiply the remainder by the approximate number of sales. While it is true a greater number of the manufactured articles may be sold if they are offered to the public at a cheap selling price, yet when there is competition many firms share in the distribution of sales, whereas a firm that is manufacturing a patented article has the privilege of its exclusive sale, as well as the opportunity of large profits.

Not so long ago a certain firm in the United States secured the exclusive license to manufacture and sell a well known article which was patented by an English inventor. At the time and previous to receiving the exclusive right of the sale and manufacture of this article, the firm was barely earning expenses, because all of its products were being sold on a keen competitive basis, at small profit. But at this date this firm is paying big dividends and has discontinued making many of the articles which it made formerly, so that more space and the sales organization are available to manufacture and sell the more profitable licensed article.

The country is full of manufacturing concerns of great wealth, that owe their success primarily to the manufacture and sale of a patented popular selling article. Of that there can be no question.

All of these things are important for inventors as well as business managers to know. A man's knowledge of a business may mean its success or failure, so also may an understanding of the inventive business (for anyone who obtains a patent, is in the inventive business) result in a patentee's success.

The value of a patent cannot be accurately estimated. That is certain. But at the same time, its points of advantage can be fully understood by the inventor who should be able to convincingly explain these advantages to a prospective purchaser. Generally speaking, *almost* all big things did not just happen. That is to say their occurrence may easily have been avoided by an accidental circumstance. The same principle is true of men—the difference between the efficient man who earns ten million dollars in a life time, and the men who consistently earns $75 per week or $120,000 in a life time, is so the scientists say, less than 5 per cent. Yet the difference in actual results in dollars and cents is almost 99 per cent.

The writer realizes "efficiency of men" appears not to be directly concerned with the value of patents; yet no one can deny that many valuable inventions have not become dividend earners simply because the patentees or inventors almost but did not quite convince some manufacturing concern of the value of the invention. Perhaps, a knowledge of the ways to know the value of patents might have assisted the inventor to give the additional "punch" needed to consummate the deal which was almost, but not quite completed.

(*Don't fail to read Mr. Parker's article in July issue, "Important Things Inventors Should Know."*)

A Visit to a Movie Studio

By A. P. PECK and M. ESSMAN.

(*Continued from page* 107)

photograph black and ordinary rouge would give a cadaverous effect to the cheeks. Therefore, other colors must be employed and it is no unusual thing to see an actress made up with vivid green or yellow cheeks when working in a studio. It is this sort of make-up that the "burlesque queens" in the particular set referred to employed. Naturally, since there was no photography being done at this location we soon lost interest but found in another part of the studio that a picture was being taken. Here in a surprisingly small space was set the interior of an attic room. The whole setting together with the space necessary for the cameraman and the director occupied no more than an area 20 feet square. However, the effects that can be obtained in such a small space are surprising and the pictures very realistic.

The large illustration used in connection with this article will give the reader some idea of how various sets are placed close together in a small area, yet when filmed, give the effect of great distances. Also you can see some of the complicated apparatus that is required for the making of motion pictures, particularly the large arcs of the upright tubular type and the spotlights. Our other illustration shows the taking of a close-up. The young lady equipped with a notebook is the scene clerk referred to in the article entitled, "How Movie Films Are Edited," appearing in the May, 1926, issue.

It was with the greatest regret that we found that there was no trick photography being done at the studio at the time of our visit, but we were promised that we would soon be shown some work of this nature and so our readers may rest assured that in the very near future we will present the details of more trick photography.

Our visit to the studio encompassed a period of only about two hours and probably at the time we did not see all that is to be seen. However, with the promise of an early return, we reluctantly left. In the near future the reader may hope to hear of more trips to the various motion picture studios and we can certainly promise some very interesting reading.

The Future of Radio Broadcasting

By A. P. PECK

(*Continued from page* 155)

price. So it will undoubtedly be with radio broadcasting. Eventually the company that undertakes to commercialize this project will be the one that will be patronized and will be the one that will reap the benefits of successful broadcasting.

Our picture shows a central radiophone exchange connected by means of a switchboard with thousands of subscribers throughout the city. There will undoubtedly be such a central distributing receiving station in every city throughout the country just as today there are central telephone offices serving a multitude of people. At the central radiophone office there will be a series of broadcast receivers tuned to various wave-lengths and under careful and constant check. It is entirely possible to use a multi-tuned circuit to receive from several different transmitters simultaneously and this system may be used. In any event, one single reception antenna can be employed for receiving from a good many different stations. With super-power transmitters distributed throughout the world it will become an easy matter for many radio receiving sets to be connected to the same antenna and for each set to receive from some certain broadcasting station. The powers of the receiving set may of course be graduated according to the stations which they are designed to bring in. The outputs of all of the receivers are to be connected to a distributing switchboard and the switchboard in turn is connected to the homes of the various subscribers. In the subscriber's home is located a loud speaker of some sort. Undoubtedly it will be small and unobstrusive and can be decorated to correspond with the furnishings of the house. On the same base as is supplied to support the loud speaker will be found a bracket for a hand telephone. This telephone and the loud speaker will be connected to the distributing switchboard.

Let us visualize a scene in a modern home equipped with such a radio installation of the not distant future. Glancing over a newspaper, it is found that a certain program of great interest to the particular home under discussion is to be broadcast at 7:00 o'clock that evening from Melbourne, Australia. It is then only necessary to pick up the hand telephone placed on the loud speaker stand, and tell the exchange operator that you desire to listen to that particular program beginning at 7:00 o'clock. The operator will make note of it and promptly on time you will hear the transmission from the Melbourne station being reproduced by your loud speaker. All this without any radio apparatus whatsoever in your home and with no trouble to you other than the ordering of the program. Could anything be simpler and more convenient?

Of course, we realize that all this will cost money. Today your telephone costs money. It could not have been developed to its present stage of perfection if a certain tax were not placed upon each and every individual who uses the telephone. So it will be with the radio distributing system of the nature described. A certain toll will be exacted from each subscriber to the system and this toll will pay for the installaton of central distributing stations and for the construction and maintenance of the super-power sta-

tions throughout the world. One company, or a combination of various companies, will finance a system of this type and will carry through the various phases to a successful completion, for the radio entertainment of the future is going to take some such form as this.

It may not do so for another twenty-five or fifty years but some system of this nature is bound to come. It will not mean the death of experimental work in the home nor will it mean the death of the home-made radio receiver. In fact, such a system will give a greater impetus to this work. With radio broadcasting stations operating on high power throughout the world, listening in to any part of the globe will be a comparatively simple matter. Although there are a good many experimenters in this country and in the world who desire to do this, still there are a multitude more who would like to have radio entertainment in their homes but who do not desire to be bothered with the up-keep and care of a radio receiving set. The controlling companies will take care of this phase of the situation and will supply the benefits of radio to those who do not want the troubles incident to maintaining a set.

When such a system as that outlined above comes into general use, it is entirely possible that every owner of a radio receiving set who is not a "line" subscriber will be taxed a nominal amount. Who among you would not be willing to pay a dollar or more a year toward the upkeep of radio broadcasting stations? Up to the present time we are receiving our radio entertainment free of charge, but if it could be improved, would you not be willing to pay a small amount for such improvement? Undoubtedly the installation of super-power stations broadcasting programs by paid artists will give us better entertainment than any that we receive today. So let us look forward to the future of radio broadcasting and toward the betterment of it, and last, but not least, the editors would like to hear your opinion on the future of radiophone broadcasting as here suggested.

A Typical Month at WRNY

By CHARLES D. ISAACSON
Program Director
(*Continued from page* 156)

tic baritone who had just returned from a triumphant tour in South American cities.

On Monday morning, Ruth Conne, adviser of wealthy women in many cities, talked on the trend of fashions; and H. O. Osgood, of *Musical Courier*, about concerts in the forthcoming weeks; and Walter Gueninger, of *Harper's Magazine*, about the best books. WRNY, broadcasting about the only noonhour program, poured forth its entertainment to hundreds of homes, restaurants and radio shops with jazz piano work, singing, etc. With the evening, the Poetry Post brought Baroness Posse, famous writer of Sweden, who told of the literary activities of her own country, and shortly afterwards, Kathryn Behnke, the original "Lullaby Lady" sang many thousands of children to sleep with her lullabies.

On Tuesday the women's clubs of New York broadcast, through their presidents, to thousands of club members throughout the country, as well as to the other women listeners. That afternoon, the Grand Ball Room of The Roosevelt was packed for a dinner given by the Consumptive Jewish Aid Society; WRNY broadcast the music and speeches.

In the evening, Joan Lowell sang ditties of

the sea. She was born on the sea; her mother died while she was a baby, and for fifteen years Miss Lowell never saw a white woman. Her father was captain of a ship which ranged the South Seas. When she came back to America, the stage drew her, and today she is one of the most interesting figures amongst the younger actresses.

On Wednesday evening, Robert William Courtney represented the Protestant Circle. Rock Ferris, former organist at Princeton University chapel, sits at the console before the pipe organ of Temple Emanu-El and WRNY broadcasts its strains through America.

Back in the studio, Ida Nachmanowitz and Max Wellerson played a two-piano recital. Jane Tuttle, contralto, sang, and Josephine Bryant played the harp.

Out of San Antonio came Bernice Hardy, who talks to the children during the Women's Hour. With her is Rose V. S. Berry, the foremost club woman in arts in America, telling the people how to appreciate painting. The next night the Jewish Circle, of which Dr. Isaac Landman is the director, brought Dr. Louis Anspacher, the playwright of "The Unchastened Woman."

You remember the man who offered to put a wrist watch on the Statue of Liberty? He was here and told us all about it.

Ben Bernie, the Maestro, as they call him, down in the Grill Room, conducts his orchestra for the merry dancers, and this music is sent out by WRNY.

On Friday Dr. Harry Finkel spoke on "Diet." Miss Margaret Hayden Rorke appeared in the series of the "Leading Women in Business," which is under the directorship of Miss Marion McCarroll, and Bob MacDonald with his ukelele sang popular songs. In the evening the Jewish Sabbath service was broadcast from Temple Emanu-El. Probably there is no choir quite equal to this, which includes in its membership operatic stars, composers—there are thirty singers, stars of the first rank. The services are extremely beautiful and practically entirely musical—the ritual being chanted by the cantor.

The Czecho-Slovak Novelty Orchestra played exactly as they might in Prague. They even came in costume.

On Tuesday our staff travelled over to the Engineering Society Building and there, in the beautiful auditorium, the Moses Montefiore Society held its annual dance and entertainment; but instead of the usual procedure of broadcasting the artists of the stage, this time we brought the artists of the radio to the stage. We gave the effect of the WRNY studio, and before the audience we introduced the Union City Four, June Lee, Bob McDonald, Hotsy Totsy Boys and Alice Heller. So the week went by.

Dabus, the Mohammedan, chanted the songs of Islam on Sunday; Milton Johnson and his quartette sang the great songs of the Christian church. Dr. Reisner gave another of his interesting sermons; and in the evening, in another splendid Charles D. Isaacson concert was heard Magdeleine Brard, the famous young French pianist, who won first prize at the Paris Conservatory, the highest honor that can be awarded any musician, Grace Divine, American mezzo-Soprano sang, and the program went merrily on to its close.

Monday evening Catherine Cronin read poetry; and then The Royal Aces Orchestra, Ferrucci's Orchestra, Florence Gerringer and Judith Roth all brought popular music. J. Van Cleft Cooper gave another of his musical travelogues; and the Irvine Players presented the second RADIO NEWS prize play, "The Fugitive." Tuesday, again, and Charles A. Vilas spoke on "Law"; Wolfe Kaufman played his musical saw; Katherine McMillan sang and then we enjoyed more of Orlando's Roosevelt Concert Orchestra. Emilio Roxas, Italian musical conductor,

with his artists gave a fine program, while Julian Huarte, one of the greatest living Spanish composers, played his own musical compositions and introduced the Mexican Nightingale, Anita Calberone, and Giovanni Gurreri.

Another theatre company comes after the show—"Not Herbert"—and the leading members of the show put on a program that is unforgettable.

The Allied Theatre Interests hurriedly summoned their leaders to the dinner at The Roosevelt to present to Captain George Fried, of the President Roosevelt, the proceeds of the Hippodrome fund benefit. Over $15,000 was given over to the crew, who, to the last stoker, came to the dinner. Augustus Thomas was toastmaster; Frank Keenon of the Players spoke there, and Thomas Meighan, who is president of the Lambs Club. There was much music. All of this went over WRNY.

A new series of noon organ recitals from the West Side Unitarian Church, in which Frank Stewart Adams, of the Rivoli Theatre, is the organist, have begun. There are now regular Tuesday and Saturday noon organ recitals at WRNY. The Catholic Circle brought John G. Coyle; Clinton Woodbridge Parker spoke on Philosophy and Lorna Lea sang love songs.

Dr. George Walton King began a series called "Life Leads Hour", with a fine inspirational message and much music. Clara Woolworth, electrical expert, told the ladies, at the women's hour, of the opportunities for women in electrical fields.

A new series began at night. Ferruccio Corradetti, who has sung with Caruso, Tetrazzini, and Melba, appeared with some of his artists and gave the high spots of the popular operas such as Rigoletto, Traviata and Carmen.

Sonya Radina sings the songs of the Ukraine; whose music has an appeal not only for those who remember them from their childhood days, but for all people.

Nick Cambourakis, a splendid young violinist, was heard. On this Friday night came an all-Irish program. Think of this—exclusively, through WRNY—William Cosgrave, the President of Ireland, sent his greetings to America. Vice-President Kevin O'Higgins cabled his greetings, as did Lord Glenavy, chairman of the Irish Senate, and the former Lord Mayor O'Neill of Dublin. Cardinal O'Donnell, Archbishop of Armagh and Primate of Ireland John McCormack and many others were in the group. In person came Howard Harrington of Dunlow Castle, Killarney and Lindsay Crawford, Irish representative to America.

Saturday night brought a group of little girls and boys under twelve, associated with the National Stage Children's Association, many of whom have appeared in the White House before the President. There were tiny tots who had to stand on a chair to reach the microphone, broadcasting popular music, and sometimes tragic.

As a special novelty, we introduced Viola Gentry, daring aviatrix, who flew under the East River bridges.

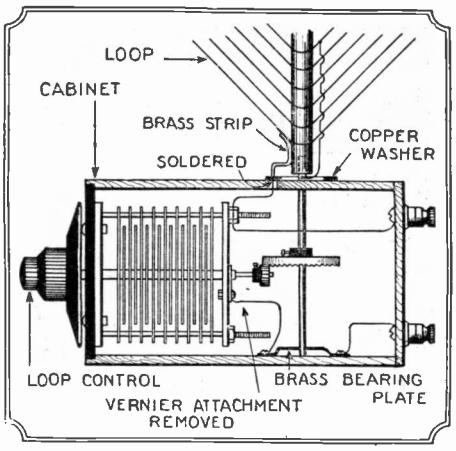
Sunday morning the Knights of Columbus packed the Astor ball room at their Communion Breakfast. Famous Catholics spoke, and WRNY carried the speeches to a great crowd listening in. Down in the Roosevelt foyer, the Cultural Circle met; The Theatre Club over at the Astor. The speeches were broadcast through WRNY.

Edwin S. Friendly, business manager of the Sun, told us about the newspaper world. A real minstrel show went on, with the interlocutor, the end men and all the other belongings and trappings.

Then there was the night that Gregory Kelly, the Duncan sisters and the cast of "The Butter and Egg Man" came over, and so on all through the thirty days.

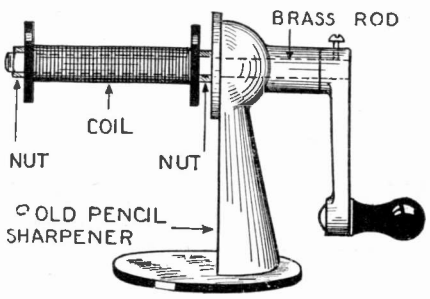
I will see you again next month.

Loop Aerial Unit



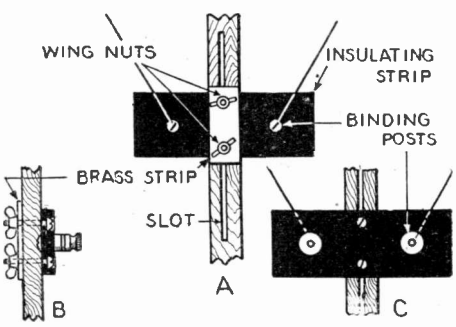
A loop antenna is invariably employed with a parallel condenser and an excellent space saving idea is to incorporate both of these instruments in one compact unit. This is done by employing an old type of variable condenser in which a separate vernier attachment was formerly used. This is removed and a small gear attached to the end of the center shaft. This gear meshes with another one mounted on the loop antenna shaft as shown. One connection to the loop is made through its copper supporting shaft and the other by means of a copper washer mounted on the top of the cabinet and a brass strip acting as a brush. —B. G. Switzer.

Coil Winder



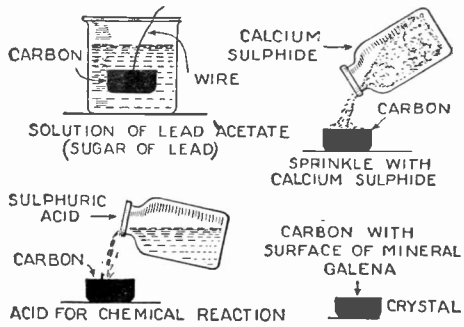
For winding various types of small coils, an old pencil sharpener may be pressed into service. The gears and other "works" of the sharpener are removed and the brass rod inserted in the bearing. Then any type of coil form may be mounted on the brass rod. With a little ingenuity, spider-web and honeycomb types of coils as well as solenoids may be wound on this little machine.—D. Epstein.

Wire Tightener



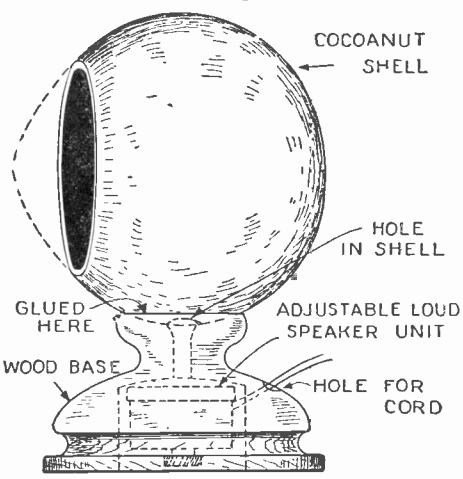
It often happens that the wire used in a loop aerial becomes loose after some period of time and is unsightly. To avoid this defect, the wire tightener illustrated in detail above may be employed. At A is shown a slot cut in the upright of the loop and a bakelite strip fastened to the upright by means of two short bolts and wing nuts. B shows a side view of the assembly and C is a rear view. By loosening the wing nuts and moving the insulating strip downward, and tightening them again the wire may be stretched to any desired degree.—B. Switzer.

Artificial Galena



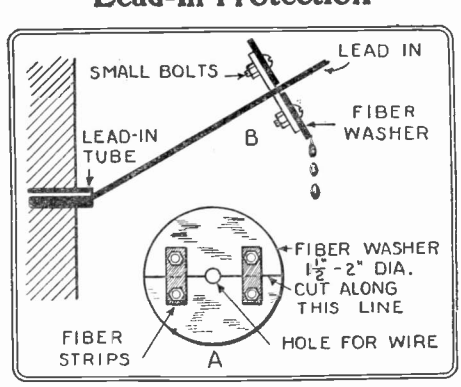
To make a synthetic crystal for use in a radio set, place a piece of carbon in a saturated solution of sugar of lead for several minutes and then sprinkle the surface with calcium sulphide. While this is still moist, add a drop or two of sulphuric acid to the surface and a coating will soon form on the block. Wash the result and allow to dry. It may then be used in a standard crystal detector with a cat whisker contact.—Minnie Stroh, Rep. No. 13171.

Loud Speaker



A decorative type of loud speaker may be easily constructed as shown above. A cocoanut is obtained and the end cut off as shown. The interior contents are removed and the inner surface smoothed and the exterior is also sandpapered. The shell is then mounted on a suitable block in which is incorporated a loud speaker unit of any available type. The entire unit may be stained and polished to suit. —Juan Estolas.

Lead-In Protection



During the rain, water often runs down the lead-in and enters the house through the bushing. This can be prevented by the method shown above. A fibre washer is drilled in the center with a small hole that will snugly fit the lead-in wire. The washer is then split, placed around the wire as at B and held in place by means of two short fibre strips and four small bolts as at A.—C. A. Oldroyd, Rep. No. 4433.

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The Radio Constructor

By WILLIAM A. VOORHEES

(*Continued from page* 159)

1,000 ohms, in series with the grid leads as indicated by X1 and X2 in Fig. 1. Placing these resistances in circuit and carefully adjusting them will usually suppress all oscillations of the R. F. circuit. If these resistances are employed, the neutralization condensers CN are not necessary and should be removed from the circuit.

With a receiver of this type it is seldom necessary to use the second stage of audio frequency amplification except on "DX" stations. However, when this second stage is employed, it will often be found of advantage to connect a fixed condenser C6 across the secondary of the second audio frequency amplifying transformer. This should have a capacity of .0005 mf.

STATEMENT OF OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

Of SCIENCE AND INVENTION, published monthly, at New York, N. Y., for April 1, 1926.

State of New York } ss.
County of New York }

Before me, a notary public, in and for the State and county aforesaid, personally appeared Hugo Gernsback, who, having been duly sworn according to law, deposes and says that he is the editor of SCIENCE AND INVENTION, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the name and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, The Experimenter Publishing Co., Inc., 53 Park Place, New York, N. Y.

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Managing Editor, H. Winfield Secor, 53 Park Place, New York, N. Y.

Business Manager, R. W. Demott, 53 Park Place, New York, N. Y.

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HUGO GERNSBACK.
Editor and Publisher.

[SEAL] Sworn to and subscribed before me this 26th day of March, 1926.

JOSEPH H. KRAUS.
Notary Public.

Notary Public, Queens County Register's No. 4523; New York County Register's No. 7364; New York County Clerk's No. 481. My Commission expires March 30, 1927.

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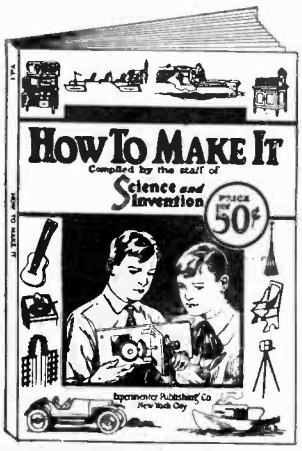

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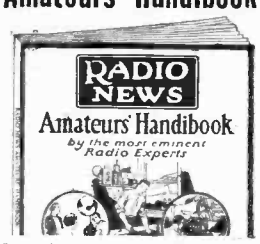

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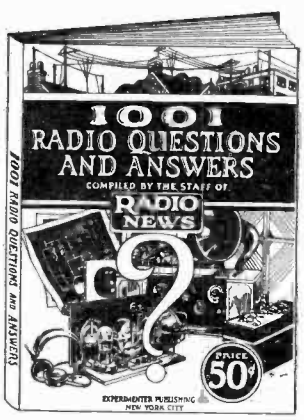

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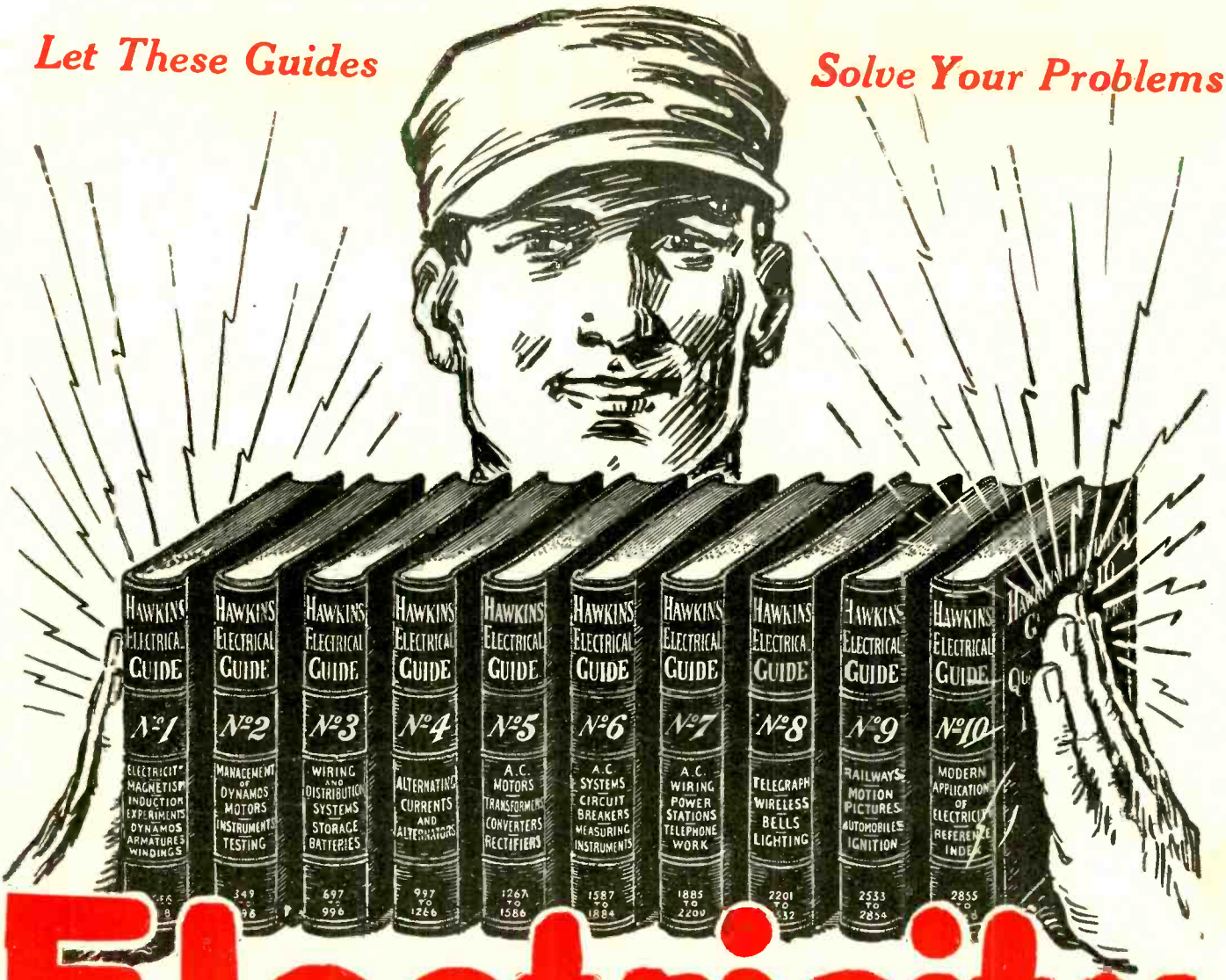

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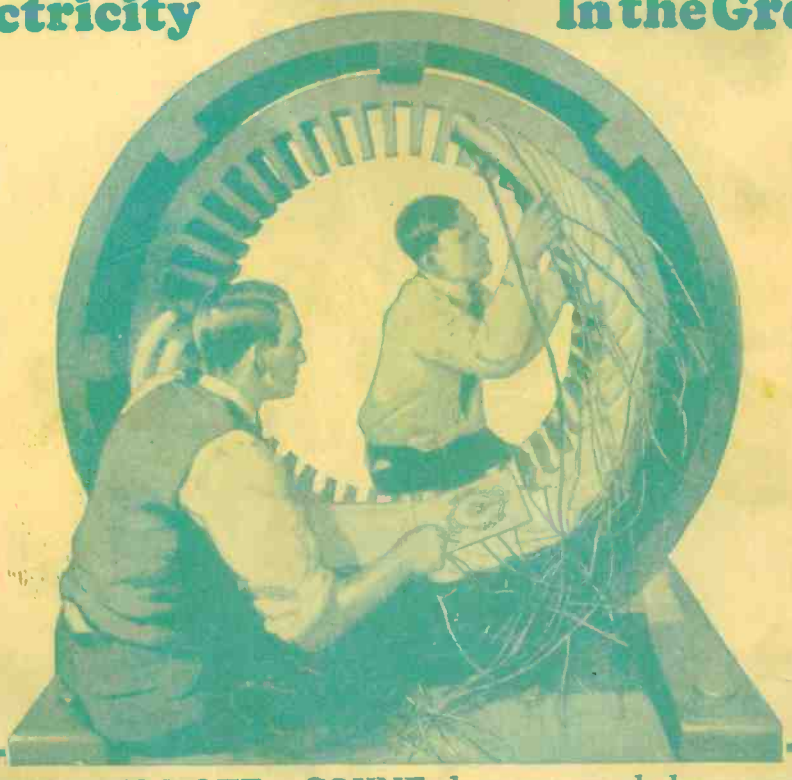

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