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Science and Invention

SEPTEMBER
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IN OCTOBER ISSUE

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A well-known authority will discuss the pro and con of the subject, and everyone should read this article without fail.

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The human body is compared anatomically to the modern automobile engine, with surprising similarities and conclusions.

How Do Geysers Work?

This article explains how the wonderful geysers operate by the forces of Nature, and explains how an artificial geyser can be built.

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HOW TO SUBSCRIBE FOR "SCIENCE AND INVENTION." Send your name, address and remittance to Experimenter Publishing Co., 230 Fifth Ave., New York City. Checks and money orders should be made payable to Experimenter Publishing Co., Inc. Mention magazine desired, inasmuch as we also publish RADIO NEWS, AMAZING STORIES, RADIO LISTENERS' GUIDE, and TIDBITS, a bi-monthly. 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. ON EXPIRATION of your subscription we enclose a renewal blank in our last number to you, and notify you by mail. Then, unless we receive your order and remittance of a renewal, delivery of the magazine is stopped.

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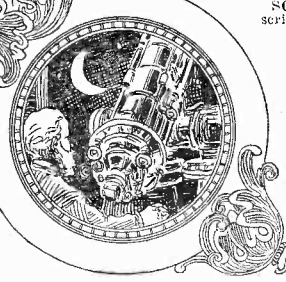
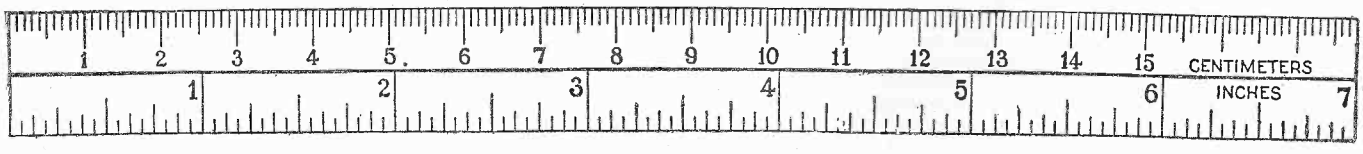
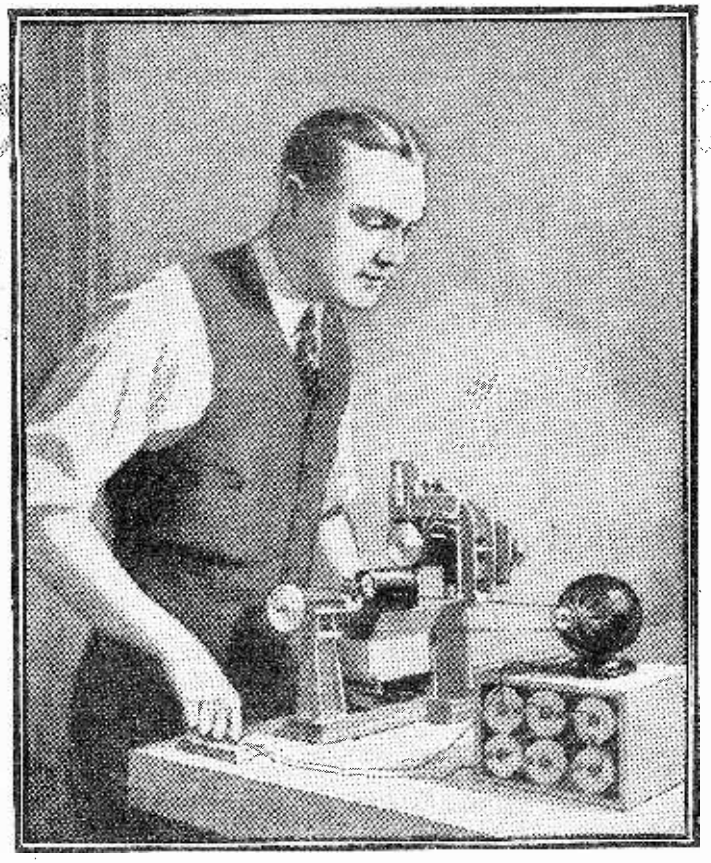


A HANDY RULE FOR YOU





When you build a working model

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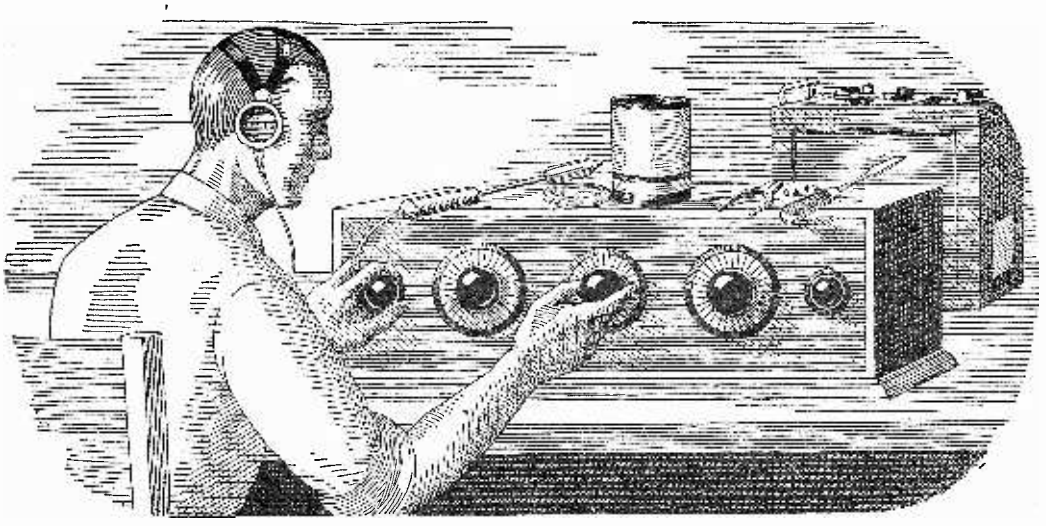

If all the Radio sets I've "fooled" with in my time were piled on top of each other, they'd reach about halfway to Mars. The trouble with me was that I thought I knew so much about Radio that I really didn't know the first thing. I thought Radio was a plaything—that was all I could see in it for me.

I Thought Radio Was a Plaything

But Now My Eyes Are Opened, And I'm Making Over $100 a Week!

$50 a week! Man alive, just one year ago a salary that big would have been the height of my ambition.

Twelve months ago I was scrimping along on starvation wages, just barely making both ends meet. It was the same old story—a little job, a salary just as small as the job, while I myself had been dragging along in the rut so long I couldn't see over the sides.

If you'd told me a year ago that in twelve months' time I would be making $100 and more every week in the Radio business—whew! I know I'd have thought you were crazy. But that's the sort of money I'm pulling down right now—and in the future I expect even more. Why only today—

But I'm getting ahead of my story. I was hard up a year ago because I was kidding myself, that's all—not because I had to be. I could have been holding then the same sort of job I'm holding now, if I'd only been wise to myself. If you've fooled around with Radio, but never thought of it as a serious business, maybe you're in just the same boat I was. If so, you'll want to read how my eyes were opened for me.

When broadcasting first became the rage, several years ago, I first began my dabbling with the new art of Radio. I was "nuts" about the subject, like many thousands of other fellows all over the country. And no wonder! There's a fascination—something that grabs hold of a fellow—about twirling a little knob and suddenly listening to a voice speaking a thousand miles away. Twirling it a little more and listening to the mysterious dots and dashes of steamers far at sea. Even today I get a thrill from this strange force. In those days, many times I stayed up almost the whole night trying for DX. Many times I missed supper because I couldn't be dragged away from the latest circuit I was trying out.

I never seemed to get very far with it, though. I used to read the Radio magazines and occasionally a Radio book, but I never understood the subject very clearly, and lots of things I didn't see through at all.

So, up to a year ago, I was just a dabbler—I thought Radio was a plaything. I never realized what an enormous fast-growing industry Radio had come to be—employing thousands and thousands of trained men. I usually stayed home in the evenings after work, because I didn't make enough money to go out very much. And generally during the evening I'd tinker a little with Radio—a set of my own or some friend's. I even made a little spare change this way, which helped a lot, but I didn't know enough to go very far with such work.

And as for the idea that a splendid Radio job might be mine, if I made a little effort to prepare for it—such an idea never entered my mind. When a friend suggested it to me one year ago, I laughed at him.

"You're kidding me," I said.

"I'm not," he replied. "Take a look at this ad."

He pointed to a page ad in a magazine, an advertisement I's seen many times but just passed up without thinking, never dreaming it applied to me. This time I read the ad carefully. It told of many big opportunities for trained men to succeed in the great new Radio field. With the advertisement was a coupon offering a big free book full of information. I sent the coupon in, and in a few days received a handsome 64-page book, printed in two colors, telling all about the opportunities in the Radio field and how a man can prepare quickly and easily at home to take advantage of these opportunities. Well, it was a revelation to me. I read the book carefully, and when I finished it I made my decision.

What's happened in the twelve months since that day, as I've already told you, seems almost like a dream to me now. For ten of those twelve months, I've had a Radio business of my own. At first, of course, I started it as a little proposition on the side, under the guidance of the National Radio Institute, the outfit that gave me my Radio training. It wasn't long before I was getting so much to do in the Radio line that I quit my measly little clerical job, and devoted my full time to my Radio business.

Since that time I've gone right on up, always under the watchful guidance of my friends at the National Radio Institute. They would have given me just as much help, too, if I had wanted to follow some other line of Radio besides building my own retail business—such as broadcasting, manufacturing, experimenting, sea operating, or any one of the score of lines they prepare you for. And to think that until that day I sent for their eye-opening book, I'd been wailing "I never had a chance!"

Now I'm making, as I told you before, over $100 a week. And I know the future holds even more, for Radio is one of the most progressive, fastest-growing businesses in the world today. And it's work that I like—work a man can get interested in.

Here's a real tip. You may not be as bad off as I was. But think it over—are you satisfied? Are you making enough money, at work that you like? Would you sign a contract to stay where you are now for the next ten years—making the same money? If not, you'd better be doing something about it instead of drifting.

This new Radio game is a live-wire field of golden rewards. The work, in any of the 20 different lines of Radio, is fascinating, absorbing, well paid. The National Radio Institute—oldest and largest Radio home-study school in the world—will train you inexpensively in your own home to know Radio from A to Z and to increase your earnings in the Radio field.

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Science and Invention

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No. 5

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

ROCKET FLYING

By HUGO GERNSBACK

A NUMBER of years ago, to be precise, in 1919, Prof. Robert H. Goddard of Clark University startled the world by his researches made with rockets propelled in a vacuum. Prof. Goddard planned to send rockets into the upper atmosphere for meteorological scientific research data. He also proposed to send a rocket to the moon, the rocket to set off a magnesium flare, which would be seen from the earth, proving that the rocket landed on our satellite.

Prof. Goddard was not taken seriously in many quarters, but since that time, a good deal of research work has been done, and now it would seem, that rocket flying is about to be used for practical purposes.

The experiments recently made in Germany, whereby von Opel used a rocket propelled automobile, tend to show that engineers are now taking the rocket principle most seriously. Von Opel's rocket propelled car, on a racetrack, obtained the marvelous velocity of 62 miles an hour within two seconds after the start. Later, a similar car was tested on rails, when the car attained a speed of 160 miles an hour, which is faster than any vehicle ever traveled on rails heretofore. During this particular experiment, the car was wrecked, because it left the rails despite the fact that deflectors, similar to airplane wings were used to keep the car on the tracks. But at any rate, the rocket principle has proven its worth, and it seems only a short time away when it will be used as a propellant, particularly for aircraft.

Much has yet to be learned, particularly as to the best kind of agent which furnishes the explosive force used to propel the machine, but this is one of many minor details, which will be developed, once the principle has proven itself correct.

As is well known, the usual rocket uses a mixture of black powder and other chemicals, and the reaction during firing lifts the rocket up into the air. As soon as the powder has burned itself out, the rocket comes down to earth, so the problem from the engineering standpoint is, to have enough rockets to explode or enough fuel constantly fed to one rocket to keep the machine, whether automobile, airplane or space flyer, going indefinitely.

Years ago, I conceived the idea of a dynamite motor, the idea being to explode small charges of dynamite in a cylinder by feeding cartridges on a belt through a special device. The ensuing gases were then expelled to propel the machine. Unfortunately, the crude experiment soon came to a close, because the engine blew up; fortunately, without hurting myself and my co-experimenters. But I see no reason why, with proper safeguards, such a propellant could not be used, working on the rocket principle.

Dynamite is a fairly safe substance to handle, if it is used in the correct manner, and its propellant force, as compared with black powder, is inordinately greater. This is because the amount of gas liberated by dynamite is 3 times that of black powder, such as is used in rockets. There may, of course, be found other fuels that can be used for rocket propulsion, because there are many more powerful explosives than dynamite known to science today. The idea of using such powerful explosives may at first appear fantastic, but no more fantastic than exploding gasoline and air mixture in the present day motor car. The difference between the explosive force of gasoline and air mixture and nitroglycerine, for instance, is only a matter of degree and speed of concussion. It all comes down to handling the fuel in a safe manner. While vastly inferior to dynamite as an explosive basis, gasoline is used today only because its liquid form gives a comparatively simple way of handling, which is not the case with dynamite, and liquid nitroglycerine would be too dangerous.

On the other hand, it should be remembered that a gasoline and air mixture is exploded in a cylinder, which then operates a piston by pushing it outward. The rocket relies upon an entirely different principle. It uses no pistons; no connecting rods; no transmission gears, it is simply a cannon without projectile in miniature. Everybody who has used a gun, particularly of the old variety, has noted the tremendous kick such a gun can give. Those who have seen one of our disappearing Coast Guard guns, where the recoil of the gun automatically makes the gun disappear behind the fortification, knows what a tremendous power the recoil can develop. This is a duplicate of the rocket principle employed in the German rocket propelled car. This particular car had a body and four wheels, minus an engine of any kind. In the rear, there was an arrangement whereby twenty-four rockets were fired, one after another, successively, by means of an electrical firing device. After all the rockets were fired, the car had to come to a stop when its momentum was expended.

The principal trouble with the present day rocket system is that it takes a tremendous amount of powder fuel to drive a car or an airplane by means of rockets. Practically all of the load that can be moved or lifted is constituted by the rockets themselves, but as I have said, this seems not unsurmountable, because with better fuel, this may be overcome.

One other important objection, at least at present, to the rocket propelled machine is its tremendous rate of acceleration. Von Opel's car attained a speed of one mile a minute within two seconds after the start. This is a terrific strain on the physique of the driver, because he is pressed back against his seat with a crushing force that takes his breath away. In the last experiment, von Opel was afraid to personally undergo the experiment, due to this tremendous acceleration, and the only passenger in the car was a live cat. When the crash came, the cat lost its life, so it could not be ascertained whether it was killed by the acceleration of the car or by accident.

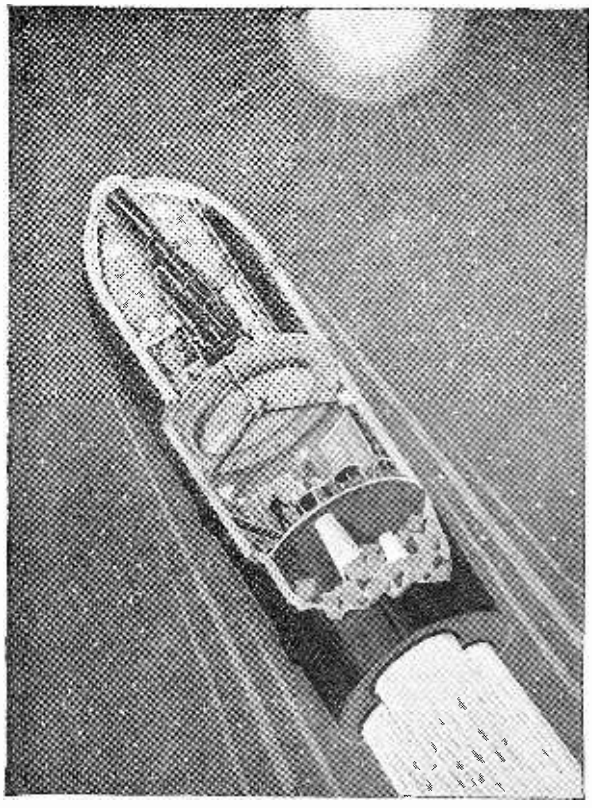
But of course, these are only the minor troubles of the new art. Once we understand the rocket principle better, and after sufficient refinements have been made, the problem of gradual acceleration of the rocket propelled machine will be overcome. It should be remembered that it is only the acceleration at the start, and the deceleration at the end that is of grave importance. If the acceleration is gradual, a human being would have no difficulty in flying at the rate of even 50,000 miles an hour, but if no precautions were taken at the start, and at the finish; and if the acceleration or deceleration were too fast or too sudden, the occupants of the machine would be crushed to death by their own mass.

Another disadvantage of the present day rocket craft which will be overcome speedily is the tremendous amount of smoke produced by the burning gases of the rockets. In the recent German experiment, it was almost impossible to see the car on account of this dense smoke. This, however, is only a minor detail and does not unduly worry the engineers. Those old enough, probably remember the first automobiles, (which were not equipped with mufflers) and the tremendous amount of noise that they made at that time. Give the engineers time enough, and they will solve these little problems speedily.

In any event, the rocket principle holds a great future, because it is the only engine that we know today by which it will be possible to fly through space at a tremendous speed. During the next twenty years, it will be possible to fly from New York to Berlin in two or three hours, and the only way that will be accomplished will be by rocket propelled flyers.

From the Earth to the

The Problem of Interplanetary Navigation



At the left is an illustration of the rocket car intended for interplanetary flying. It is divided into three compartments, the upper of which contains a telescope and oxygen producing apparatus, the middle compartment contains an electric motor and disintegration chambers, the rear compartment contains the ejection cones.

SHADES of Jules Verne! A space flyer propelled by rockets attains a tremendous speed and solves the problem of inter-planetary navigation (?) The rocket car has proved feasible and attained the surprising speed of nearly three miles per minute on tracks. Further developments are being made by an aviation company in Germany, which is now building the first

IF interplanetary voyages are realized some time in the future, it will be in a vehicle far more developed than the projectile-car fired from a cannon 300 meters in length, which Jule Verne brings into his famous voyage, "From the Earth to the Moon."

These voyages across the heavens, several learned spirits and very serious ones, have had no fear in prophesying. Captain Ferber bases his view on the opinion of Mr. H. G. Wells, Rev. Archdeacon, Quinton, and M. Esnault-Pelterie, to predict the fatal exodus of humanity, which had attained a civilization far superior to ours, and who quitted the exhausted earth in search of more interesting planets.

If we wish to follow these amusing but scientific dreams they will lead us straight to special problems, which are very curious and which present some practical interest, because they touch upon almost all the branches of natural science. It follows that astronautic science (this is the epithet with which Mr. J. H. Rosny has endowed the future interplanetary navigation) can bring before us a whole series of investigations theoretical or practical, and extremely serious.

TRUE CONDITIONS FOR AN INTERPLANETARY CANNON SHOT

THE ballisticians, for example, can take up again the problem of the projectile vehicle and correct the calculations of Jules Verne, which were manifestly insufficient.

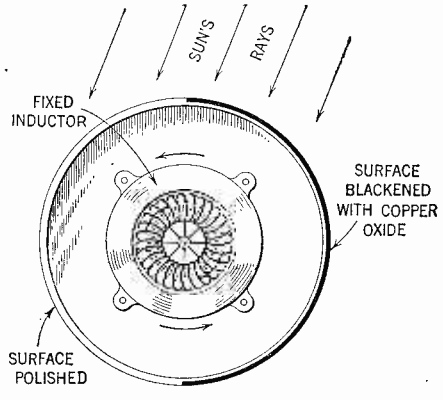
After having shown, without difficulty, that the necessary velocity to enable a projectile to escape definitely from the earth's influence could not be given by any cannon, even if it were 300 meters long, and that there is no way of cushioning the shot within the projectile, at the moment that the discharge takes place, the ballisticians are naturally brought face to face with the real conditions of the problem, and there arises an interesting theoretical discussion in which the most eminent artillerists are not in accord as yet with each other.

The projectile would receive, in any case, on leaving the mouth of the gun, a second shock, coming from the resistance of the air, so that the traveler already driven down against the base of the shell, would be driven back against its head section a second time. Finally, the heat due to the adiabatic compression of the air in front of the projectile would soon make it volatilize. The object of theoretical controversies are the determination of the critical moments when such accidents would be produced, whose practical interest is recalled to us by the too celebrated Big Bertha. In a word, in reference to the projectile car labeled "Earth - Moon," we are always face to face with this question: what is the longest range which can be realized by the methods of present artillery or by that which may be conceived in the future?

FROM JULES VERNE'S CANNON TO THE REACTION MOTOR

BUT the real problem, and the only important one in the matter of astronautics is not there. It abides in the simple formula, can we make motors of any power we wish indefinitely?

If we can indefinitely increase the power of a motor of limited weight (and by motor I mean the machine supplied with its combustible), then there is no doubt that astronautics is not a Utopia. It would be possible on some day, more or less remote, to leave the earth. It will be enough, using such a motor, to keep constant for several hours the acceleration of any vehicle, so as to attain a certain "critical velocity," which, directed toward the zenith, will bring us outside of the zone of attraction of the earth. At this moment the heavens belong to the travelers. They were conquered by the velocity the machine has developed.



The rotation stabilizer is illustrated above. To control rotation around its axis the projectile would be fitted with an electric motor placed on its side, on the floor of the rocket.

THE SPEED LIMIT REQUIRED

WE now come to the essential point of the problem, the astronomical point of view. Let us then determine what is this "critical velocity" capable of overcoming gravity. It is quite simple to understand its nature, and to verify mathematically its dimensions, if we only keep in mind this theorem of celestial mechanics: "A body coming from the infinite and falling on any planet whatever reaches such planet with a velocity which is finite."

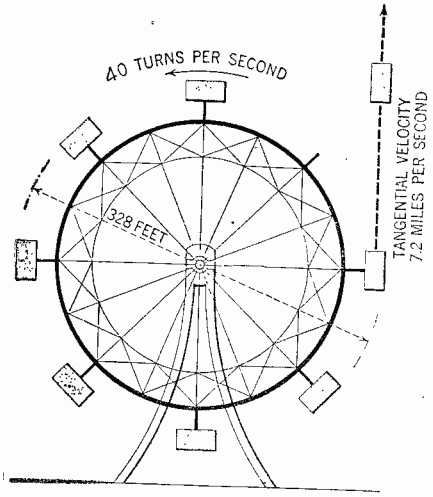
It is well to insist on this, because many educated people are encountered who have no scientific education and who think: "The greater the height from which one falls, the greater is the velocity with which one reaches the ground. If then, a body left the heights of the heavens and fell without meeting any obstacle upon the earth, it would reach there with a velocity of several millions of kilometers per second, perhaps faster than the speed of light—which would contradict very nicely Mr. Einstein."

To this simple idea the theory of gravity potentials gives us definite denial: No! Such a projectile in free falling would never reach the earth at any other speed than 11,180 meters per second. This is not very great, if we realize that some nebulæ go at the rate of 600 meters per second, and that the earth in its orbit far exceeds these few 11 kilometers, which would be enough to leave it.

Now you will have perceived that the reciprocal is true: For, if in leaving the infinite, the earth is reached at 11,180 meter-seconds only, it would suffice to reacquire this velocity in the opposite sense to return to the infinite, whence theoretically you have departed.

PASSING FROM TERRESTRIAL TO LUNAR GRAVITATION

ALL this is precise, but if one is not going to the infinite of space, if one desires only to reach the moon, a far less velocity will suffice.



The theoretical turbine, which has to be developed for sending a vehicle from the earth to the moon, is illustrated above. Before the necessary velocity will be reached, however, the wheel would burst.

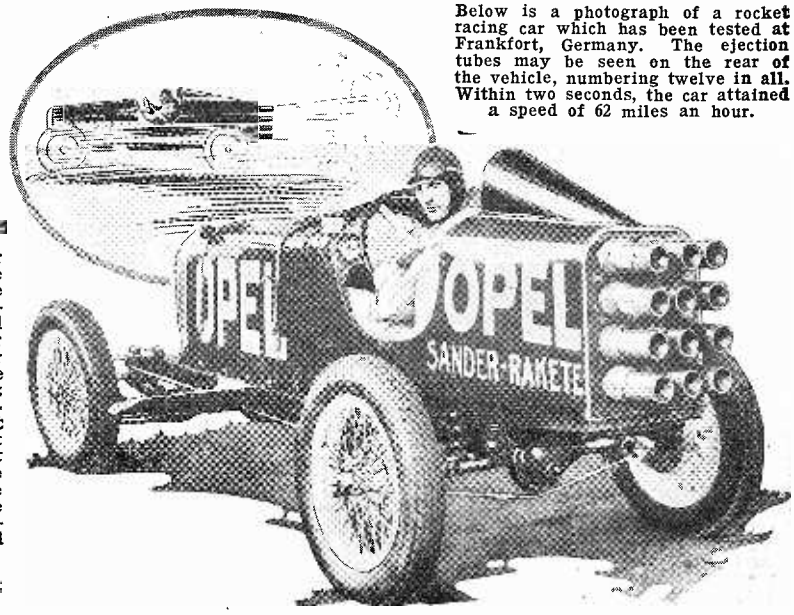
Moon via Rocket

Is of Real Scientific Interest

Suppose one manages to impart to a vehicle of the weight of a ton, an acceleration only one-tenth that of terrestrial gravity (in other words, if you succeed in applying to it a constant force of 1,100 kilograms), this vehicle will acquire an ascension so greatly accelerated, that at a distance of 5,780 meters, its speed will have risen to 8,180 meters per second. This result will have been obtained in twenty-four minutes and nine seconds and will be enough in itself, so that the propelling force can be shut off. The voyage will continue by the velocity acquired (inertia).

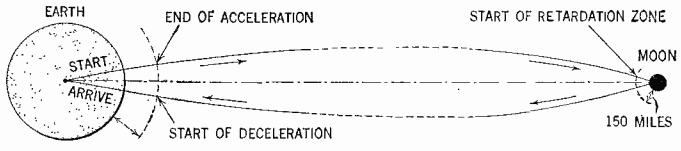
rocket planes, which may revolutionize aviation. At a conservative estimate, these planes will attain a speed of more than 350 miles an hour. If we could but utilize the partial intra-molecular energy of radium, or the total intra-molecular energy of disintegrated matter, we would undoubtedly be able to construct a rocket attaining unheard of velocities.

Nevertheless, the terrestrial weight will play a part, acting as a brake. The velocity will then diminish, but at that it will be 2,300 meters when the vehicle reaches the zone of equal attraction, separating the respective domains of terrestrial gravity and lunar gravity. This last now coming into play will appear in a new positive acceleration, and the velocity will rise to 3,060 meters. At this instant the vehicle will reach the lunar surface. This would be a "lunar collision," absolutely annihilating. It then is necessary to have a parachute. This parachute, in the absence of all atmosphere, would be useless, and in any case even in an atmosphere would be quite inefficacious, so the motor would have to be called upon at the proper moment to operate against the acquired velocity. This would be nothing difficult for it, if by a positive acceleration maintained for twenty-four minutes and nine seconds it could overcome terrestrial gravity, the same motor *a fortiori* could oppose the lunar attraction which is seven times less intense. The braking action would only need to last three minutes and forty-six seconds, and it would be sufficient to start the operation only two hundred and fifty kilometers before reaching the moon.

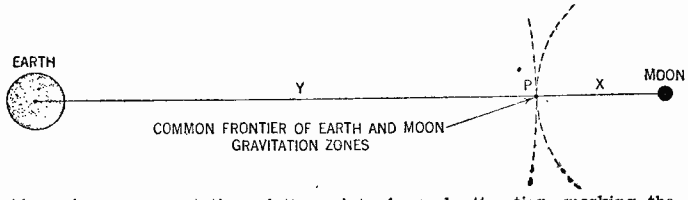


Below is a photograph of a rocket racing car which has been tested at Frankfort, Germany. The ejection tubes may be seen on the rear of the vehicle, numbering twelve in all. Within two seconds, the car attained a speed of 62 miles an hour.

Twenty - four rockets were carried in the car, which eventually attained a speed of over two miles per minute. The owner, Fritz Von Opel, predicted that within a short time, a flight around the earth would be made in twelve hours by an airplane propelled with rockets.

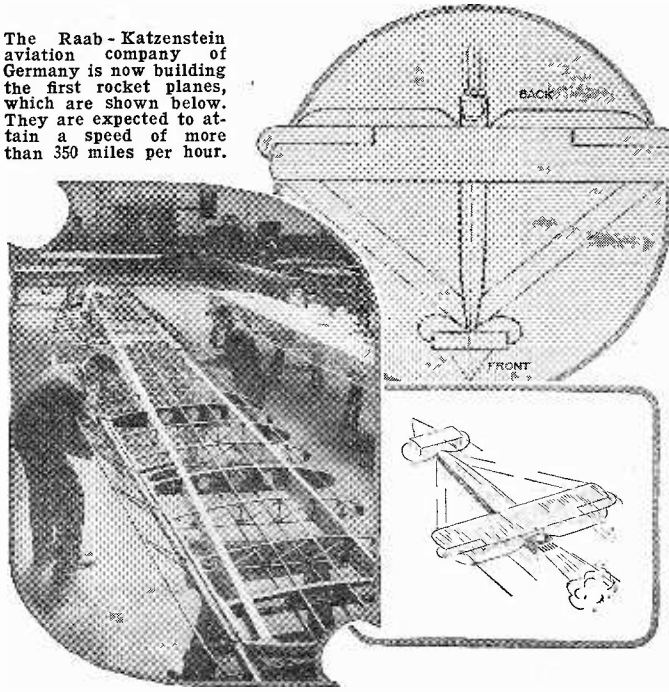


The mean distance from the earth to the moon is 30 terrestrial diameters. The atmosphere of the earth, however, offers an obstacle. The various paths for the trip to the moon are shown above.



Above is a representation of the point of equal attraction, marking the common frontier between the respective fields of gravitation of the earth and the moon, if the two were alone in space.

The Raab - Katzenstein aviation company of Germany is now building the first rocket planes, which are shown below. They are expected to attain a speed of more than 350 miles per hour.



THE REACTION MOTOR, ITS FORMS AND RELATIONS WITH THE ATMOSPHERE

IT is now time to examine if there is a motor in existence capable of such power, or if it can exist, and what kind it would be.

It exists exactly represented (naturally of reduced power) in the modest fireworks, as in rockets and pin wheels.

Such are reaction motors and indeed the reaction motors *par excellence*.

The rocket does not act by pushing against the air, as so many people believe by mistaken intuition; it progresses in the manner of a machine gun, which mounted on wheels on a perfectly smooth surface, such as a frozen lake, will constantly recoil if it burns up its cartridges in sufficient amount to maintain the recoil motion. Recoil, which is a great trouble for artillerists, is precisely the reaction effect which drives the rocket. This it is which M. Robert-Pelterie specially studied with a view of carrying out interplanetary travel.

The work of Mr. Esnault-Pelterie covers all possible hypothesis relating to existing explosives, and its calculation covers all forms of the theoretical rocket.

There are certainly rockets and rockets.

Let us construct a cylindrical rocket exactly like those we find in commerce, its orifice for the escape of gases is unchanged over its entire course. Calculation shows that this form of rocket, independent of the explosive employed and of whether it works in the air or in a vacuum, is the best form for raising to the greatest possible height, a certain dead weight calculated for it in advance. The same form is also adapted to raise to a certain height, the largest useful load, but that does not say that a cylindrical rocket is best for interplanetary travel.

For the rocket, as for the projectile-car of Jules Verne, the atmospheric layer gives a difficult road. If the velocity of any projectile exceeds for instance, a certain amount, the heat due to the resistance of air on its face rapidly raises the temperature of the projectile itself.

As long as the rocket is passing through terrestrial atmosphere, it will have to be kept below a certain velocity. This is somewhat annoying. After having done everything to acquire velocity, we have now to sacrifice it!

And this is what aggravates the matter. The density of the air does not enter into the heating question, which is contrary to what we might believe. To put it otherwise in rarefied air, at very high altitudes the projectile will be heated on the average as much as on lower altitude. This is the result of accurate theoretical calculations. Therefore, the obstacle of heating by the resistance of the air is prolonged far above that which we might believe.

On the other hand, at the extreme limit of the atmosphere, the projectile will attain

(*Continued on page* 440)

Thought Transference?

Some Experiments on the Exchange of Ideas

By BARON MANFRED VON ARDENNE

Fig. 4. The illustration above shows the general arrangement of the apparatus used in the laboratory experiments. In these experiments not the slightest high frequency field could be detected by the intensifier.

BASED on the fact that in the case of some individuals especially adapted therefor, transmission of thought is possible, even if the two participators are not in the one room, we can conclude that for thought-transmission we have to deal with a process that works with a specific band of electro-magnetic waves. The fact that scientific experiments in the transmission of thought seldom are carried on at a greater distance than fifteen meters, the suspicion is created that in thought transmission the brain, like a little broadcasting set, sends out a weak high-frequency field, that is received by a proper receiver. In these well-known relations we are strongly impelled to consider the high-frequency field that seems to result from thinking as an electric phenomenon, and the result of this field strengthened by a vacuum tube may be taken as affecting a second brain as the receiver. In Fig. 1, an experiment is shown which in the laboratory of the author was carried out with the intensifier described beblow, but which gave negative results. For the same thought to be produced in the second brain it is necessary that the intensifier should intensify the great range of mixed frequencies with uniformity, which were due to the enormous complexity of thought. For carrying out such experiments the so-called aperiodic intensifier is needed, not tuned to a limited frequency yet not out of tune, which as a resistance intensifier today can be built for waves of 150 meters and less with proportionately high intensifying power (Lowe Mehrfachrohre 2 HF). If it were possible to intensify the mixture of frequencies corresponding to a thought and to transmit them to a second brain, then we could imagine that the second brain is forced to think the same things which were in the brain of the first subject. By regulating the degree of intensification it were then perhaps possible to introduce the intensity of the thought into the second brain. By using a little imagination, which certainly has definite foundations, we could believe that for hearing the thoughts of another person a slight intensification is necessary, so that the real thought will not be completely suppressed. Taking it in the reverse sense, one can have a higher degree of intensification if one wishes to receive the thoughts and feelings of another person with equal or higher concentration than were either thought or felt in the first brain. Such experiments with very high degree of intensification can be extremely dangerous for it is very probable that the man concerned, just as under natural conditions, would be made mentally ill under the influence of too intensive thought or sensation. If we once succeeded in intensifying the process of thought transmission, in such a way by the operation of electricity, so that in listening to thoughts we would not be restricted to people especially susceptible thereto, but that every man would be in a condition to receive them, there would result for private life and for criminalism unforseeable possibilities. In the conduct of mass manufacturing the thought process, by which the action of the various muscles is controlled, can be determined automatically by a pre-thinker ("Vordenker"). The work would then follow in a sort of trance-condition. The expenditure of energy, especially through the thought process, would in this case be the same, but the automatic workman after the termination of the working time, when the apparatus is switched off, would awake to conscious life. By the use of a lower grade of intensification, which is conceivable in such a case, his own thoughts would be concerned with various other things, while the thought, producing the direction of the work, would be transmitted by electricity. A special importance would follow the solution of this problem for instructional purposes. In this way it might be possible for posterity to take possession directly of the knowledge developed in the experience of mankind, so that the development of men would be hastened. In this way it would be possible to cultivate and utilize the fallow land in the brain which represents the almost unlimited power of absorption of the mind. Unfortunately, on account of the individual oscillation of the intensifier, which then would operate, it is not possible to increase the concentration of one's own brain thereby, so that one can develop the intensifying field for himself. The few practical experiences as indicated of an electric apparatus for thought transmission will suffice to make known the importance of this problem.

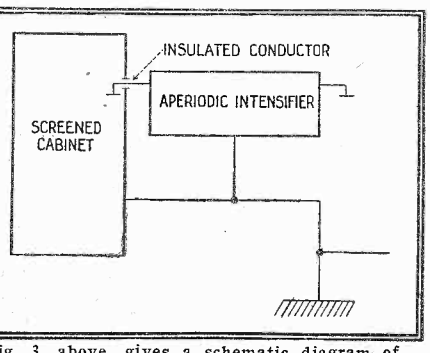


Fig. 3, above, gives a schematic diagram of the hook-up of the apparatus.

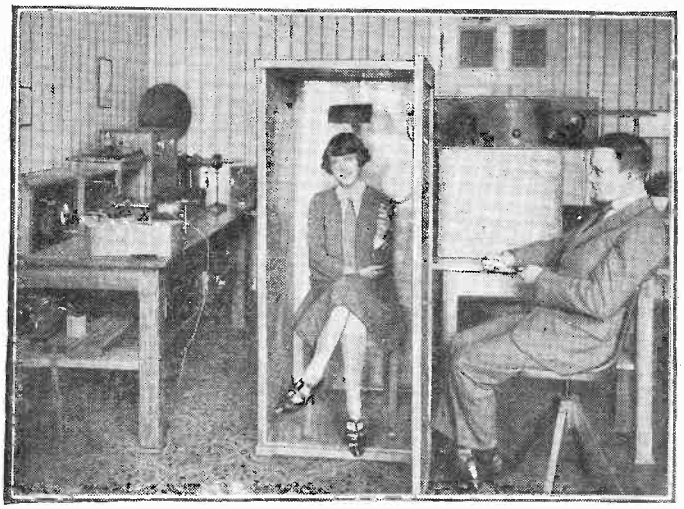
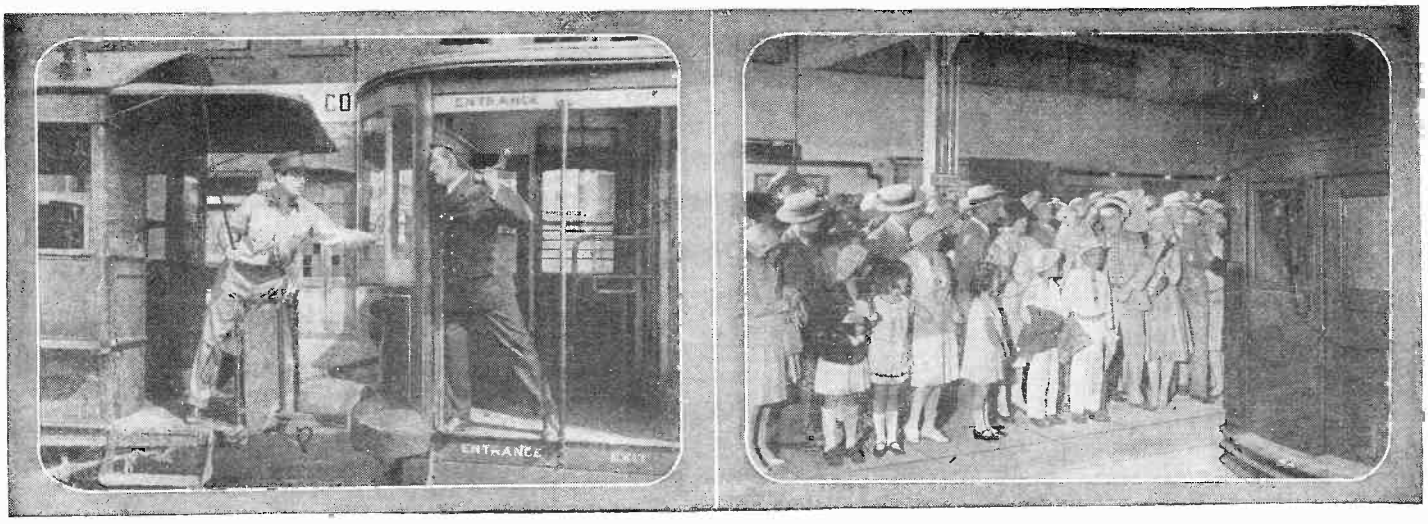


Fig. 1. The photograph at the left shows an experiment being tried out in the author's laboratory with an intensifier. Negative results were obtained, however, and thought transference was not accomplished.

Fig. 2. The shielding box or screen cabinet in which the subject was placed.

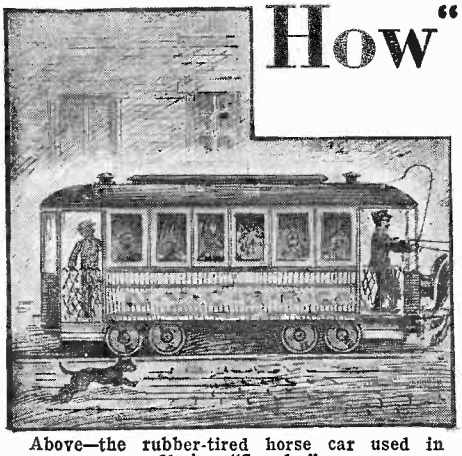
Unfortunately, up to the present time it has been impossible to indicate any electric field produced by thought. The proof of electric fields produced by muscular action presents no difficulty, as various experiments

(Continued on page 459)

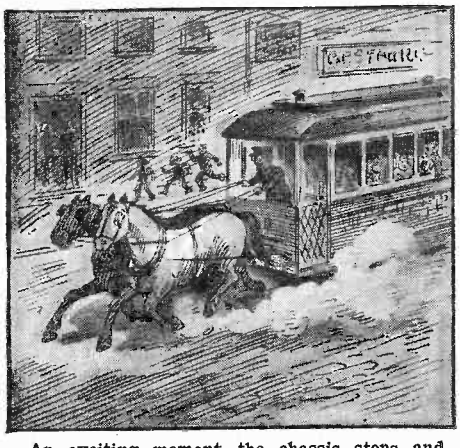


How "Speedy" was Filmed

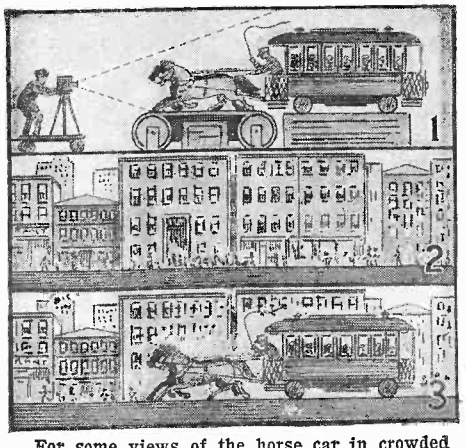
By EDWIN SCHALLERT



Above—the rubber-tired horse car used in filming "Speedy."



An exciting moment—the chassis stops and car frame continues onward.



For some views of the horse car in crowded traffic double printing was used.

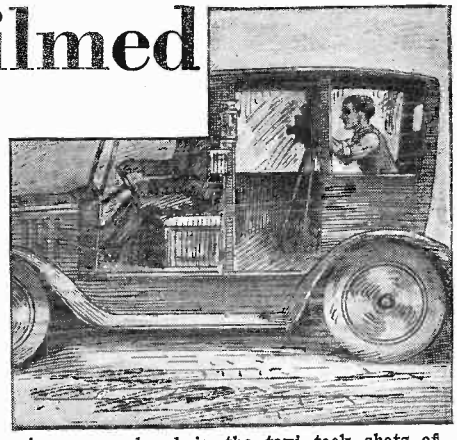
HOW to make a movie comedy in the midst of humming metropolitan traffic is demonstrated in Harold Lloyd's motion picture, "Speedy," with scenes actually photographed in New York City. This film portrays one of the most exciting races ever shown on the screen, when the star is seen driving an old-fashioned horsecar at breakneck speed through crowded streets and across busy intersections in an effort to safeguard a franchise. Trick photography was used for certain effects, but the film is unusual in that many of the stunts were performed against the actual background of the eastern metropolis. This was also particularly true of a taxicab sequence in which Lloyd is shown driving Babe Ruth to the Yankee Stadium at wild speed, apparently risking collision.

Much of the work on the picture was done on Sundays and during the quieter hours of the day. Various subterfuges were used to fool the onlookers, especially when Lloyd himself was appearing before the camera. For example, a number of scenes in the picture were shot at Coney Island, and to prevent the star from being surrounded by a mob of people, it was necessary to conceal the camera in a moving van. Lloyd himself remained hidden until preparations for photographing the scene were completed, and then at a given signal, such as dropping a handkerchief, came forth and mingled with the crowd. Before a sufficient number of people had recognized him to form a circle around him, the scene was finished, and he was able to retire into his hiding place, until it was time for another episode in the picture.

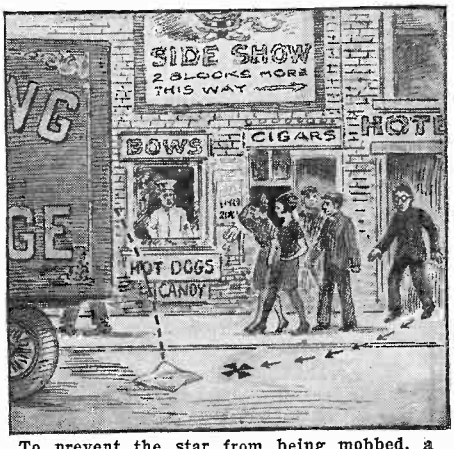
The saving of the horse-car franchise is the main feature of "Speedy." The location chosen for this in New York was the Sheridan Square district, near Greenwich Village. An exact duplicate of this district was built at the Lloyd studio in Hollywood, where various portions of the chase were photographed, as well as all of those scenes which show the horsecar going over its daily route in the earlier part of the film.

Toward the close of the picture the horse-car is stolen by a railroad company, which is intent on freezing out the owner. It is supposedly taken to a remote part of the city called Kent Road. Lloyd learns of the car's whereabouts, recovers it, and drives it back to the location of the line, in order that it may traverse its route on time to prevent the loss of the franchise. During the chase it is

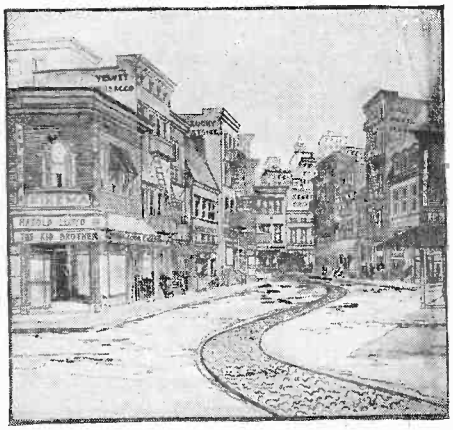
(*Continued on page* 463)



A camera placed in the taxi took shots of Harold Lloyd at the wheel.



To prevent the star from being mobbed, a handkerchief was dropped when Harold Lloyd was to appear.



Some of the New York City street scenes were taken in Hollywood with a set, such as that shown above.

FREEZES MAN IN ICE

MASTER WONDER OF MODERN MAGIC PERFECTED BY LATE HARRY HOUDINI

By H. WINFIELD SECOR

The above photograph shows Mrs. Harry Houdini presenting the "man frozen in ice" trick.

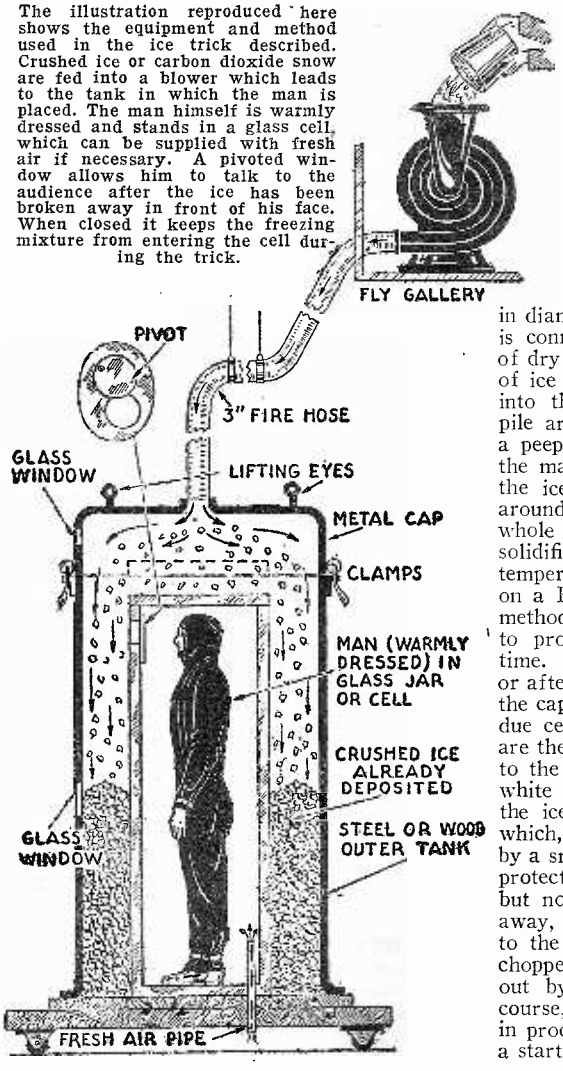
This explanation of how the illusion of freezing a man in ice is accomplished has been given to this magazine by Mrs. Beatrice Houdini, with whose permission it is herewith published. Mrs. Houdini has granted SCIENCE & INVENTION Magazine this privilege as a courtesy to Mr. Joseph Dunninger, the magic editor of this publication, and Chairman of our Psychic Investigation Committee.

FREEZING a man alive is one of the newest of modern stage illusions. It is one of the most sensational tricks ever conceived and executed in the theatre. The subject is clad in an insulated suit and lowered into a tank. Water apparently freezes around his body and he is tightly imprisoned in the frozen mass. In order to free the subject, the ice has to be chopped away where it is seemingly frozen tightly around his body. The effect produced is that the man was placed in a tank of water which froze solidly around his body.

In the stage presentation of this scientific illusion, an appropriate back drop is used, with the rest of the stage bare, except for a small raised platform or dais placed in the center. Assistants, entering upon the stage from each side, stand ready to hoist the subject up and then lower him into the steel tank on the dais. The subject, clad in an insulated suit resembling that used in Arctic expeditions, is lowered into the tank, in which, as we shall see, a glass cell has been concealed in order to protect the man during the freezing process. Naturally, it appears to the audience that he is directly lowered into the tank and is apparently exposed to the water, which is introduced through the top by a hose. In manipulating the hose the water is turned off when the end is dipped over the edge of the tank and again turned on when the hose is to be removed. The cap is now lowered onto the tank and clamped in place. The man is visible at all times to the audience, due to the provision of a glass window fitted in one of the sides of the tank. Ice can be seen gradually forming behind the window, and it is apparent that the man is to be frozen solidly in an ice cake. After a short time, the cap and sides of the tank are removed and a hole is chopped in the ice and the subject speaks to the audience. The ice on top is then chopped away and the man hoisted out, apparently none the worse after being frozen alive.

In the trick as presented by Mrs. Houdini this was claimed to be a feat of suspended animation. The subject used was a Sioux Indian who was in the first presentation hypnotized before being placed in the tank.

The reader himself might care to duplicate this trick and therefore we are describing one method which is perfectly harmless to the subject chosen. Details will, of course, vary with the individual magician and the mode of presentation. If dry ice is not available, scraped ice can be used in its stead. The average person will not want to make the freezing tank from metal, but there is no reason why it cannot be built with wood and provided with suitable clamps.

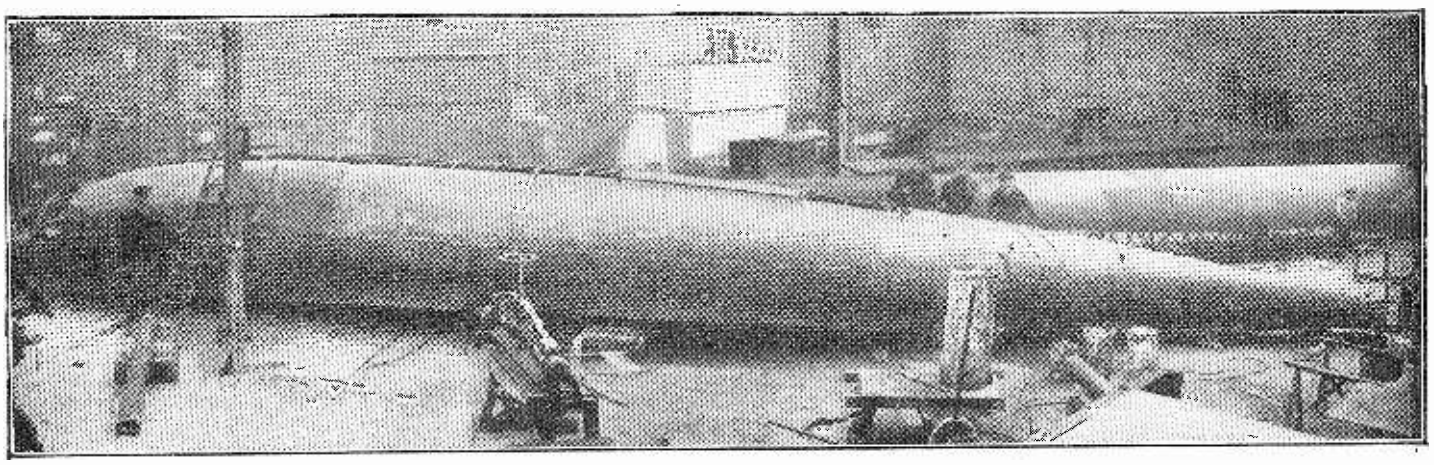


The illustration reproduced here shows the equipment and method used in the ice trick described. Crushed ice or carbon dioxide snow are fed into a blower which leads to the tank in which the man is placed. The man himself is warmly dressed and stands in a glass cell, which can be supplied with fresh air if necessary. A pivoted window allows him to talk to the audience after the ice has been broken away in front of his face. When closed it keeps the freezing mixture from entering the cell during the trick.

The ice is broken away and the man lifted out with ropes, as illustrated above.

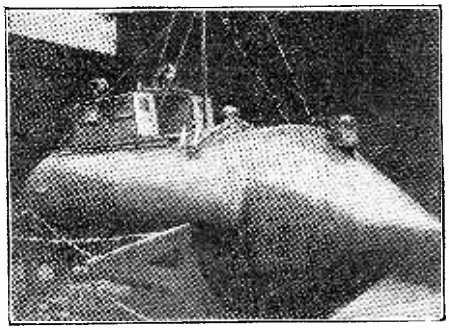
This startling illusion was performed on the stage by using carbon dioxide snow, scraped ice, or preferably a mixture of both. The man is lowered by block and fall into an opaque tank of steel or wood. Concealed in this tank is a glass jar or cell. Of course, the effect produced upon the audience is that the man is actually placed within the freezing or outer tank. Glass windows in the outer tank permit him to be clearly visible to the audience. A pipe supplying fresh air is introduced into the bottom of the protecting glass cell. A specially constructed cap is lowered down onto the tank within, in which is concealed a small top to close the inner glass cell so as to keep the ice away from the man. This cap fits tightly and is clamped in position, as illustrated. From the top of the cap, a large hose about 2 or 3 inches in diameter leads to the fly gallery. Here it is connected to a blower into which pieces of dry ice or carbon dioxide snow and pieces of ice are fed. These are then forced down into the freezing tank. The ice particles pile around the glass cell and by means of a peep hole covered with glass in the tank, the magician or the assistant can tell when the ice has completely filled the enclosure around the glass. When using dry ice, the whole mass freezes almost instantly, as this solidified carbon dioxide gas has an average temperature of about 114 degrees below zero on a Fahrenheit scale. With the perfected method described here, it was found possible to produce a cake of ice within a short time. After a short talk by the magician or after the execution of several other tricks, the cap on the freezing tank is removed with due ceremony. The four sides of the tank are then unclamped and lifted away, showing to the astounded audience, a huge block of white ice. A hole is then chopped through the ice in order to expose the man's face, which, it will be remembered, was covered by a small window placed upon a pivot. This protected him during the freezing operation, but now, as he sees the ice being chopped away, he pushes the window up and speaks to the audience. Later, some of the ice is chopped away at the top and the man hoisted out by means of a block and fall. Of course, the trick is subject to variations both in procedure and equipment, but in any case a startling effect is always produced.

A Trans-Oceanic Pontoon Boat



Above we see the interior of the factory where the two pontoons were made.

A PONTOON glider which skims over the surface of the water (driven by water propellors) and attains a tremendous speed has been constructed in France for a trip across the Atlantic to the United States. It consists essentially of two floats of the shape shown in the photograph, between which is suspended a cabin. It is constructed entirely of steel. In the interior of each float are two groups of thirteen reservoirs which are used for the storage of gas and oil. The cabin of sheet steel is perfectly cylindrical except for two extremities, where it is cone-shaped. It is divided into two parts by a horizontal floor, the lower portion housing the motors and the mechanics' quarters. A complete radio transmitter and receiver is placed in the rear cone. The pilot and navigator take their place in the upper portion of the cabin. Surface resistance between the pontoons and the water has been reduced to a minimum by their peculiar construction. If the projected voyage proves successful, the inventor intends to build another ocean glider of larger size in order to carry a number of passengers. This will be propelled by an airplane engine and will attain a speed of 60 knots an hour if the expectations of the builder are to be realized.—*Lucien Fournier, our Paris correspondent.*



The main portion or cabin of the boat is shown above. This is placed between two pontoons.

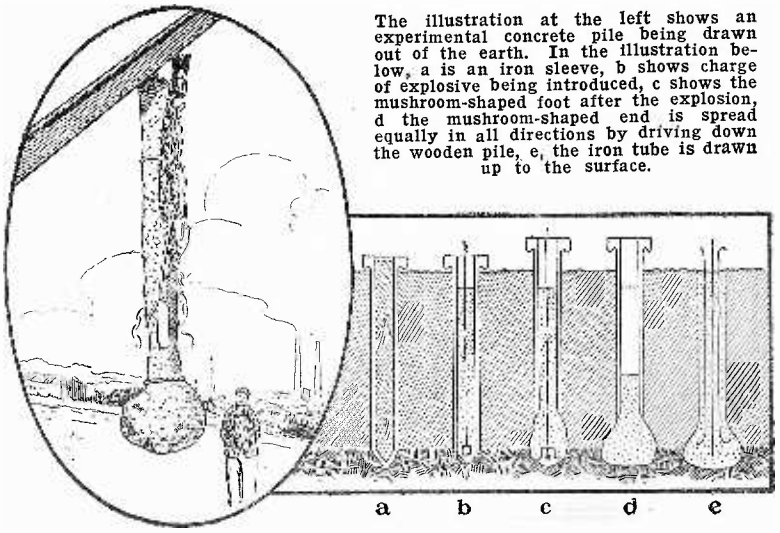
The complete boat afloat on the water appears in the above photograph.

Explosive Concrete Piles

THE foundation is of importance for everything, but specially in building constructions. The fact that so much is said of foundations, of bases and the like, shows how deeply the feeling of importance of things of this order has penetrated our flesh and blood. The usual way of carrying out foundation work is the laying down of a flat foundation, which carries the weight of the building in conjunction with the natural ground below it. But when the firmness of the natural soil is slight, the above is not sufficient. We have to try to support the building better, and the usual method is to drive piling for the foundation. The method is to drive down a series of long beams with a heavy ram or weight operated by the pile-driver, keeping them vertical, so as to avoid all side strain. In the first place, it must be accurately known what load each pile has to carry eventually. By the distance which the pile traverses in a definite number of blows, say from 20 to 30, it can be calculated how many kilograms of resistance the earth offers to its further penetration. The weight of the ram used and the proposed load to be carried when the building is erected, gives simple factors from which we can calculate the greatest amount of penetration determined by the last series of blows, in order to get the necessary sustaining power. We must not be satisfied if the lower end of the pile strikes some small solid surface area, such as a big stone, which seems for the moment to give a good bearing; such will not last long. Consideration of how the whole series of piles are driven gives a far better estimate for the supporting power of the soil.

But in many cases, it is very difficult to get a sufficient sustaining power for the pile in soil of low resistance. Often it will seem to be quite secure enough, but when a sufficiently intense series of testing blows are given, the pile goes down still further. In such cases, it is often necessary to put another pile on top of the one driven down to its full length, so as to virtually lengthen it by some meters, but such additional piece has never half the reliability of the original pile, and often more than one of these extra pieces are required. It often wants more, and it is quite expensive in the end. In swampy soil in which sustaining stratum of ground cannot be reached, some relief is obtained if a very large number of piles are driven down, one beside the other, which increases the specific pressure of the soil so greatly that the bearing power of the ground reaches a reliable minimum. But to be very sure, the upper ends of the pilings are joined by a sort of platform of beams or else by a great layer of concrete, so that the whole building eventually will rest almost floating on a spongy sub-stratum, all of which must be well studied out. In the case of Dutch railroad viaducts, which are partly carried by such

(*Continued on page* 447)



The illustration at the left shows an experimental concrete pile being drawn out of the earth. In the illustration below, a is an iron sleeve, b shows charge of explosive being introduced, c shows the mushroom-shaped foot after the explosion, d the mushroom-shaped end is spread equally in all directions by driving down the wooden pile, e, the iron tube is drawn up to the surface.

$500.00 SCIENCE CONTEST

YOU ARE INVITED TO JUDGE WHAT IS WRONG WITH THE COVER. IF YOUR CONCLUSIONS ARE GOOD YOU MAY WIN A CASH AWARD.

By HUGO GERNSBACK
Member American Physical Society

THIS month we are pleased to present to our readers an entirely new kind of a contest; a contest such as, we believe, has not been presented heretofore anywhere.

It is true, that "What's Wrong" contests are no novelty, and have previously appeared in many publications, but it is believed that this particular contest is new, because *it is strictly scientific* throughout.

In short, you are asked to find the scientific mistakes which have been purposely incorporated in the front cover picture of this magazine. A reproduction of the cover appears on this page, but for many reasons, you are asked to work from the cover only and not from this picture.

At first glance, there seems to be nothing much wrong with the picture, but it actually contains 48 scientific errors, most of which the average layman will not be able to detect unless he knows something about science in general.

Here, then, is an excellent educational pastime, and this particular contest is the first one of a series that we hope to present to our readers in the near future.

We strongly wish to stress the point that ALL mistakes are of a purely scientific nature. You must know something about science, and you must use your reasoning powers, if you wish to correctly list the scientific mistakes.

Practically every branch of science is represented in the mistakes on this cover. The following are represented: Astronomy, Meteorology, Hydraulics, Optics, Gravitation, Electricity, Radio, Mechanics, Aeronautics, etc.

You must know something about these branches of science in order to correctly find the mistakes purposely made.

Aside from being highly educational, the feature should be of great interest to all artists, amateur artists and draughtsmen. Very frequently, even in famous paintings, artists have made grevious scientific errors. While to the ordinary layman, such a drawing or picture may appear to be perfect, to the scientist it looks absurd, because there could be no such circumstances, such as we see pictured frequently, it being a physical impossibility to have them thus. This, the front cover illustration, brings vividly home.

It appears at first, like an ordinary seashore scene, and it would seem impossible to the layman that there could actually be 48 mistakes in this particular picture. Nevertheless, they are all there, and it is up to you to find them.

Aside from the prizes which we are going to award, the contest is most interesting and you will find a great deal of amusement for yourself as well as your friends.

PLEASE DO NOT LOOK FOR TRICKS. There are no tricks in this contest. DO NOT LOOK FOR MISTAKES THAT ARE NOT OF A SCIENTIFIC NATURE. Thus, for instance, the color of the sun is correct, as shown on the cover drawing. Do not look for a mistake in the color, as very frequently the sun can be seen with such a color. Remember, that the mistakes are ALL of a scientific nature. Just to give you a hint, we name one mistake: The man sitting at the beach is smoking a cigar. The smoke could not possibly go straight up, for reasons that will be clear if you study the picture. *This is a meteorological mistake.*

If you wish to qualify as a prize contestant, be sure to read the following rules carefully. In most prize contests, it is found that people jump at conclusions, and do not read the rules and, frequently, someone who would be entitled to a high prize, does not earn any money at all, because he or she disregarded the essential ruling, so please follow the rules carefully:

1—In making your answer to this prize contest, use a white sheet of paper, letter size, 9 x 12 inches, using nothing else.

2—On the left-hand margin, write the figures from 1 to 48. Write your answers alongside each number. Remember, there are only 48 scientific mistakes, and that you will not find any more. Do not look for trick mistakes, of a non-scientific nature, as these are ruled out.

3—Make answers as short as possible. Thus: "Cigar smoke of man wrong due to breeze."

4—All answers must be written in pen and ink or else typewritten. No penciled matter can or will be considered. Write legibly and neatly.

5—As there will be duplications in correct answers, the higher prizes will go to those whose description is judged best from a scientific viewpoint; as well as the nature of the letter in being concise, brief, neat and correct at the same time.

6—In case of a tie, a prize identical with that scheduled for the award tied for will be paid each contestant so tying. This contest closes at midnight, October 5th, 1928, and the prize-winning answers will appear in the December issue.

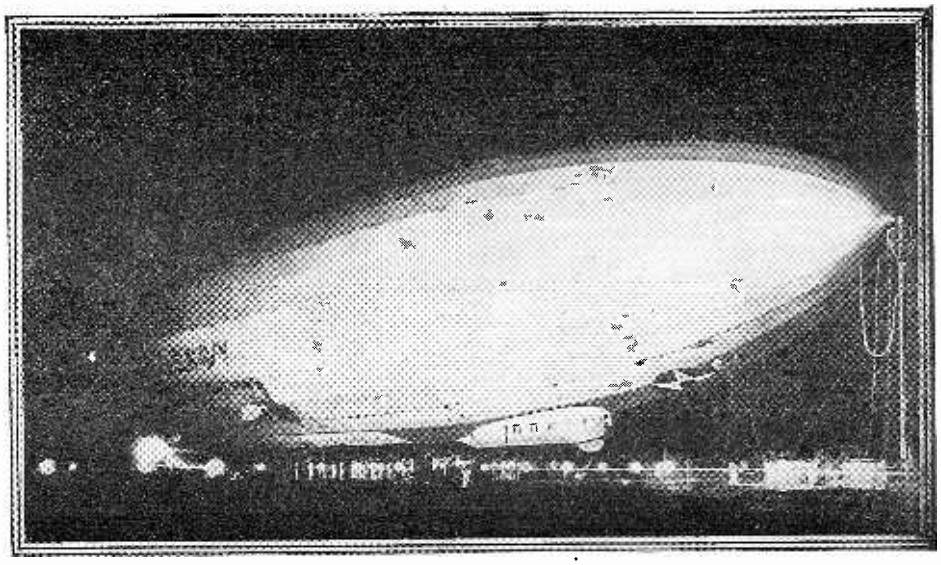
$500.00 IN PRIZES

— 73 Cash Awards —

1st Prize	$100.00
2nd Prize	50.00
3rd Prize	35.00
4th Prize	20.00
5th Prize	15.00
Eight 6th Prizes of $10.00 each	80.00
Twenty 7th Prizes of $5.00 each	100.00
Forty 8th Prizes of $2.50 each	100.00
Total	$500.00

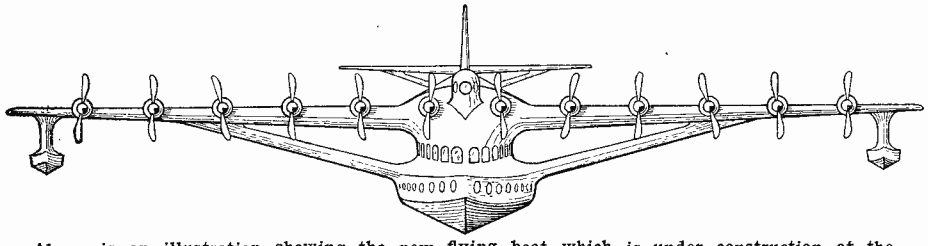
Dirigible Mooring Mast

A NEW stub mast has been devised by the Navy Department for use in handling large airships of the "Los Angeles" type. The mast is but 60 ft. high, a small height compared with that of the standard mooring mast as high as a 15-story building, located at Lakehurst, New Jersey. The stub construction does much to solve the problem of landing and taking off for the rigid airships. The stub mast carries a mooring cup which receives the steel mooring cone carried by the ship. When the cone is locked in the cup, the ship is securely anchored, but is free to swing in the wind. To prevent the stern from being lifted from the ground, the equipment include weight wheels which hold the craft in a horizontal position, minimizing the strain in heavy storms. This vertical control is impossible where high masts are used.—*N. C. McLoud.*



The above photograph shows the Los Angeles moored to the new 60 ft. mast.

A Super Flying Boat

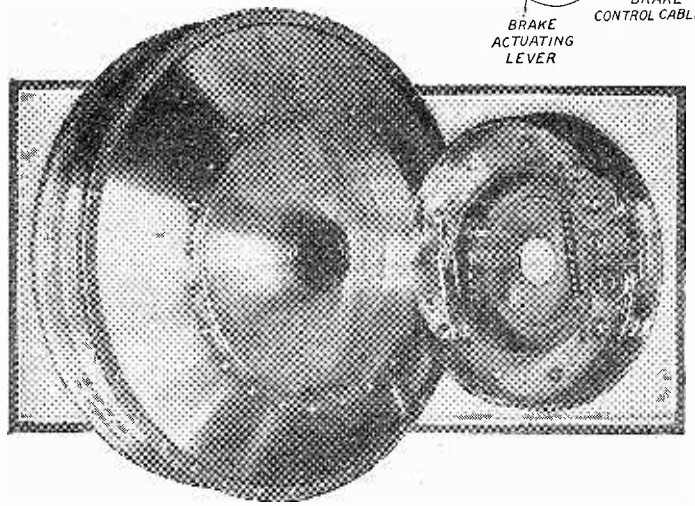


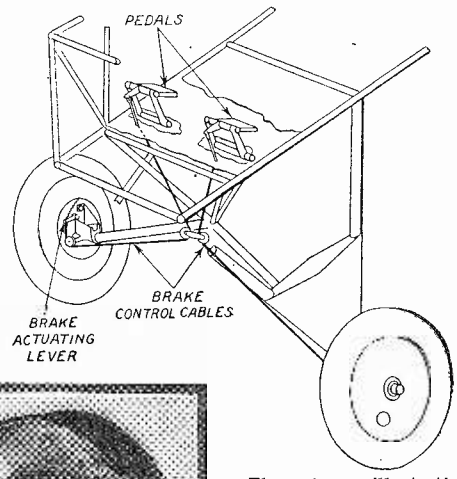
Above is an illustration showing the new flying boat which is under construction at the German Dornier Co., on the Swiss side of Lake Constance.

A SUPER flying boat to be used in Germany-United States flying service is now under construction in Switzerland. It will hold fifty passengers and has a wing span of approximately 158 ft. Fully loaded, it will weigh 44 tons and is to be propelled by 12 huge engines. Dining room and sleeping compartments will be provided for the convenience of the passengers. The flying boat is to be a monoplane involving an entirely new phase of aircraft design. When in commercial operation, the craft will carry a crew of nine men.

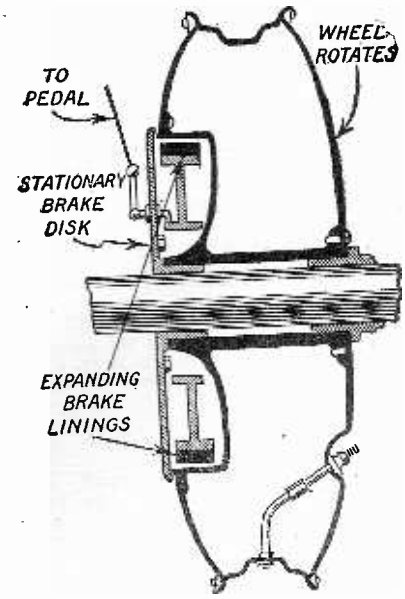
How Airplane Brakes Work

AIRPLANE brakes, a relatively new invention, one of the stepping stones to safer aviation, have proved practical and are now being used on many planes. To obtain successful operation, the two brakes are separately controlled by means of pedals or hand levers. Directional control of the airplane on the ground is one of the major functions of the brakes, and this can only be obtained by controlling each brake separately. A minimum amount of pedal movement is needed to obtain full braking effect and yet smooth action and power of control are secured by this newest adjunct to aviation. Except for the springs, anchor pin and camshaft, all parts of the brake are made of an aluminum alloy of very low specific gravity. Any adjustment of the brake can be made from the outside and the wheel does not have to be disturbed. The wheel and its brake are made in streamline form and are closed by an extension on the valve itself. The streamline form is obtained at no expense in weight or strength, but adds to the side load strength of the wheel. The parts used are standard for all sizes of wheels. The sectional view shows the brake side of the wheel with backing plate or cover. This backing plate forms the mounting for the brake and is attached to the axle-flange of the plane. The brake torque is not taken through this plate, but through an extension of the axle flange to a bolt just above the operating lever shown in the illustration.





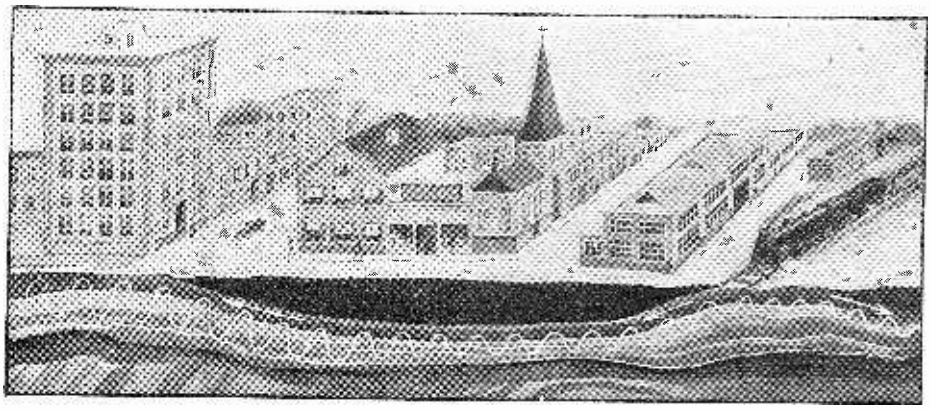
The above illustration shows the details of the brake control system. At the left is a photograph of the airplane disc wheel and brake disassembled. Ample provision for thrust is made in the wheel through the medium of specially constructed thrust bearings. The brake is of the two-shoe type. Except for the springs, anchor pin and camshaft, all parts of this brake are made of aluminum alloy giving minimum weight and maximum strength.



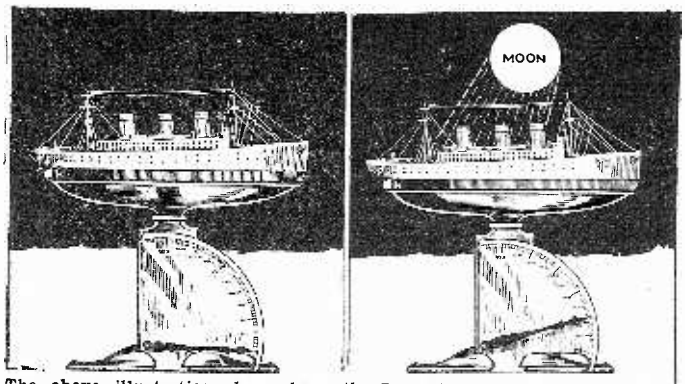
The above illustration shows a section of the wheel and brake assembly. The brake disc is stationary.

The "Shimmying" House

IN New Haven, Connecticut, there is a most mysterious house which is often given to "shimmying." For some time the occupants have been alarmed by the swaying movements of the structure, and the report spread that the house was haunted. The solution of this mystery is credited to Prof. Chester Longwell, of the Dept. of Geology, of Yale University. It is his idea that the most general cause for recurrent shaking of houses in that part of New Haven in which the mystery house is located, is due to heavy trains passing on one of the railroads. He has not, however, made any scientific study of the problem, but mentioned the trains as the most likely cause of the phenomenon. The illustration appearing here shows how a wavelike motion may be imparted to the rock strata by the vibrations of the trains.



Moon's Attraction

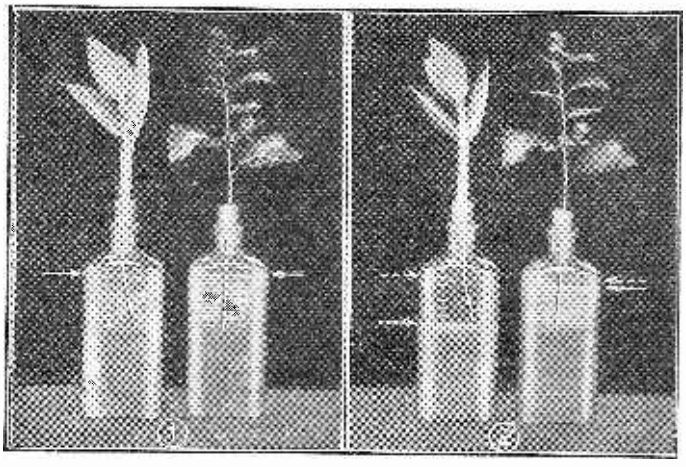


The above illustration shows how the Leviathan weighs less on moonlit nights, due to the attraction of the moon.

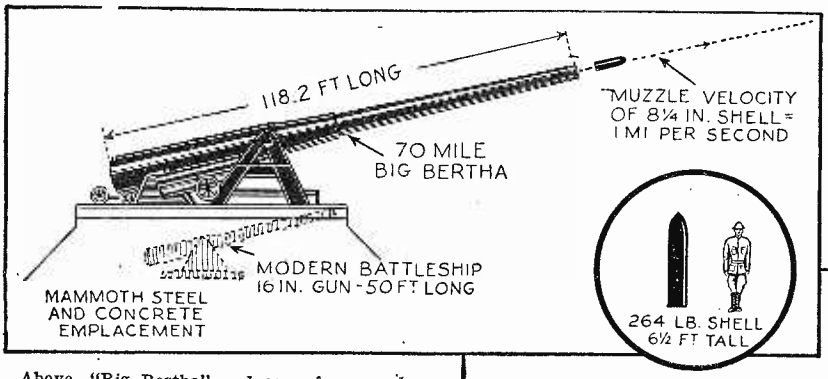
A BULLETIN from the Washington headquarters of the National Geographic Society states that the great steamship *Leviathan* weighs some ten to twelve pounds less when the moon is directly over it, than when it is on the horizon. In fact, everything which the moon shines directly down upon loses a certain amount of its weight. The downward pull of gravity which keeps objects on the earth's surface is ten million times as great as the lifting power of the moon. Thus the moon can only steal away one-ten-millionth of the weight of an object.

Thirsty Trees

THERE is no other tree known which takes up or absorbs as much water as the blue gum of eucalyptus globulus. For this reason these trees are useful for the drainage of land. In the photographs are shown the results of an experiment with a young blue gum and a plum tree. The level of water is indicated by the white arrow, both at the start, at 1, and the conclusion of the test at 2. The plant at the left is the blue gum.—*S. Leonard Bastin.*

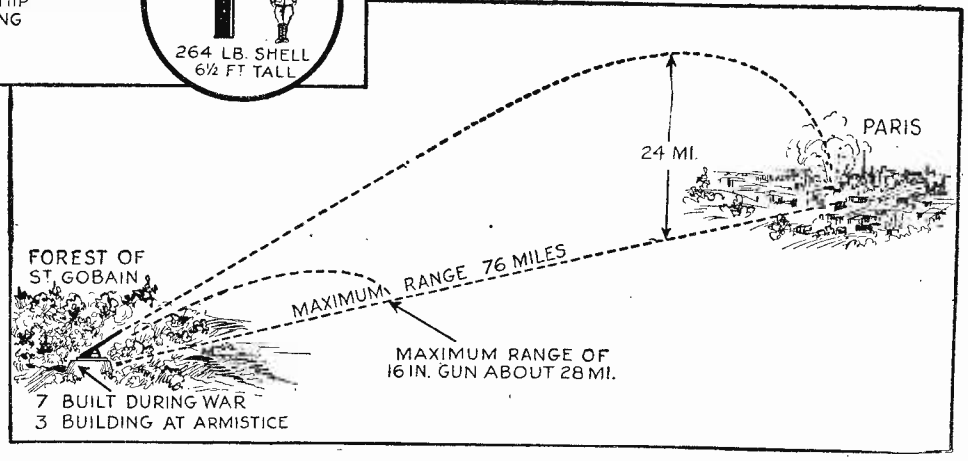


Germany's Super Guns



Above, "Big Bertha" and one of our modern battleship guns are compared. This huge gun fired a projectile weighting 264 pounds. At the right, the ranges of the 16 in. gun and the German gun, "Big Bertha," are compared.

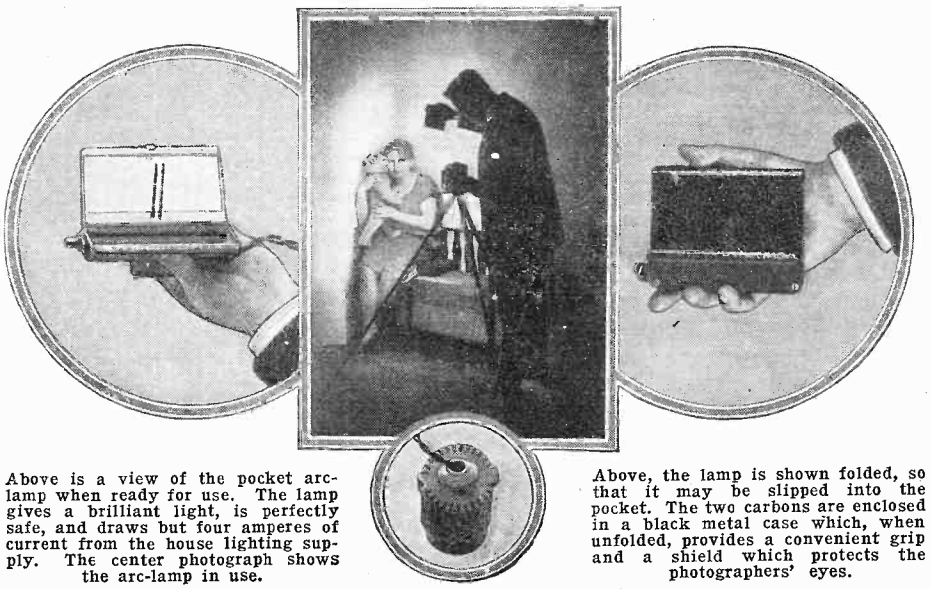
THE mystery of "Big Bertha," super-gun, has at last been disclosed by the U. S. Army Bureau of Ordnance. In the files of this bureau is a complete description of the big gun. This master gun was built to shell Paris, being placed in the forest of St. Gobain. It was first constructed for 8.27 inch shells, and after being worn was rebored for 9.45 inch shells. It really consisted of two sections, the main one being 98.5 feet long, and the forward section 19.7 feet in length. The finished gun weighed 318,000 pounds and the shell left the muzzle at a velocity of nearly a mile a second. The projectiles used weighed 264 pounds and were approximately 6½ feet long. The maximum range was 76 miles, and the projectiles had to reach an altitude of 24 miles, in order to cover this extreme distance. This is more than twice as far as the most powerful gun of today can fire. A modern 16 inch gun and a Big Bertha are compared in the illustration.



NEW GERMAN INVENTIONS

Pocket Arc-Lamp for Photographers

A SMALL folding pocket arc-lamp has recently appeared in Germany. This can be connected to the ordinary house lines and takes but four amperes of current. Disadvantages of using magnesium ribbon or flash powder in photography are well known. There is usually a startled look on the face of persons so photographed, and there is also danger of fire and injury to the operator's fingers. The new arc-lamp of miniature size gives a brilliant light, is absolutely clean and perfectly safe. It is suitable for all kinds of photography and can be used advantageously in this work whenever daylight is not available. It is also useful as an auxiliary source of illumination when the daylight is weak.



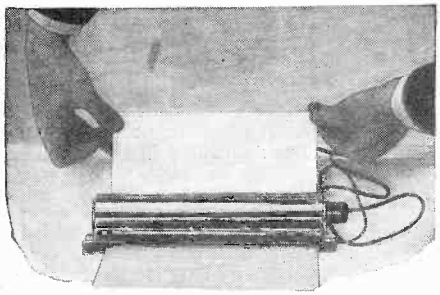
Above is a view of the pocket arc-lamp when ready for use. The lamp gives a brilliant light, is perfectly safe, and draws but four amperes of current from the house lighting supply. The center photograph shows the arc-lamp in use.

Above, the lamp is shown folded, so that it may be slipped into the pocket. The two carbons are enclosed in a black metal case which, when unfolded, provides a convenient grip and a shield which protects the photographers' eyes.

The two carbons are housed within a folding metal case, which offers suitable protection. As may be seen in the photos, the lamp can be held in the hand and when opened provides a convenient handle for the photographer. A suitable length of lampcord is provided, so that it may be conveniently attached to the nearest outlet. The handling of the lamp is easy and it can be carried anywhere in the coat pocket.—*A.W.H.*

CARBON PAPER RENEWER

The illustration shows a carbon paper renewer which recoats the paper with carbon.



The above photo shows a carbon paper renewer for lengthening the life of worn-out carbons.

It is connected to an electric current for heating the cylinder.—*A. W. Herbert.*

PHONOGRAPH PICK-UP

A NEW device, which is said to be far superior to any of a similar nature, has been introduced in Germany for using the amplifier and speaker of a radio receiver, in order to reproduce phonograph records. The pick-up is fitted with a counter-balance and is attached to the tone arm of the phonograph, in place of the ordinary sound box. The record is then played in the usual manner, but since the pick-up is connected to the audio amplifier, the sound issues from the loud speaker and not from the phonograph. The illustration at the left shows the phonograph pick-up being used with a radio receiver.—*A. W. H.*

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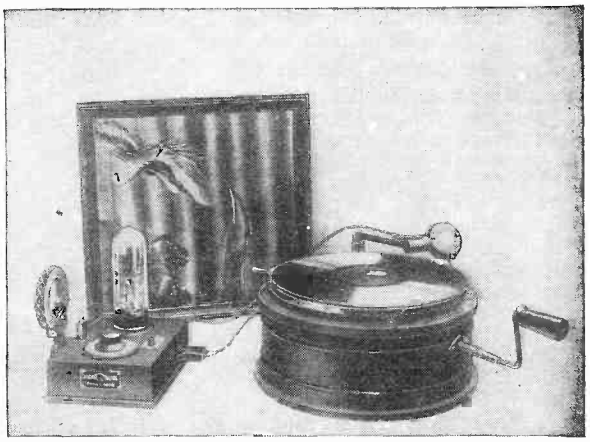
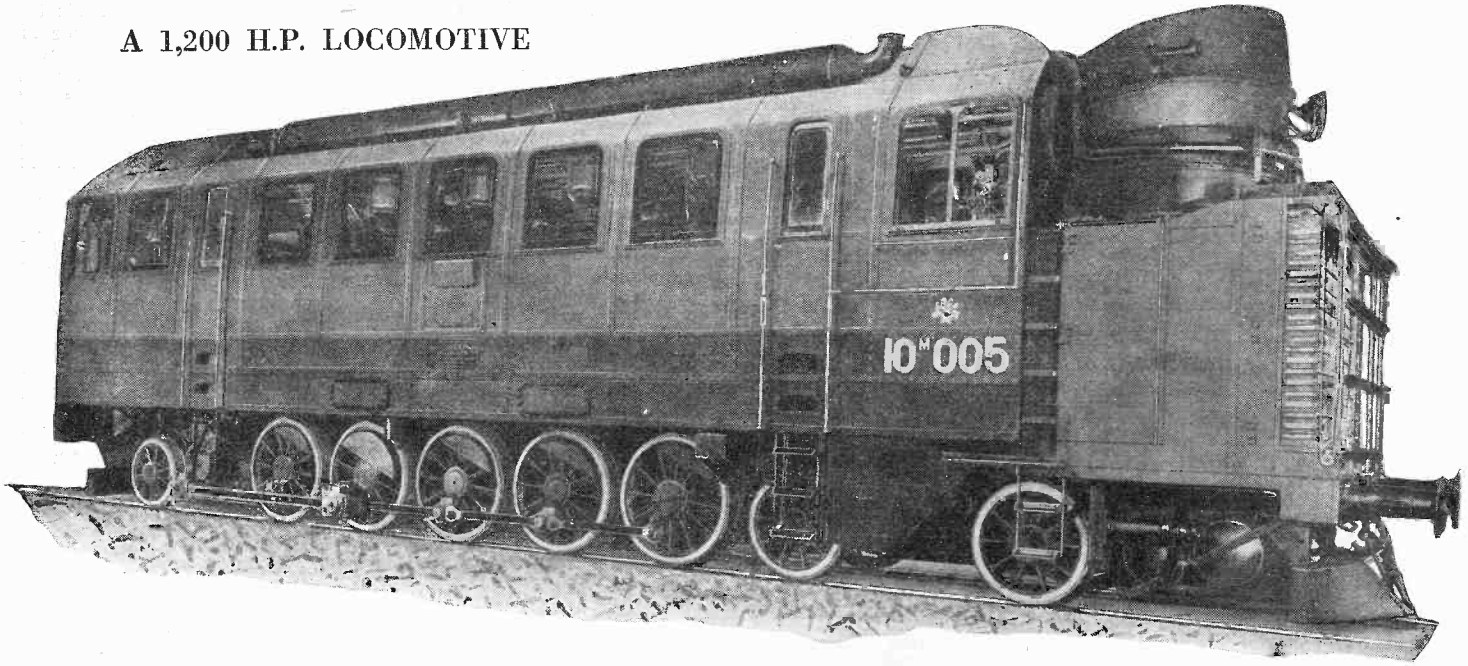


The above photo shows a new arrangement for connecting the phonograph to a loud speaker.

A 1,200 H.P. LOCOMOTIVE



A number of huge locomotives, such as that shown above, are now being built in Germany for the Russian Federal Railroad.

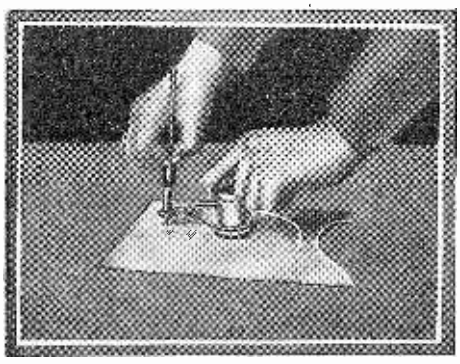
The locomotive is driven by Diesel engines, developing 1,200 horsepower at 450 R.P.M. These motors are of the six-cylinder type.

Sealed Aquarium—A Microcosm

In Which a Goldfish Lives in a Sealed Aquarium as Naturally as in a Pond

By P. P. B. BROOKS

HOW can a fish live without air? This question has been asked hundreds of times, with amazement approaching incredulity, by the different people who have seen the goldfish



The photograph above shows how an ordinary glass cutter is applied toward cutting a circular disk for use in this sealed aquarium.

which has been contentedly living for the past six months in the air-tight, sealed aquarium pictured in this article.

WHAT IS A MICROCOSM?

THE answer is "It does not." The aquarium is *balanced,* it is a *microcosm,* which Webster defines as "a little world, a miniature universe". In that jar are reproduced, on a small scale, the conditions necessary for life, which the goldfish would find in a lake or pond. To the advantage of the owner, the aquarium needs absolutely no attention except to keep it in a well lighted place where it will never be exposed to the direct rays of the sun. There is no feeding, no emptying and cleaning of the bowl and refilling with fresh water. The advantages to the fish are that the composition of the water is always constant, the water is always saturated with life giving oxygen, and there is no starving when the owner forgets to feed or goes on a prolonged visit, no overfeeding at other times, but a continuous supply of natural food. In no more convenient way can the conditions of nature be so nearly reproduced.

THE ROLE OF THE PLANT

THE plants require, during daylight, carbon dioxide for growth. This is supplied as a waste product by the breathing of the fish. The plants use carbon dioxide only in the light. Hence, plenty of light is necessary, but direct sunlight is to be avoided because of the danger of over-heating the aquarium and killing the fish. A well lighted north window is the best location. In return for carbon dioxide, the plants give off oxygen. Thus, the requirements of the plants and the fish for these two gases keep the supply in the water and in the atmosphere of the aquarium in their ideal relations just as the needs of animal life and plant life do in the large world.

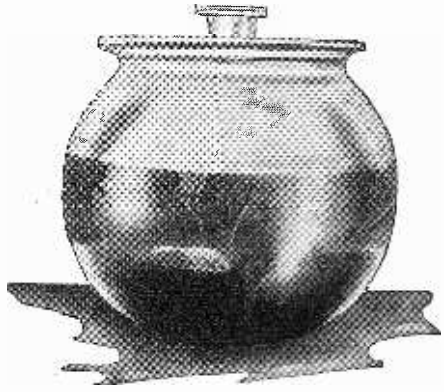
FOOD FOR THE FISH

THE plants furnish a large part of the food for the fish. Thus they are kept from over-crowding the bowl. While new growth may be seen at almost any time, the quantity of plant material in the bowl has not increased appreciably in the past five months. Usually, however, the fish is observed feeding in the ooze at the bottom. Here, there are, undoubtedly, myriads of microscopic animals. On the other hand, the solid and liquid wastes from the fish contain the essential mineral and nitrogenous matter for plant life. Thus, again, it is seen that plant and animal life contribute to each other, through a never ending cycle, the essentials for continued existence.

The nitrogenous wastes from the fish must be rendered available to the plants through a process of decay. This is brought about by bacteria—not disease germs, but a group of benevolent, microscopic plants that have mastered an important branch of the chemistry of life in which their larger cousins are unskilled. These bacteria are present in adequate numbers.

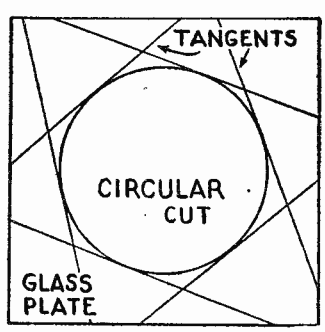
A PECULIAR EXPERIENCE

AN incident illustrating the presence of the bacteria of decay occurred when one of the fish in the bowl died. For originally there were two fish sealed in. They had been purchased from the local five-and-ten-cent store, placed in the bowl, and observed for a week before sealing. Apparently, everything was all right, so the lid was sealed on. In three or four days, one of the fish was found floating dead. Naturally, I expected a pollution of the water which would kill the other fish, just as I had seen happen many times in the ordinary open bowl. It was impossible to take time to open the bowl at once, hence the task was postponed, with misgivings for the welfare of the living fish, until the next day. The following day there was no pollution of



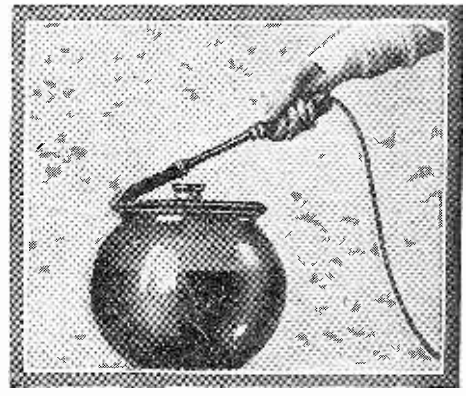
Months after the microcosm has been built, the fish poses for his picture, as shown in this photograph.

the water farther than about one inch from the dead fish. Decomposition was going on with surprising rapidity. The live fish showed every sign of perfect health. It was decided, therefore, to continue the experiment to observe results. Inside of two weeks, the dead fish had completely disappeared without any apparent ill effects to the live fish.



After a piece of glass is cut to the desired circular form, tangental cuts will aid in permitting the edges to be cracked off more easily.

The cause of the fish's death is uncertain. The size of the bowl and the supply



The sealing is accomplished by the aid of an ordinary electrically heated soldering iron, the glass disk being put in place after the aquarium has been properly loaded.

of food and air were probably adequate. I remember, however, that that particular fish had been difficult to catch and had been battered around considerably by the clerk before she got it into her net. I believe that it was injured at that time. In any case, the event serves to show how completely the complex and delicately balanced processes which make continued life possible in the world are duplicated in this miniature reproduction.

BALANCED AQUARIUM EASILY MADE

A BALANCED aquarium of this kind is not difficult to make. In this case a bowl with a capacity of ten or twelve quarts was used. For a single fish a smaller bowl would do. On the bottom of the bowl was placed a piece of charcoal nearly the size of the closed fist. This was weighted in place by pebbles and small stones. Then a handful of *elodea,* a moss-like plant found growing in shady places in ponds was straightened out so as to get the roots together, and the roots caught under some of the pebbles. Still holding some of the elodea in the hand, sand was added until most of the spaces between the pebbles and rocks were filled. Then the bowl was filled slightly more than half full of hydrant water to which nutrient chemicals had been added.

MAKE-UP OF SOLUTION

THE nutrient solution is made by dissolving in suitable proportions the minerals necessary for plant growth, very much as the scientific farmer adds appropriate fertilizers to his soil to feed his crops. The formula which follows is known as Moore's nutrient solution for algae. The measurements are given in both metric and English units:

Ammonium nitrate	0.5 gram	7.5 grains
Potassium phosphate	0.2 gram	3.0 grains
Magnesium sulphate	0.2 gram	3.0 grains
Calcium chloride	0.1 gram	1.5 grains
Iron sulphate	trace	trace
Water	4000 c.c.	1.0 gallon

Enough of this solution should be prepared to fill the bowl slightly more than half full.

The bowl is then covered and placed in a good light to allow the plants to become established and to start into growth. Unless

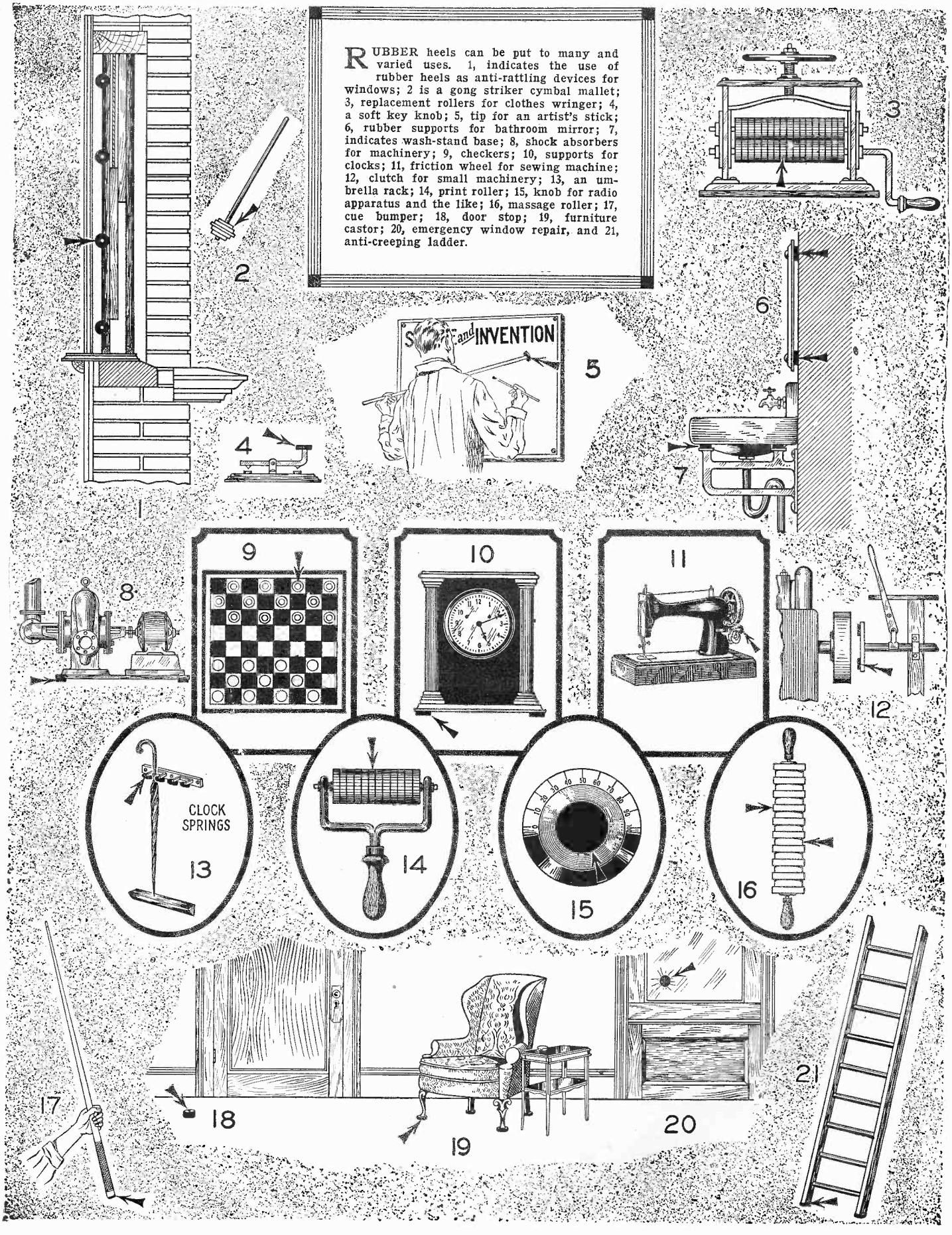
(*Continued on page* 448)

USES FOR OLD

Cutting and Shaping Rubber Heels for

By P. C.

RUBBER heels can be put to many and varied uses. 1, indicates the use of rubber heels as anti-rattling devices for windows; 2 is a gong striker cymbal mallet; 3, replacement rollers for clothes wringer; 4, a soft key knob; 5, tip for an artist's stick; 6, rubber supports for bathroom mirror; 7, indicates wash-stand base; 8, shock absorbers for machinery; 9, checkers; 10, supports for clocks; 11, friction wheel for sewing machine; 12, clutch for small machinery; 13, an umbrella rack; 14, print roller; 15, knob for radio apparatus and the like; 16, massage roller; 17, cue bumper; 18, door stop; 19, furniture castor; 20, emergency window repair, and 21, anti-creeping ladder.



on the end of a rod as indicated in Fig. 2. On the other hand, it may be desirable to make the mallet square when the rubber heels are cut according to the desired shape. It might be well to mention here that soft hammers can be made of the same material, the bolt being pulled up well into the rubber pieces and if required, another piece can be mounted outside of the bolt and held in this position by rubber cement, or by vulcanization.

An old wringer can be put into service again by replacing the worn-out rollers with rubber heel discs. It will be found that when the old rollers are removed, a square rod serves as the axle. The rubber discs will then have to have a square hole cut in them, which can be performed by the aid of a chisel or a piece of square tubing, or else a square rod of identical size. The replacement rollers are shown in Fig. 3.

There are many times when it is desirable to use a knob which has some resiliency about it, such as in the case of a circuit-closing key, which must be operated repeatedly or as in the case of a telegrapher's key. A knob made from a rubber heel will serve in good stead in this position, and it can be held in place by shellacing it to the old key. This position on a circuit-closing device is indicated in Fig. 4 on the opposite page.

For the lettering of signs and to serve as a hand rest, it will be found that a rubber tip made from a rubber heel and attached to the hand rest will prevent that rest from slipping, and yet will not mar the easel or the material upon which the work is being done. This procedure is illustrated in Fig. 5.

RUBBER BATHROOM ADJUNCTS

EVEN in the bath-room we can find many uses for rubber heels. But a few of these are shown in Fig. 6, but it will be

now let us see what idea you can think up for another new contest or article. Address your suggestions to the Editor, New Contests, Science and Invention, 230 Fifth Ave., New York City.

trifle too much. With a hard wall behind, breakage would not easily be prevented. A resilient support for a washstand is indicated in Fig. 7 which is a portion of the same illustration.

Much of the noise and vibration from small machinery can be absorbed if the builder employs the method shown in Fig. 8. The machinery is raised on its base and several rubber heels are placed under it to take up the shock.

There is a noiseless checker board indicated in Fig. 9. Here an ordinary board is used, but discs of rubber are the checkers. In order to differentiate between them, these discs may be either painted, or a ring may be cut in the top of half the number of checkers. These checkers have the property of being noiseless when moved about. Thus, greater concentration is possible because one can then really enjoy a quiet game of checkers.

PROTECTING POLISHED SURFACES

MANY articles are placed on polished furniture surfaces which, if moved but slightly, would mar the furniture. Small buttons of rubber with a hole punched through the center to admit a screw can be affixed to various articles of furniture, the larger sizes for chairs and tables, as shown in 19, and the smaller ones for mantle clocks and articles of alike nature, as indicated in Fig. 10. In the latter case, it might be more desirable to shellac the rub-

BODY MASSAGER

MANY claim that fat can be massaged from the body. Well, here is a massaging device for just such a purpose, made up of discs of two different sizes and alternately placed on a rod which is subsequently provided with two handles. This massage roller is to be rolled up and down over the muscles. We do not guarantee results, but you will see the device illustrated in Fig. 16.

Small discs or buttons of rubber can be shellacked to the end of a cue handle as shown at 17, or if desired, a hole may be punched in the rubber piece and this screwed into the bottom of the handle.

An excellent door stop is indicated in Fig. 18, also on the opposite page. The disc being small, and flat, is not likely to be as unsightly as some of the door stops now in general use. It can be mounted on a pin driven into the wood floor or better yet, securely fasten the pin to the rubber disc and make a hole but slightly larger than the pin so that it will slide into the hole drilled for it and yet will permit of its removal.

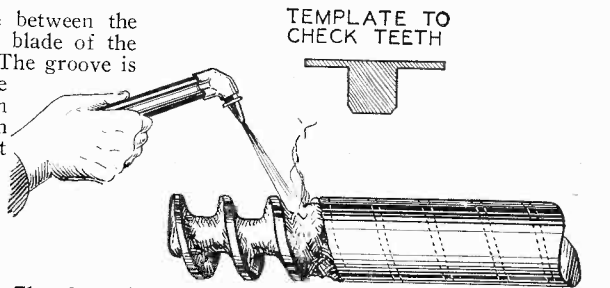
The same rubber can be put to use in case of the accidental cracking of a window. A piece of rubber is put on either side of the window at the point where the break occurred and a bolt is then run through both rubber discs and tightened. This will prevent the window from smashing altogether, and will serve as a temporary repair. The article is indicated in use in illustration 20.

Ladders have a habit of slipping when we least expect them to slide. Anti-creepers for ladders can be made of the same material as is used to heel our shoes. Two strips are cut, or if necessary, several pieces are made and fastened to the bottom of the ladder so that they will turn around both the front and the back part of the uprights, as indicated in illustration 21.

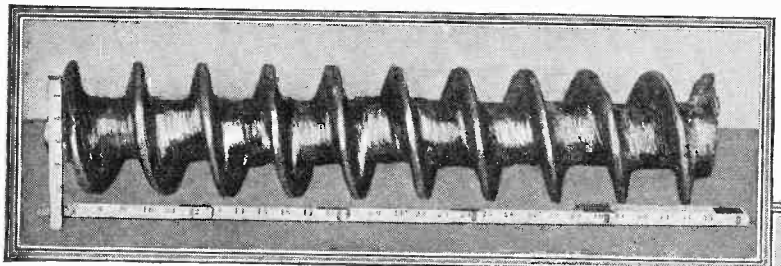
Solid Steel Conveyors

UP till the present time screw conveyors consisted of worms of cast iron sections mounted upon a driving shaft which proved to be unsatisfactory because the cast iron sections frequently broke. Steel flights or sections were then ordered substituted for the cast iron ones. The possibility of making the entire conveyor from one piece of steel by cutting with a blowpipe was suggested. Two worms were desired, one thirty inches and the other forty inches in length. Upon a piece of machine steel six inches in diameter, prick marks were made as illustrated and a template made from sheet metal.

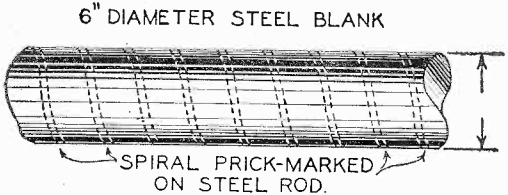
A welder cut out the groove between the turns of the helix, leaving the blade of the worm integral with the hub. The groove is cut easily with an oxyacetylene blowpipe and in five hours an operator had cut the thirty-inch length shown here. In eight hours the forty-eight-inch piece was finished. The template used was made slightly smaller than the desired finish of the groove, in order that the finishing cuts might be made in a lathe for precision and smoothness. There was relatively little machining needed and the cut surfaces showed no difference whatever in cutting quality and softness, from the inner metal. The thirty-inch length required twenty-three hours for finishing the blade and hub, while the forty-eight-inch piece required twenty-nine hours for finishing. — *Illustrations courtesy Oxyacetylene Tips.*

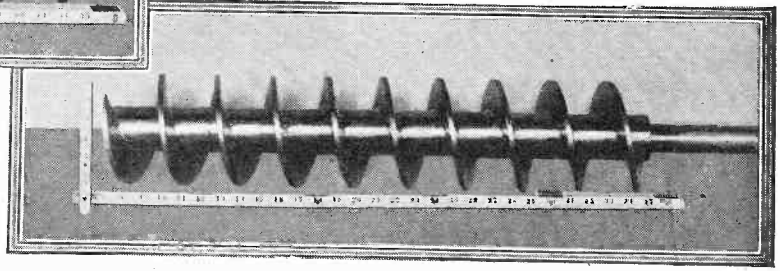


The above illustration shows how the worm cut is made with an oxyacetylene pipe and the template used in making the teeth or cuts.



Above is a three-foot section of a conveyor cut out in the rough in five hours by the process outlined here.

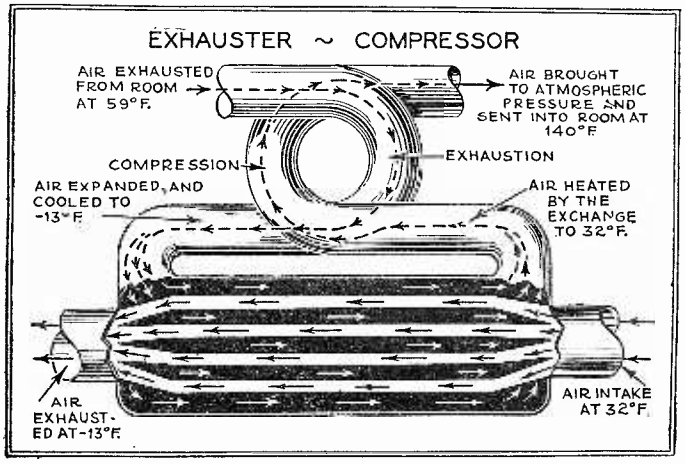




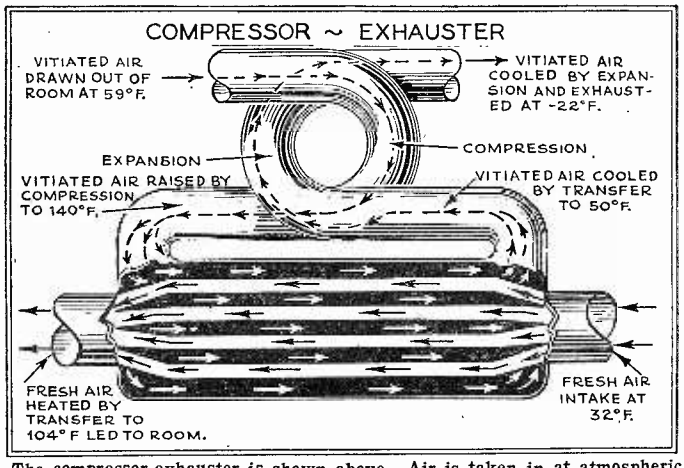
Above is a perfect one-piece conveyor after machining. At the left is a steel blank six inches in diameter, with spiral prick marks used as a guide when cutting the worms.

Heating Your House with Atmospheric Air

A Physics Paradox Which Seems to Indicate That We Get Something for Nothing



The final operation in the heat-changing process is completed by the discharge of a quantity of very cold air at —13 degrees Fahrenheit, into the external air at 32 degrees Fahrenheit.



The compressor-exhauster is shown above. Air is taken in at atmospheric pressure, is rarefied, and then brought back by compression to atmospheric pressure. These two cycles are placed in series in one machine.

A KILOWATT-HOUR of electricity represents exactly 860 calories. In other words, if you use the kilowatt-hour in an electric radiator (which absorbs it by the Joule effect in a resisting circuit brought to incandescence) you will obtain a radiation of heat equivalent to that due to the combustion of 120 to 150 grams of carbon. Now this kilowatt hour reaching you through conducting cables which carried it, coming from the alternator which generated it, from the turbine which turned the alternator and from the boiler which drives the turbine requires, because of all the successive losses, the combustion of a good kilogram of carbon, representing 7,000 calories, on the grate bars of the boilers of the central station.

Following this out, it is far more economical if not more convenient, to burn the kilogram of carbon directly in your small stove or else in the furnace of the building; or better yet, to have steam piped to you directly from the central station, instead of "transforming" this steam into electricity. This is the solution of all city heating of which we have already spoken (See *La Science et la Vie*, February 1926). Deducting all losses this will always carry 50% of the heat produced in the central station to your residence, instead of a bare 10 to 12%, which electricity will give you when applied to heating.

But the problem changes in aspect, if we find that the 860 calories of the kilowatt can be doubled at the place of consumption by an apparatus which will utilize *and dispense* them according to the exact laws of thermodynamics.

This is the demonstration which we have to make.

EXPLANATION OF THE PARADOX CAN BE MADE VERY SIMPLY

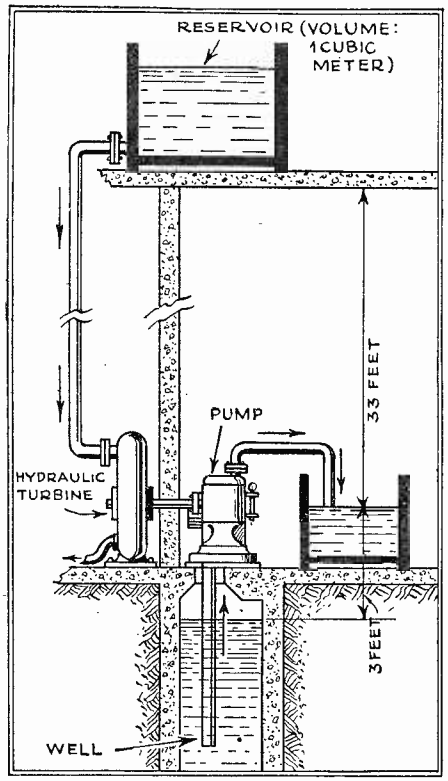
BUT you will say such a project is a contradiction of the principle of conservation of energy. How could the 860 calories of the kilowatt-hour be doubled except by some magic process? Where are you going to find the missing 9/10ths of the total heat we started with?

In the natural atmosphere, although it may be winter and several degrees below freezing.

This is really magic. The first magician who invented this feat is called Lord Kelvin. Afterwards, Mr. Henry Le Chatelier studied once more the question of thermodynamics, known to scientists under the name of "The Kelvin Paradox," to show that by means of a good steam engine, you could manufacture ten times more heat than could the boiler furnace of the same machine. With the current supplied by a steam central station at a distance, it is also possible to generate a quantity of heat ten times that of the electric energy received, that is to say, the quantity theoretically equal to that developed in the furnaces of the central station.

The mathematical explanation of this paradox is made by the aid of diagrams by which we measure the work of the heat engine, but it would be much more simple to invoke here a classic analogy.

As Sadi Carnot himself did in his immortal work on the motive power of fire, let us compare thermic energy to hydraulic energy, and every thermic machine to a water mill, which transforms the energy of the water into useful work. In this parallel or comparison, the quantity of heat (number of calories) is the analogue of the quantity of water actuating the mill wheel, and the temperature at which this quantity of heat is captured has its analogue in the height of the fall of water.



The above illustration shows how it is possible to raise a cubic meter of water one meter by passing one-tenth of a cubic meter of water through a hydraulic turbine.

A "MAGIC" WATER PARADOX

ALL this being well understood, suppose you are utilizing a cubic meter (a cube measuring 3.28 x 3.28 x 3.28 feet) of water placed on the roof of your house at an elevation of ten meters (32.8 ft.) and simultaneously are utilizing a well, the level of whose water would be only one meter below your bathroom. These simple data being given, see if you can solve the little problem which follows: Fill your bathroom under the most favorable economic conditions.

What are you going to do? Simply run into the bathtub the cubic meter from the roof? All right. But then you cannot take but a single bath (supposing that the bathtub holds just the cubic meter).

Now, here's how you can take ten baths out of a cubic meter; emptying only once the reservoir on the roof.

You will install a hydraulic turbine coupled to a pump and you will pass the water from your roof to the turbine; the pump will draw up the water from the well as this is only a meter (3.28 ft.) below the level of the bathtub. The laws of mechanics tell us that 1/10 of the cubic meter passing through the turbine from a height of ten meters can raise a cubic meter from the depth of one meter.

By this principle, a cubic meter of water placed upon your roof can pump up ten cubic meters into your bathtub.

FROM HYDRAULICS TO ELECTRICITY

I ASSUME that you are getting from your service line the quantity of electricity equal to one kilowatt. If you transform this electricity directly into heat by heating a resistance (electric radiator) it's as if you emptied the cubic meter at an elevation of ten meters into your bathtub.

On the other hand, if you conduct this electricity through a good motor, coupled to an air compressor, this is what goes on, everything being arranged to give the desired effect: the compressor will deliver into your apartment, the air (vitiated) which is found at 60°F. and will bring it to a temperature of 140°F. by the effect of the compression.

(*Continued on page* 449)

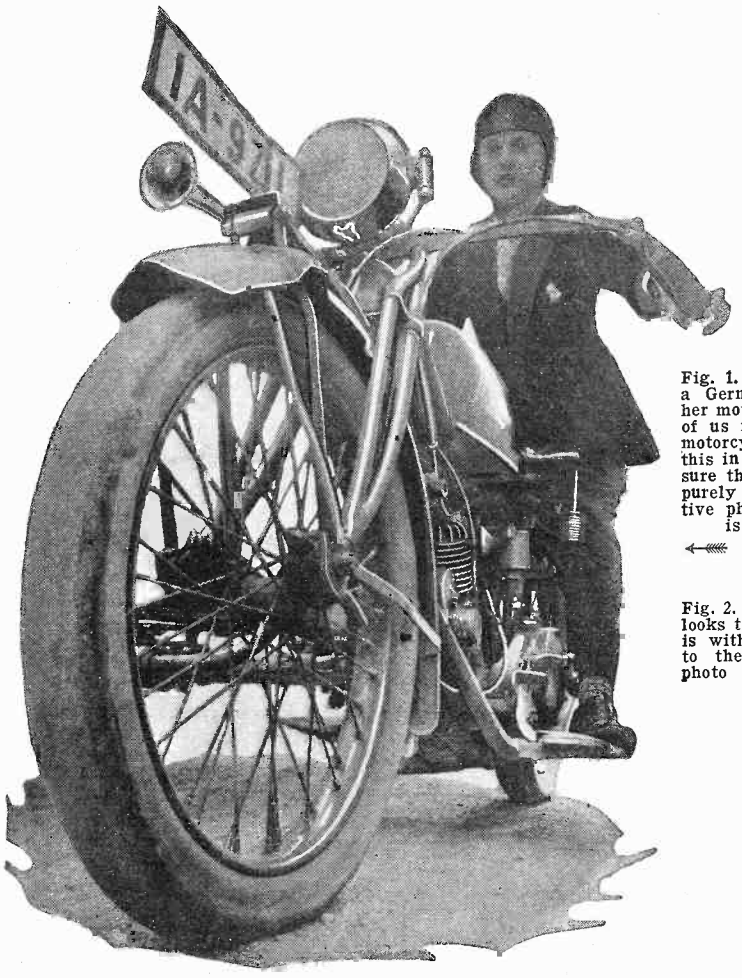


Fig. 1. At the left you see a German Fräulein astride her motorcycle. While some of us might believe that a motorcycle may look like this in Germany, we can assure the reader than this is purely a distorted perspective photo. The motorcycle is quite ordinary.

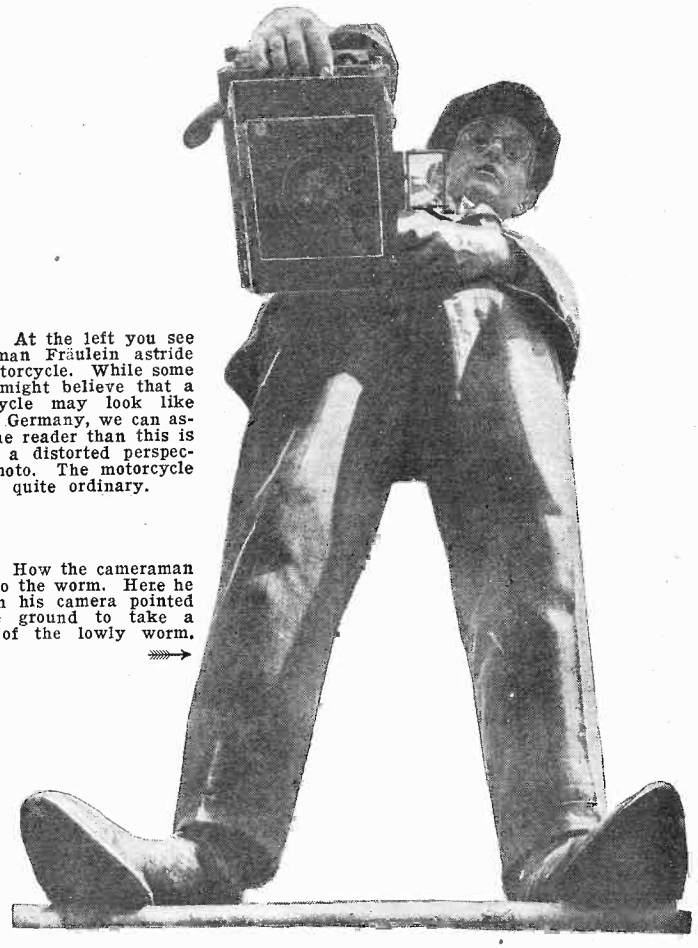


Fig. 2. How the cameraman looks to the worm. Here he is with his camera pointed to the ground to take a photo of the lowly worm.

DISTORTED PERSPECTIVES

By JOSEPH H. KRAUS

It will be remembered that in the last issue (August, 1928) we first announced our intention to publish perspective photos. In that issue several excellent examples of this type of material are given, among which we find a bridge with a lake-like reflection, the photo of which was taken on a bright clear day. The details for constructing the device to reproduce photos of this nature were given in that particular issue. It consisted of an ordinary shell made of cardboard or other tubing into which a piece of plain glass had been inserted. The glass was put at an angle, so that it would reproduce on its surface an exact image of the object to be photographed, and it would throw this image back into the camera again to give the effect of a lake.

In the same issue, there is a multi-legged dog, taken with a panoramic camera. It so happened that at the time this photo was taken, the dog moved several paces, practically keeping time with the movement of the camera.

Already camera fiends have taken to the distorted perspective craze and have commenced to pour in their contributions to the editors. In the next month's issue we will probably have some interesting photographs to show the readers. Cameras have been used to photograph buildings, ships, airplanes, street cars and naturally, members of both sexes, in various ludicrous positions characteristic of distorted perspectives.

An ordinary camera does not reproduce perspectives the way the human eye sees them. Anything close to a camera appears much larger than it actually is. Those things further away from the camera diminish in size. Thus, a photograph taken close to the hands shows tremendously big fingers and then if the arm is also seen in the view, the arm appears to gradually taper off into the distance.

Fig. 3. This is not exactly the kind of portrait you would care to send to your friends. It was taken with the camera near the feet.

Taking advantage of this defect of the camera, the editors have decided to start a craze, if such it may be called, for the production of distorted perspectives. Frequently during the summer months, pictures of this nature are taken accidentally, but when one knows how to make them purposely, it is rare that an accidental freak picture will be snapped. This statement may sound paradoxical, but it is nevertheless true. If an error is purposely repeatedly produced, any subsequent production is never accidentally accomplished. For example, many a typist, in spelling the word "the," transposes the letters, making them "hte." Psychologists have found that the way to prevent such accidental errors is to make the typist write the word "hte" over and over again for several days or until such time as she definitely realizes she is writing "hte" rather than "the." After this, no further errors are made.

And so it is with photography. Make an error purposely and you will not do so accidentally.

In an effort to make ludicrous pictures lucrative, the editors have decided to stage a distorted perspective fad and also to pay $5.00 for every distorted perspective photo accepted and

published. Also, in attempting to help the readers, we have decided to place on these pages several distorted pictures which show exactly what it is that is desired.

Fig. 1 shows a German motorcycle taken with the camera fitted with a wide angle lens and the camera placed close to the ground and a little to one side of the front wheel of the motorcycle. Note the peculiar distortion to the picture and observe the "length" of the motorized bicycle.

In Fig. 2, a cameraman is standing on a ledge, his feet projecting over the edge slightly. The photographer has snapped this picture from beneath, giving us what might characteristically be called a worm's eye view of a man.

How a young lady could possibly take it easy with legs and feet of the size and nature indicated by our fair damsel in the photograph in Fig. 3 is something difficult to determine. Nevertheless, here she is with rather exaggerated pedal extremities, looking none the less sorrowful for such a feat (if we may be permitted the pun). In this view the camera was placed at a level approximately the height of milady's knees.

In Fig. 4 we have Old Dobbin; but how he has changed. Here again, the camera was placed rather close to the horse's head, a little to one side thereof.

Use Your Camera to Take Distorted Perspective Photos

Send these pictures to the editor of this publication. $5.00 will be paid for each one accepted and published.

We now come to an airplane or bird's eye view, taken rather close to another fair damsel. She is anxiously peering up at the camera. The photograph was taken from an overhanging balcony and the product is astounding, to say the least. This view is indicated in Fig. 5.

It is thus seen that by simply shifting the position of the camera, or by some slight movement on the part of the individual photographed, or change in position of the object photographed, a very peculiar effect can be obtained. The nature of this depends entirely on the ingenuity of the cameraman.

Here is another hint for assisting distorted perspective photographers. While the average camera using plates or film packs is fitted with a ground glass, roll film cameras are not usually provided with a ground glass. It therefore becomes almost impossible to see what one is about to take, if one is using such a camera. A hint here is not amiss. If the film is left out of a roll film camera and a piece of thin paper held there in the position usually occupied by the film, and if this paper has been greased to render it transparent (paraffined paper may be substituted), the paper will serve as an admirable ground glass.

The person using the camera opens the shutter and leaves it open and then places the intended victim in front of him and moves around with the camera until the greatest amount of distortion and the most peculiar appearance is observed in the improvised ground glass. He marks his position and then assumes another position, employing another subject if desired. After having taken six different positions and after having marked each one of them, the paraffined paper is removed from the back and the regular photographic film inserted. All six pictures can now be taken, one after the other, and unusually good results will be obtained. It will thus be seen that the plan is merely one to enable those roll film camera users to secure the advantages which are possessed by the film pack and plate camera owners.

Distorted perspective photographs can also be taken with motion picture cameras, and those who are fortunate enough to possess cameras will find that a reel of distortions is quite interesting, particularly if the people will move while the camera is taking the distorted views. A motion picture camera can easily be used to give instruction in the taking of distorted pictures by gradually shifting it from one position to another. Remember that all the time you are taking distorted pictures, not only are you learning how to take them, but you are also learning what not to do in order to get good results in the taking of pictures. You will know how to set the stops of the camera so as to get a depth of focus, at the same time preserving the distortion.

In conclusion, we would like to advise all our distorted perspective fiends to send prints, rather than the films of their original pictures. We would not like to see a valuable film destroyed because of a wet envelope or accidentally lost. The print will answer the purpose admirably and if we find it necessary to get the film for enlargement purposes, the editor of the department will write to the contestant. Get busy and rush your distorted perspective photos into the Distorted Perspective Editor, in care of this publication.

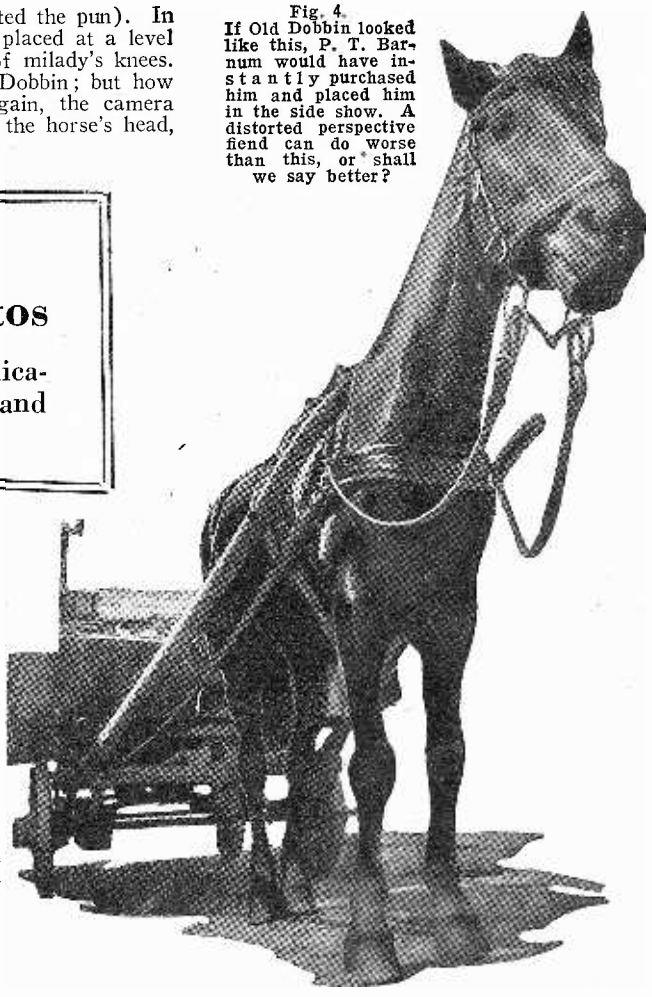
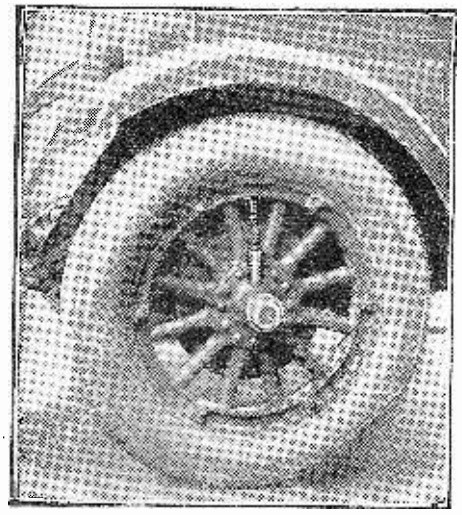


Fig. 4. If Old Dobbin looked like this, P. T. Barnum would have instantly purchased him and placed him in the side show. A distorted perspective fiend can do worse than this, or shall we say better?

Fig. 5. You often wonder what you look like to a bird flying directly over your head. It is very probable that he gets a view of you similar to this photograph.

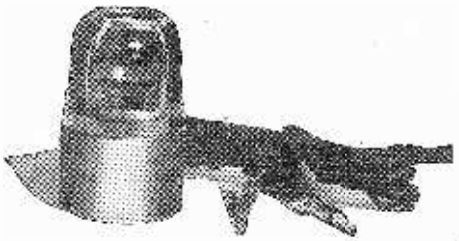
New Accessories

Recent Developments



Tire Inflator

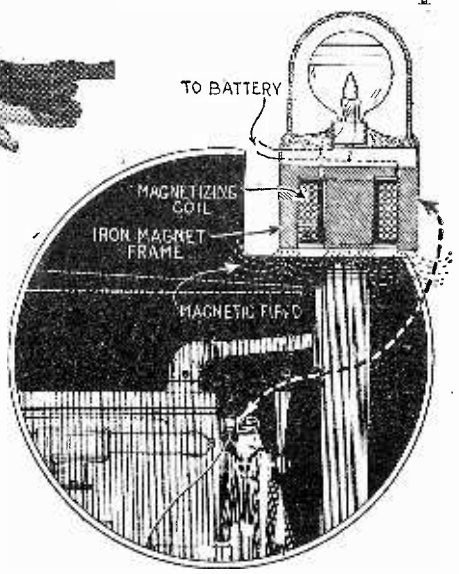
The photo above shows an automatic tire inflator which operates continuously, discharging to the atmosphere when the tire is at the correct pressure or pumping air into the tire if it is below pressure. This device is absolutely fool-proof and is attached to the valve with an ordinary hose connection. The centrifugal force filters all oil and water which collects in the bottom of the pump when the wheel is revolving.



At the right is a photograph of the new electro - magnetic emergency and trouble lamp, which will cling to any part of the steel car frame or engine.

Trouble Lamp

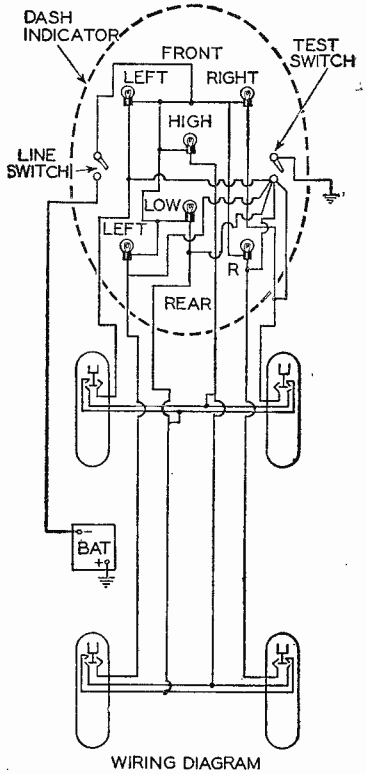
AN emergency light and trouble lamp, which will hold to any part of the metal framework of the car, is shown here. The magnetic base holds it in place and leaves both hands free for work. It is operated by the battery of the auto and comes equipped with a twelve-foot cord complete with clips. It is quite compact, being only three and one-half inches long. A special reflector helps to throw a light beam 100 feet when using a 21-candlepower headlight bulb. The glare protector shields the eyes when making repairs on the car. A heavy metal guard surrounds the bulb so that it is not easily broken. The small lamp is admirably adapted for use as an emergency headlight or tail light. In the base of the lamp is an iron magnet frame, upon which a coil of wire has been wound, so that the electro-magnetic action is obtained when this coil is connected to the battery.



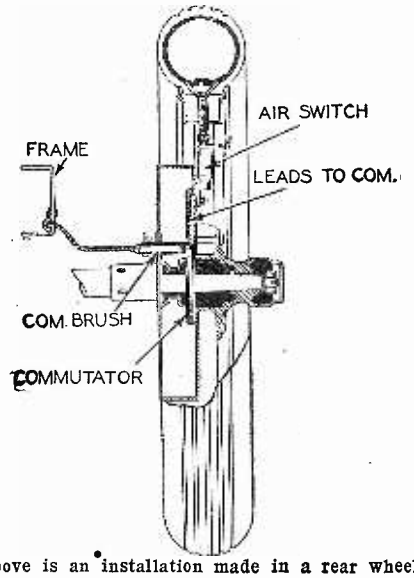
The above illustration shows how the lamp is magnetized by using a coil connected to the battery.

Tire Pressure Indicator

A PUNCTURE indicator has recently been placed on the market for the added convenience of the motorist. This device indicates the pressure in all four tires. A special dash indicator is provided and consists of a number of small lamps. An air switch is attached to each wheel and when the pressure in the tire is correct, the indicator on the dash glows green. When the pressure is too high, a blue light shows up on the indicator, and when the tire is flat a red light is lit. The wiring diagram, showing four air switches and six indicating lights, appears here. The air switch is of good design and causes the correct indicating lights to glow in accordance with the pressure in the tires. The installation of this system is not difficult, and the convenience of motoring is greatly augmented by it, as it saves the time and annoyance of climbing out of the car and inspecting each tire separately. A special test switch has been provided, so that the complete installation can be checked over in order to see if it is in working order, by simply throwing this switch.

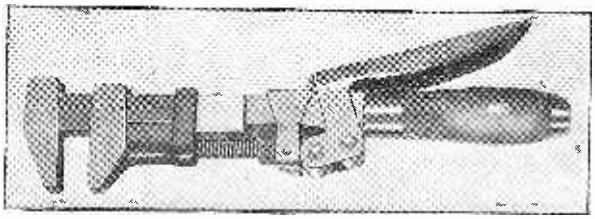


The wiring diagram of the indicator is shown above.



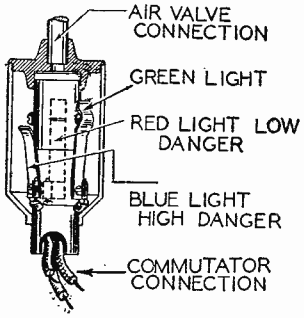
Above is an installation made in a rear wheel.

Quick Acting Monkey-Wrench



At the left is a photograph of a quick-acting monkey-wrench which is adjustable to the correct opening within a second. A special lever has been provided on the handle and has to be pressed down in order to close and fix the jaws.
—Walter J. O'Neill.

The indicator which is placed on the dash board of the automobile tells at a glance the condition existing in all the tires. It is small and of neat design, containing six small indicating lights and two switches. The lights are connected to the various air switches, as shown in the wiring diagram, and a line switch is placed in series with the lead from the negative terminal of the storage battery. A test switch, connecting to the lights and having one end grounded on the frame, serves to indicate when the system is in perfect working order.

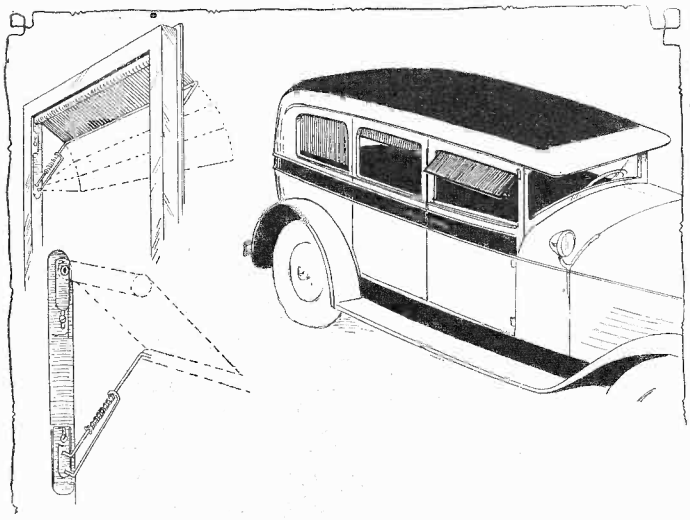


The air switch, showing the contact arrangements, is illustrated above. The air valve connection is made at the top and the commutator connection at the bottom. A red light denotes low pressure and a blue light high pressure, both of which are undesirable. When the tire pressure is correct, the air switch causes a green light to glow.

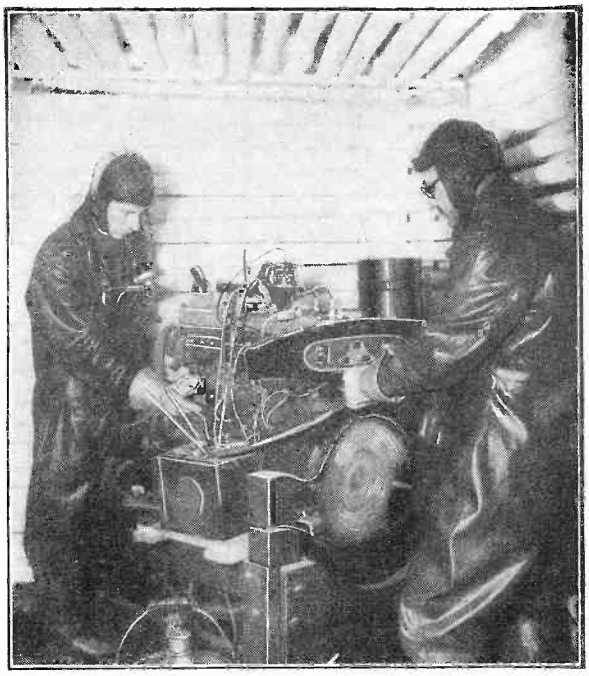
for the Auto

Insure Better Motoring

Combination Shade and Awning



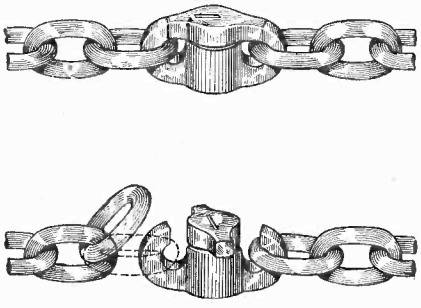
A combination shade and awning for closed cars is illustrated at the left. It is adaptable to every type of door or window casing, and is changed from awning to shade and vice versa by a unique spring device, which also prevents the shade from flapping.



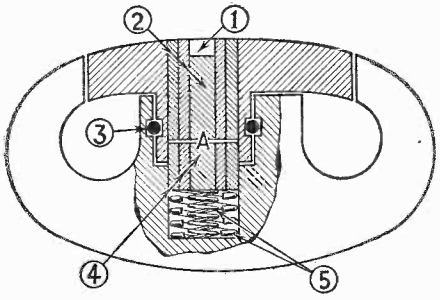
The above photograph shows a testing room used in the manufacture of automobile storage batteries. Cold weather performance is tested in a giant icebox and the temperature of the motor, gasoline, oil and battery is brought down below zero. The engineers stand inside of the box and communicate with those outside by means of a telephone.

Adjustable Combination Chain Lock

The illustration at the right shows a new chain lock to be used with the spare tire. The lock is too compact and solid to be opened by hammer blows and the hardened steel forgings cannot be cut with bolt cutters, hacksaw or file. The shape of the lock is so designed that it forms a link in the chain. The key is self-ejecting and cannot stick in the lock which also can be closed without a key.



Above—the lock in closed and open position.

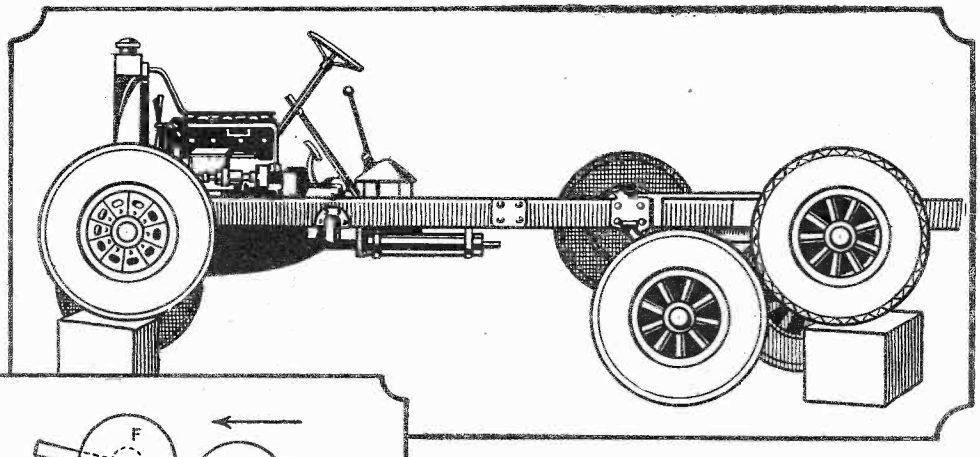


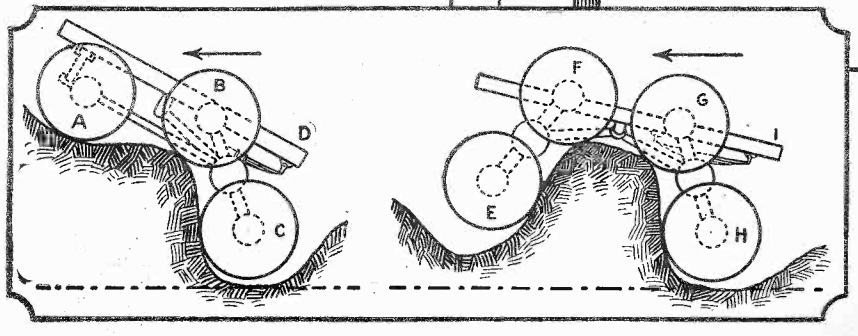
A cross-sectional view of the lock appears above.

At the left is a cross-sectional view of the mechanism. If the keys are lost, a new combination can be made. In the illustration 1 indicates the key slot, 2 shows three upper brass tubes, 3 shows brass wire surrounding lock, 4 shows three lower brass tubes, and 5 shows springs, which when key is removed, push part of lower tubes past point A, thus preventing the lock from being opened.

Flexible Wheel Trucks

AN ingenious flexible wheel truck, to be used with motor trucks, has recently been described in *"La Science et La Vie,"* Paris, France. Through the courtesy of this magazine we are illustrating here some of the features of this new device. The illustration at the right shows a truck equipped in the manner mentioned, with wheels mounted on flexible trucks, so that they are at all times in contact with the roadway, no matter how rough it may be. The wheels are free to move with an up-and-down motion, readily keeping to the road, as shown, when blocks are placed under them.



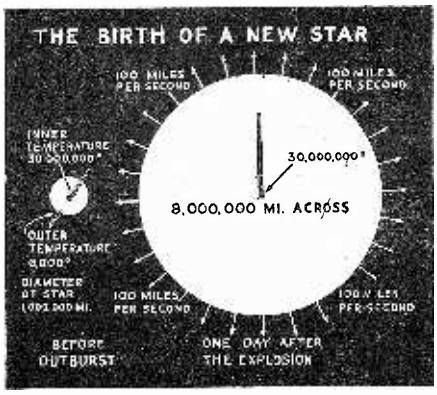


AT the left is an illustration showing the schematic disposition of the wheels and how they are mounted on vehicles using six or eight of them. A, B and C are the wheels, of which B and C are mounted so as to swing. The axle-tree is free to move. D is the chassis support. In the illustration of a vehicle having eight wheels, E, F, G and H are the four groups of wheels, which are all free to move, as shown in the illustration. I is the chassis support.

Names of manufacturers supplied upon request.

New Stars and the Rejuvenation of the Universe

By W. J. LUYTEN
HARVARD COLLEGE OBSERVATORY



The above illustration shows the birth of a new star and the speed with which it expands. Before the outburst or explosion, it measured 1,000,000 miles in diameter and one day after the explosion it measured 8,000,000 miles in diameter. The temperatures before and after the explosions are also indicated.

FOR years, decades, perhaps thousands of years the heavens may rotate round the earth, stars rise and set, and no apparent change occurs. Until some evening, after dark, a faint spot of light is seen which grows rapidly brighter. Perhaps unnoticed at first, it keeps on growing brighter, until at last some astronomer or some amateur, by chance looks at this particular spot of the heavens more carefully, and notices a strange star, not shown in any star atlas and never seen before. A *new star.*

He rushes to the telegraph office and sends a message to the Harvard College Observatory, giving the position in the sky and the brightness of the new object. Within a few hours the wheels of the international astronomical machinery have been set in motion, observatories all over the world have been notified, and everyone immediately stops work and turns his telescope on the new star.

Photographs are taken, the increase in brightness is very closely watched, and, most important of all, the spectroscope is immediately gotten ready for action to decipher the mystery of the new catastrophe. In less than a day the new star reaches its maximum brightness, remains there but a few hours, and by the time the original discoverer sees it again, it is generally on the decline. By that time the star has recovered its poise, and slowly—almost majestically, it begins its inevitable downward path, to end up again, after a long time as a very insignificant if not entirely invisible object.

WHY NEW STARS EXCITE ASTRONOMERS

THE reason that astronomers are thrown into such a frenzy by the discovery of a new star, is that they do not yet know what really happens. The birth of a new star is one of the greatest mysteries we have in astronomy. And the worst of it is that probably the most significant part of the life of a new star is the very short time spent in getting brighter. It is during those few hours that most of the enigma lies, and it is an exceedingly rare occurrence if we pick up a nova, before it is so far advanced as to have lost its pre-maximum characteristics.

What really happens when a new star appears? We do not know for certain, we can only conjecture, and describe the phenomenon in the most general and uncertain terms. How is the stage set for this, Nature's greatest drama? We do not know, we grope completely in the dark. In all probability it is all done inside the star, in the turbulent, fermenting, hodge-podge of hot gases, hidden from our view, shut off from our hearing by the eternal silence of empty space. Nevertheless, the process is going on, the celestial T.N.T. is stored up, and put together, the charges are all made ready, and the surrounding space cleared of onlookers. No advertising is allowed, so far as we now know, and there is only one performance, with possibly a few feeble encores. The appointed hour comes and the trigger is pulled mysteriously. The terrific explosion is instantaneous, but silent, because the voids of infinite space cannot carry any sound.

SPECTACULAR EXPLOSION

THE most spectacular explosion in creation, it is swift as thought, yet silent as doom. In one great leap the incandescent gases come rushing out of the interior, the whole star suddenly begins to expand at the rate of a hundred miles a second. Inside a day its diameter may have increased a thousandfold, its light a millionfold, its bulk a billionfold! If before it was the puniest of "dwarf" stars it now ranks equal to the most aristocratic giant; if it was a giant previously, it will have changed into the mightiest of all "super-giants." For the moment of its glory it has no rival in the realm of transparent space. But its reign is short, such a giant among giants cannot stay at the pinnacle of its fame but for a few hours or a day at the most. And what are a few days in the life of a star, which is counted in quadrillions of years? A cosmical instant! The star begins to fade, but while the celestial scavengers are searching through the debris, minor charges, forgotten in the general blow up are brought to light and touched off. The star is, figuratively speaking, thrown into convulsions, as if indicating its unwillingness to start on its downward career. However, obstinacy is of no avail, fade away it must, on this point the unwritten law of the conduct of new stars is quite clear. It may be a matter of months, sometimes of years, before the new star returns to its normal state, the "status quo ante," but in the end the morgue claims its prey.

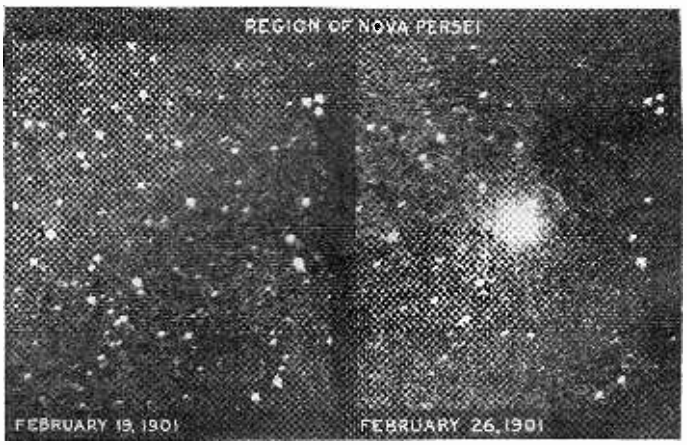
CHINESE RECORDS OF NEW STARS

AS with so many of our striking celestial phenomena, the earliest recorded observations of new stars, or "novae" as the astronomers call them, date back to the Chinese. Unfortunately, their descriptions are often very vague; translated in the language of our modern constellations such Chinese observations might read: "three days after the first full moon after the harvest a star as bright as Venus was seen near the left eye of the Scorpion," etc.

The first really systematic observations of a nova were made by Tycho Brahe, the celebrated Danish astronomer, who gave his name to a magnificent new star of 1572. When he first saw this miraculous object, he could hardly believe his eyes, and summoned all his servants, who were following him, to confirm his discovery. For a time this nova was as bright as the planet Venus, and could be seen in broad daylight. It appeared in the constellation Cassiopeia, near the five bright stars, but far outshone all of them. At its brightest this nova was twenty-five times as bright as Sirius, and now, when we look at the exact spot where it appeared we can see no star brighter than the twelfth magnitude, three hundred times too faint to be seen by the unaided eye, and we are not even sure that that is it. The remains of the nova may have entirely disappeared. But at the very least the new star has suffered a decrease in brilliance from five million to one! Other famous new stars were Kepler's star, which appeared in 1604 in "the foot of Ophiuchus," the new star in Perseus which flashed up in 1901. It was photographed in England on one night as a star of the twelfth magnitude, on the next night it was of the first, more than twenty-five thousand times brighter!

BEST KNOWN NEW STAR

PERHAPS the best known of all novae was Nova Aquilae No. 3, the new star which appeared on the scene on June 8, 1918. It was discovered independently in all different parts of the globe; the news was immediately flashed to Harvard, and immediately it was looked up on the large collection of plates there. It was then found that previous to June 6, 1918, it had been a star of the eleventh magnitude, of otherwise perfectly normal behavior. On June 7, by a piece of good luck, the region in which the nova appeared happened to have been photographed at Harvard, and the nova found to be of the seventh magnitude. When, on June 2, night fell in Japan, the new star had reached the fourth magnitude; bright enough to be visible to the unaided eye, but not yet conspicuous. When darkness advanced over India, the nova had climbed up to the second magnitude, was a conspicuous object, and was promptly discovered by an amateur in Madras. Still later, as Europe saw the sun set on its battlefields, the nova was bright enough so it could be picked out in twilight, and by the time night again fell at Harvard,



Above—the new star of 1901 Nova Persei photographed on February 19th when it was fainter than the thirteenth magnitude, and on February 26th when it was the second brightest star in the sky.

telegrams had preceded it, and immediately all telescopes were trained on it. In Chicago, the next night, it was seen as bright as Sirius, and although it declined rather rapidly after that, it remained visible to the naked eye for over a year. Even now, nine years later, it is still of the tenth magnitude, and shows no signs of returning to its former stage.

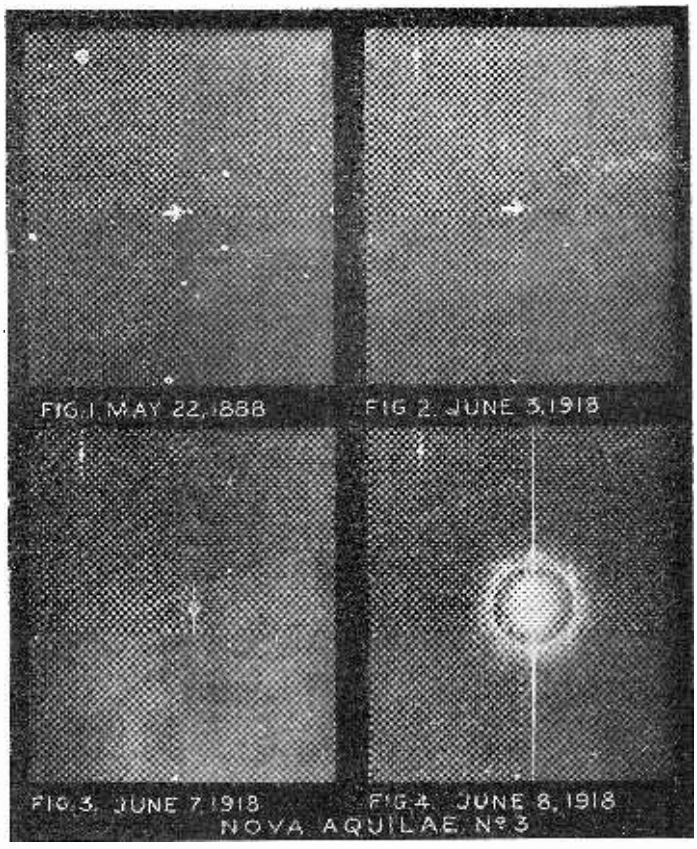
BRIGHT NEW STARS RARE

BUT such bright novae are quite exceptional. Ever since Harvard began patrolling the skies with its photographic telescopes, novae have become more and more plentiful, and new novae are found at all times. Sometimes they are "old new stars," stars that might have appeared several years ago, flashed up, and gone down again, but not discovered until several years after, as was the case with a new star which appeared in 1897, but was not discovered until 1926. When comparing two plates taken of the same part of the sky, but at different dates, it was noticed that a plate taken in June, 1897, showed a bright star, which was not visible on the later plate. Immediately the whole plate collection—the "rogues gallery" where all new stars, and everything else which happens in the sky, leaves its fingerprints, was examined, and it was found that the star had been invisible prior to May, 1897, was bright, that is to say of the eighth magnitude, in June of that year; and had fallen below the limit of visibility on the Harvard plates again, in October of the same year. A few months ago, something like this happened again: a faint star, of the twelfth magnitude, was found in the southern sky, in a great star cloud, which is known to be a hundred thousand light years distant. The star was fainter than the seventeenth magnitude all through the time this star cloud was under observation, but suddenly appeared as a star of the twelfth magnitude during the month of October, 1926. Owing to bad weather conditions, it was not seen again afterwards. This much was found out about the star when the plates were examined in April, 1927, so that we say that this nova was "one hundred thousand years and six months old."

AN INTERESTING NOVA

A VERY interesting nova was the one which appeared in May, 1925, in the southern hemisphere, particularly because its rise in brilliance was unusually slow, thereby giving us a chance to study it during this most interesting part of its career. We now know e.g., that prior to 1925 this star appeared as a star of the thirteenth magnitude, actually being three times fainter than the sun and 700 light years distant. In all probability it was a little smaller than the sun, say seven hundred thousand miles in diameter, a little cooler and a little lighter, but otherwise a perfectly normal dwarf star. Then, in May, 1925, it began to misbehave,

Do you know that stars explode? The spectacular outburst, silent yet as swift as lightning caused by gases, expand the star at the incredible rate of 100 miles per second. Many interesting things can happen, as told by the author in this engrossing story of new stars for old.

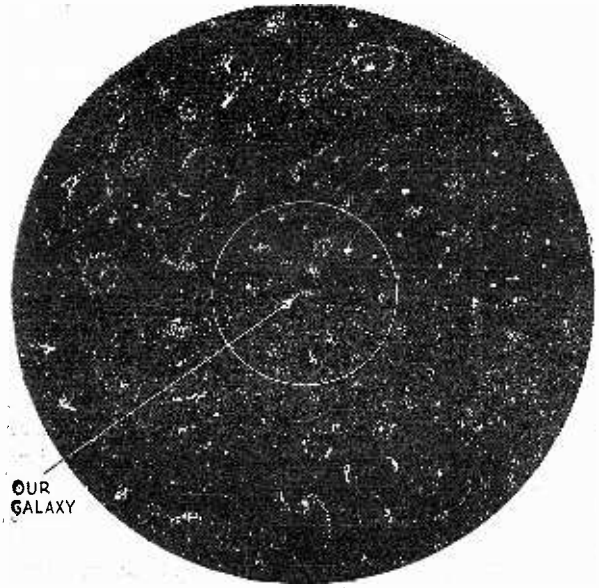


The rapid rise in brilliance of a new star is shown above. Figs. 1 and 2 show the star in aquila before it burst out on May 22nd, 1888 and June 3rd,1918. On June 7th, 1918 it had increased from the eleventh to seventh magnitude and on June 8th, it had reached a brilliancy almost equal to Sirius. The last two photographs were taken with a telescope fitted with a wire grating over the lens.

and on May 25 it had increased its diameter to 40 million miles; on June 6 it was outshining the sun 10,000 times actually, although because of its great distance it appeared to us as a star of the first magnitude, billions of times fainter than the sun.

In a few weeks this star had blown itself up from a sphere a little smaller than the sun to one ninety times its diameter, and almost a million times larger in bulk. Between May 28 and June 9 its radius had grown almost twenty million miles, indicating an average speed of twenty miles a second. And yet this is a mild case. We have known novae which hurled out their gases at the rate of more than a thousand miles a second. Can you wonder we call them explosions?

And such an explosion brings up another interesting point, viz., that one single nova can give almost as much light as a whole "universe of stars." Take the famous nova of 1885 for instance; this one appeared in the Andromeda Nebula, at a distance of a million light years. Yet it appeared to us as a star of the seventh magnitude indicating that it was actually more than one hundred million times brighter than our sun, while the whole "Andromeda nebula universe" is less than a billion times brighter than the sun.

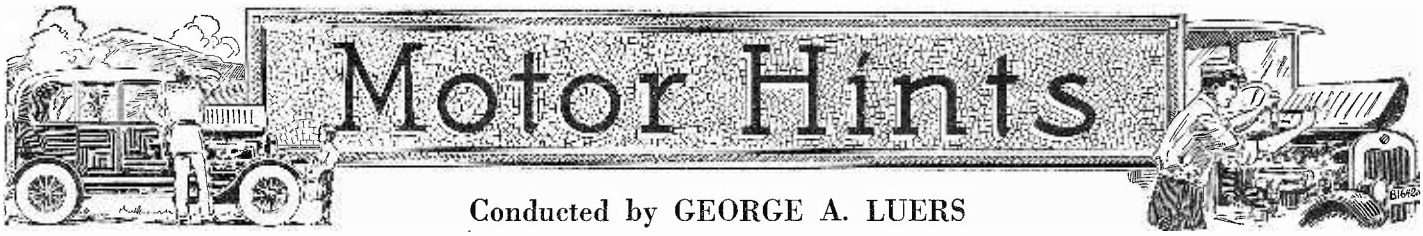


In the above illustration, the smaller circle has a radius of 300,000 000 light years and represents the limits of vision with a 100 in. reflecting telescope. The larger circle has a radius of 1,000,000,000 light years showing what the proposed 25 ft. diameter reflector would reveal.

WHAT FOLLOWS A NOVA EXPLOSION?

SOMETIMES the aftermath of the nova explosion is very interesting too, as e.g., with Nova Persei of 1901. This star very soon began to develop into a nebula, and the nebula itself seemed to expand at a perfectly terrific rate. Even the most conservative estimate of the distance would mean that the whole of this "new star nebula" was expanding at the rate of tens of thousands of miles a second. This looked suspicious, and someone immediately made the brilliant suggestion that the nebula was not really expanding, that the nebula in fact had always been there, and that the only reason that we saw it expand was that, as time went on, the light from the explosion in the center reached the outlying parts of the nebula and lighted them up; in other words, we *saw the speed of light!*

Finally, there is one more significant thing about novae, and that is the great frequency with which they occur. Even with our present surveys of the heavens which are admittedly and deplorably incomplete, we catch a nova about once a year. And since we can only catch the brighter ones the total number of new stars, including all the faint and far distant ones must be much larger. Our Galactic System contains probably fifty billion stars. We also know that the earth has existed for over five hundred million years, and the sun probably for billions and trillions of years. Now it does not seem reasonable to suppose that the past fifty years have been much different in the universe at large from the previous billion, and we have every right to assume that nova outbursts have always been about as frequent as they are now. Then at least five hundred million novae must have appeared during the time the earth has existed, which means that during this astronomically very short time, one percent of all the stars have been novae. This places us before the following dilemma: either all stars become novae in time, or: "once a nova always a nova." Either the nova stage is something which every star has to go through at least once, or it is a disease, a habit which, once acquired, returns time and again. Astronomical opinion favors the latter supposition



Conducted by GEORGE A. LUERS

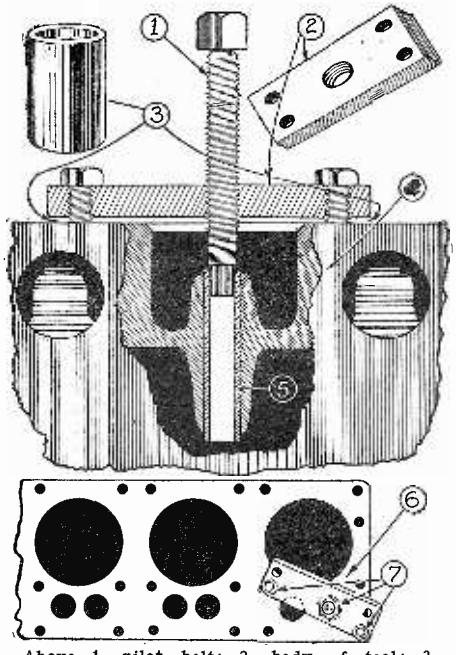
SPECIAL TOOL FOR RENEWING VALVE GUIDES

Worn valve guides, which allow air to pass through and disturb the carburetor mixture, are equivalent to leaks in the manifold and result in imperfect engine running, especially at low speed.

Also, the wear of guides and valve stems prevents the valves seating uniformly, with resultant missing.

To renew these guides, a tool of the type shown in the attached sketch can be made up quickly and easily, using only a plate of iron or steel, a long bolt, turned down with a pilot on the end, and two support pieces of pipe as spacers.

In use, this tool is fastened to the top of the engine, using cylinder head bolt holes. The turning of the long screw pushes out the old bushing. To install a new bushing, this is first entered into the valve port hole. The spacers are used under the tool and it is



Above—1, pilot bolt; 2, body of tool; 3, spacers; 4, section through valve port; 5, valve guide bushing; 6, plan view showing tool on engine head.

secured by the cylinder head bolts. Turning down the pilot bolt forces the new bushing into the seat.

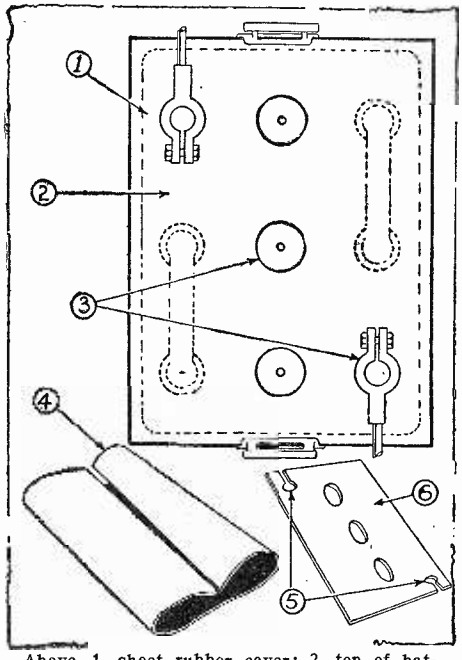
The short time spent in making up the tool will be saved on the first job of bushing renewals.

RUBBER BATTERY COVER TO PREVENT CORROSION

Fall touring usually imposes a strain on the battery, due to the long charging runs, dust accumulations, frequent refilling and extensive battery use.

Corroded terminals will occur from the acid on the battery top, or the gassing due to charging for long periods. The owner knows this condition of terminal corrosion will frequently produce resistance, interfere with the current, and cause trouble.

To avoid this trouble, a simple but effective battery cover can be made from a sheet

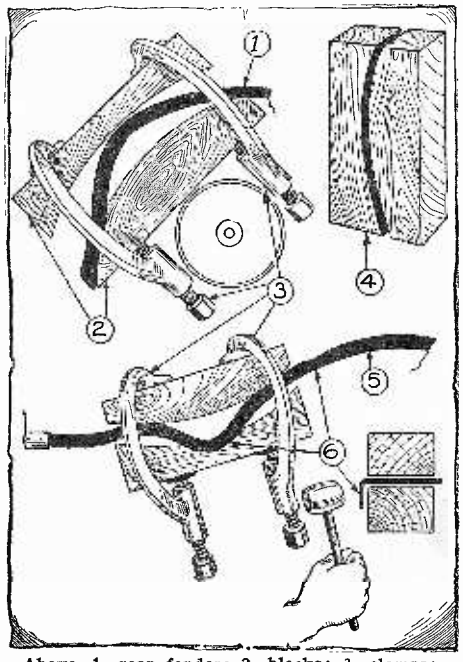


Above—1, sheet rubber cover; 2, top of battery; 3, tight fitting holes; 4, inner tube; 5, slits, and 6, the completed cover.

of rubber cut from a heavy inner tube, as indicated in the sketch.

Make this cover so that the sheet gives a tight fit around the filling caps and around the terminals. While the terminal openings are shown split, it is desirable not to split them, requiring only the removal of the connections to attach the protecting cover. This rubber cover is unaffected by the battery acid, can be wiped clean or removed for wiping, and affords a protection for the battery at practically no cost.

STRAIGHTENING FENDER DENTS



Above—1, rear fender; 2, blocks; 3, clamps; 4, method of making blocks; 5, fender, and 6, where rubber hammer is used on edges.

DO YOU KNOW—

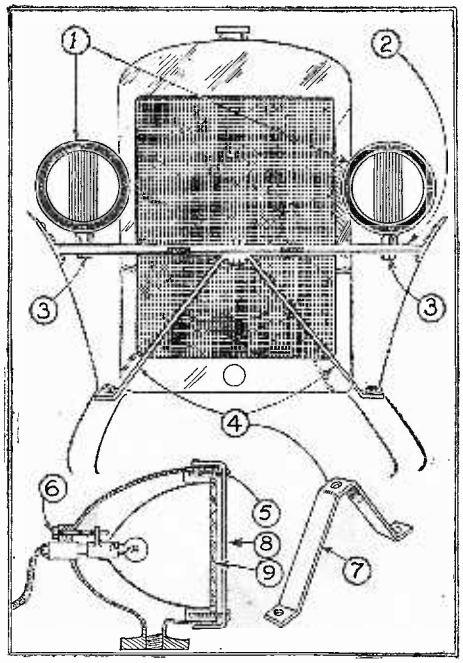
for touring, a spare key or set of keys for the car is a wise precaution. They can be safely hidden on the car. One owner places them in a hub cap.

Dented fenders are frequent, and the car owner usually is dissatisfied with appearances, if these are removed with the hammer. The marks show, and the battered condition is next to impossible to conceal.

It is far better to force these dented parts back into position than to ever hammer them. Means to force out dents are shown in the attached sketch. This affords the owner a simple method, that is not injurious to the enamel and almost invariably will restore the fender to the original shape, with little or no hammering.

Cut a six by six or larger wooden block with a narrow blade saw, so the curvature of the separating cut is approximately the curvature of the fender or slightly more curved.

Place them as shown in the sketch, force them together with two large C clamps. The buckle in the fender will be taken out



Above—1, headlights; 2, license-plate bar; 3, nuts to be tightened; 4, strap-iron brace; 5, headlight rim; 6, adjusting screw; 7, details of brace; 8, section through headlights; 9, gasket.

and unless a distinct bruised dent exists, the job will be complete without breaking the enamel. If the edge of the fender requires straightening up, this can be done while the blocks are clamped solidly to the fender.

HEADLIGHTS—METHOD OF BRACING

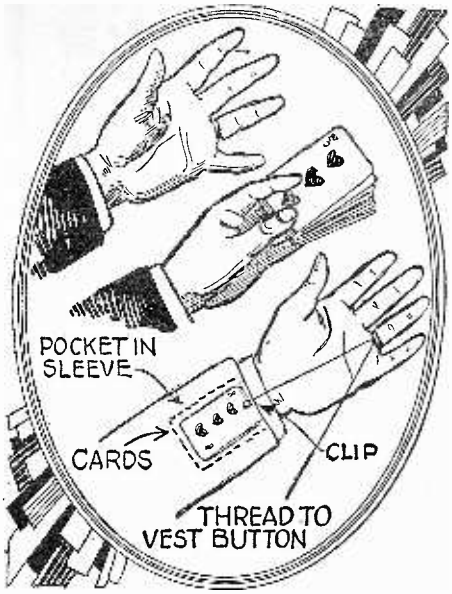
Practically all instruction books give space to methods to use in adjusting headlights. Repetition of these details are hardly necessary, as the owner is most familiar with these. (*Continued on page* 452)

MAGIC

By "DUNNINGER"

NO. 66 OF A SERIES

CARD PRODUCTION



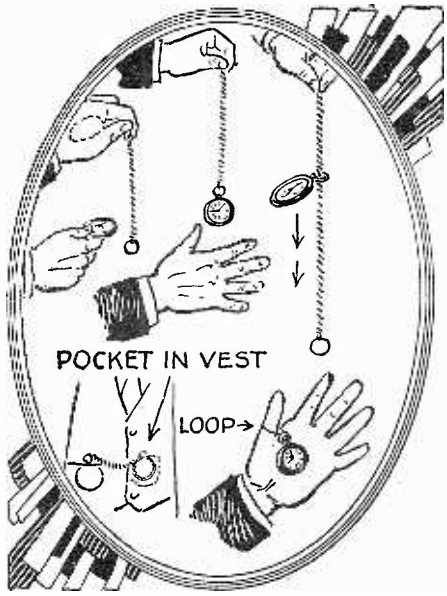
The hand is first shown empty. Suddenly it is full of cards. The effect is accomplished by having a deck of cards in the sleeve connect with the finger ring via a thread. The thread pulls the cards out.

THIS trick has never previously been published, and will be found a welcome number to those desirous of something really different. The conjurer holds his right hand far away from his body. Slowly and distinctly, he shows both back and front of his hand, fingers wide apart. Reaching into space, a handful of playing cards mysteriously make their appearance in the wizard's outstretched hand.

The diagram clearly illustrates the modus operandi. A number of cards are held together with a small clip. These cards are then secreted in a pocket, which has been formed in the lining upon the inside of the performer's sleeve. A piece of fine silk thread is tied to the clip, and passes through a small eyelet of the magician's finger ring. This ring is worn upon the middle finger. The free end of the thread is tied to the magician's waistcoat button. Moving the hand forward draws the cards out of the sleeve and brings them safely to the magician's palm.

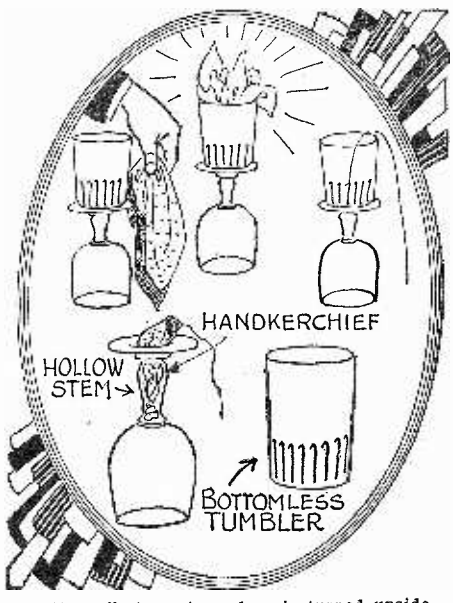
WATCH IT

HERE is an excellent impromptu trick. The effect is that a watch is taken out of the vest pocket and suspended from the chain. In this position the performer removes it from the clasp which holds it to the chain, then invisibly throws it into the air and apparently catches it on the chain again, down which it is seen to slide, coming to a stop at the bottom. In practice, the stunt is accompished in the following manner. There are two watches attached to the chain. When the performer removes one watch, he at the same time conceals in the palm of his left hand the other watch, of identical construction. The ring on this second watch is soldered at an angle directly to the stem so as not to interfere with any downward motion of the watch as it is dropped. Thus, after removing the watch from the bottom of the chain, it is apparenty tossed toward the chain again, but in reality it is palmed, with the aid of a loop of flesh colored thread.



A watch chain is removed from the bottom of a chain, tossed in the air and is caught by the chain, down which it slides to the bottom. Actually two watches are employed.

HANDKERCHIEF TRICK

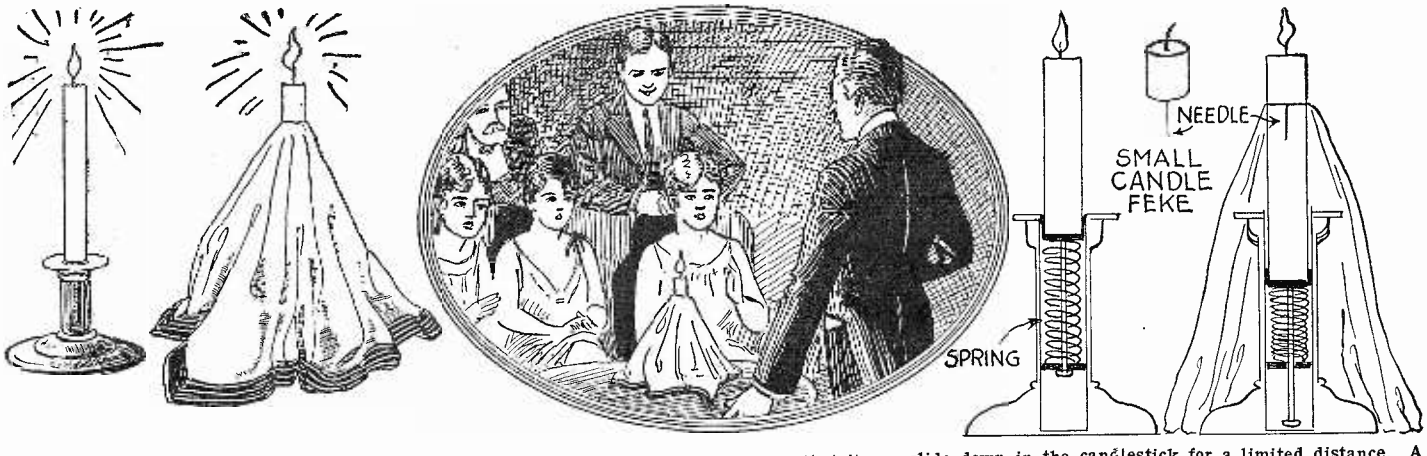


In this effect, a stem glass is turned upside-down and a tumbler placed on top of it. A moment later, a handkerchief previously vanished appears in the tumbler. The stunt is accomplished by the aid of a hollow stem glass, and a bottomless tumbler.

THE effect to the audience is approximately as follows. A transparent glass goblet is placed mouthdown on the table. A tumbler is stood on the foot. A silk handkerchief is now made to vanish and mystically appears as quick as a flash, in the tumbler which a moment ago was empty.

In presenting this trick, both tumblers are prepared. The silk handkerchief is a duplicate of the one that is vanished. It is pushed into the hollow stem of a goblet. In order to prevent this handkerchief from being seen, the stem is first lined with tinfoil. At a short distance it appears that the stem is transparent. The other piece of apparatus necessary in this effect is a bottomless tumbler. This is of the regulation type used in many different mysteries. The handkerchief is drawn into this bottomless tumbler from the stem of the glass by an assistant, who, at the proper moment, pulls it into view. Of course, a thin black thread is used.

THE PENETRATING HANDKERCHIEF



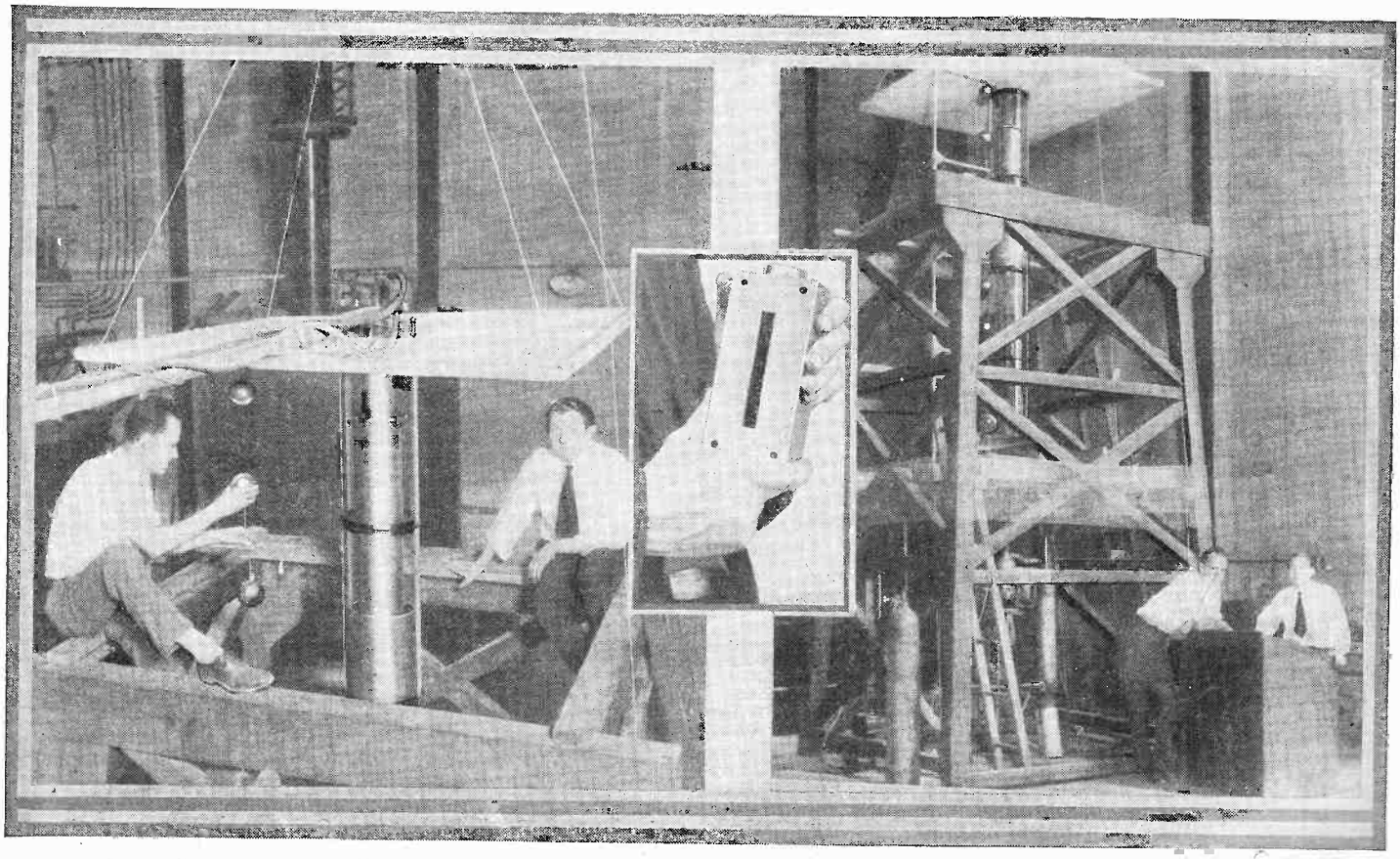
In this effect a candle is seen in a candlestick. The magician pushes a handkerchief over the flame, extinguishing it, and then, with a little additional pressure, he forces the candle clear through the kerchief. He again lights the tip of the candle. A short time later he removes the kerchief again, and relights the candle, returning the handkerchief intact. The effect is accomplished by having a candle fitted into a holder and so arranged that it can slide down in the candlestick for a limited distance. A weighted piece of candle with a needle is poked through the handkerchief unobserved by the audience and this is then put on top of the candle in the candlestick. The weight of this small section pushes the candle down, preventing the effect of a change in height. Of course, the feke is palmed both times, but this is easy under cover of the kerchief.

Can You Answer These Questions?

(Form your own answer before turning to page indicated)

1. How much more gas is liberated with a given quantity of dynamite as compared to black powder? (See page 391.)
2. Is it possible for a rocket-propelled vehicle to move in a vacuum, where there is no air for the expanding gases to push against? (See page 392.)
3. Do you believe in thought transference between two or more persons? Is there any scientific fact to make one believe that a thought wave, of an electrical nature, emanates from the brain? (See page 394.)
4. How do you explain the motion picture photography in some of the leading comedy films, wherein you see a man driving a team of horses at high speed through a crowded city street? (See page 395.)
5. If you were asked by a magician to scheme out an act for him, whereby a man would be frozen inside a cake of ice, before the very eyes of a theater audience, how would you go about it? (See page 396.)
6. Some years ago, one of the standing jokes used to revolve about the term "brakes for airplanes." The wag meant, of course, brakes for use while flying in the air. Do you know how modern airplane brakes work? (See page 399.)
7. Do you know how the famous 70-mile German gun, used to shell Paris, operated? (See page 400.)
8. Do you believe that it is possible for goldfish to live in an air-tight aquarium? If so, how do you account for the fact? (See page 402.)
9. If you are a student of astronomy, how do you explain the birth of a new star? How fast do the gases expand? (See page 412.)
10. What is a simple way in which to take motion pictures of microscopic life? (See page 418.)
11. What simple optical means would you employ to ascertain whether the filament in a frosted or incandescent lamp bulb was broken or short-circuited? How could you tell whether the lamp was new or old? (See page 422.)
12. What is the simplest manner in which you would attempt to build an iceless refrigerator? (See page 425.)

Million Volt X-Ray Tube



The above photograph shows Professors C. C. Lauritsen and R. D. Bennett adjusting the safety gaps. Professor Bennett is at the left.

A general view of the gigantic X-ray tube is shown above. In the insert may be seen a section of lead "camera" for taking pictures with the rays.

A SUPER X-ray tube which produces rays as penetrating as the gamma rays produced by radium has been developed by Profs. Lauritsen and Bennett, at the California Institute of Technology. One million volts are used with this gigantic high-voltage tube, which is made of glass and is nearly 20 ft. in length. It is built in sections, each one measuring 12″ x 28″. The cathode is a steel cylinder 9 ft. 6 in. long, and is cooled by water. The anode or positive electrode is a disc of copper, also water-cooled. The exhaustion process is kept going continuously by a mercury diffusion pump with a 5-in. nozzle, and three smaller pumps which operate just before, during, and immediately after the production of the X-rays. Power is supplied to the tube by four high-voltage transformers connected in cascade, each one capable of delivering 250,000 volts. The rays produced by the tube will penetrate 2 inches of lead and the emanations can be observed a distance of 300 ft. from the tube. Since experimentation with this tube is fraught with danger, a concrete tunnel was built, with all control switches placed therein. Observations are taken behind the tunnel walls with mirrors. This is possible, since X-rays are not reflected like light rays and thus do not affect the observers. The tube is run for about one second every thirty seconds, after which a close inspection is made and readings taken from an electroscope and auxiliary apparatus, which enables the scientists to measure the wavelengths of the X-rays.

Home Movies

CONDUCTED BY DON BENNETT

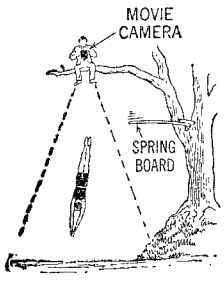
Criticizing the First Film

No. 2

"ARE my films back yet, Mr. Jones?" The speaker was Rockland's newest user of an amateur movie camera and the man he addressed came forward from the projection room of the store.

"They just came in this morning, Mr. Blake. If you'll step back here in the projection room we'll take a look at them and see how they turned out."

Blake was a little excited at the prospect of seeing his first attempts as a movie man screened, and he could hardly contain himself as Jones threaded the projector and darkened the room. A switch was thrown and the screen was flooded with light for a moment and then it darkened. This continued for almost ten seconds and Blake fidgeted. "Where are the pictures?" he asked.

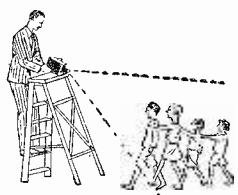


The illustration at the left shows how a novel effect can be produced by placing the movie camera above a springboard or the like and taking a down shot of the swimmer as he leaps off the board. This is often seen in the movies and is easily duplicated by the amateur.

"They'll be right along," replied Jones, "you ran off too much leader when you threaded your camera. On your camera, which has a removable lens, you can unscrew the lens and let the motor run until the film shows in the aperture. After the yellow film appears, stop the camera and set the footage meter at zero. Then you are ready to shoot." As Jones finished speaking, the picture appeared on the screen. It was a picture taken across a valley and the hills on the far side were dim and hazy.

THE RESULT OF OVER-EXPOSURE

"THAT scene is badly over-exposed, and should have been made with a filter to eliminate the haze that usually appears in scenes taken from a great distance. At that it is very hard to take a scene of a subject several miles away, no matter how large it is and get a recognizable picture."



The effect of marching straight toward and by the spectator can be produced with a movie camera arranged as illustrated at the right. Here the camera is placed upon a support, such as a ladder, for convenience.

Jones had stopped the projector as he talked and he now started it again, bringing on the screen a nicely exposed medium shot of a group of people on a lawn. They showed animation, moved around freely, and one of the children was chasing the dog around. The exposure was perfect and Blake was pleased by the compliments of Jones. Then came a close-up of the group, they were standing now in a line and the camera moved rapidly from one to another, so rapidly in fact that only occasionally could a person be recognized.

The effect of looking across the bulwarks of a ship is produced by mounting the camera as illustrated.
Photo courtesy Gotham Productions

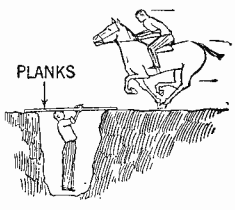
HOW TO PANORAM

"THAT panorama was taken too fast. It is a common fault of every beginner. You see the eye can rapidly move around and it will accept everything before it, but a lens and camera is not as adaptable as the human eye. A rule that I follow for a "pan" is to decide how slow I want to pan, and then go just twice as slow as that. It takes a little more film but the results justify the expenditure of the extra few feet. And your audience will appreciate your respect for their optic nerves."

"Speaking of the length of scenes, Mr. Jones, how many feet of film should I use for each shot?"

AVERAGE LENGTH OF SCENE

"A FOOT of sixteen millimeter film takes two and one-half seconds to run. Seven or eight seconds is the average length of a scene, and that means that three or three and one-half feet is about the right length for a normal scene without any unusual movement or interest. If you are following Baby's first steps, by all means keep shooting as long as the film or the baby holds out. When photographing a race or athletic event, follow your subject, keeping it as nearly center as possible. The background will be fuzzy but the center of interest will stay sharp and clear.



For oncoming shots of horses, automobiles and the like, the camera is arranged below the road bed, as illustrated. Planks can be placed over a trench with a small opening for the camera lens. This gives the effect of rushing straight onward and over the audience.

"Do not carry to extremes the rule of keeping your scenes short. One of my customers made a trip to Europe several years ago, carrying an expensive camera with him. After a six weeks tour of England and France he returned with four rolls of film, and I thought that perhaps he had been too busy to use his camera. When they had been processed and returned, we screened them here in the projection room, and I found that he had made scenes of every place he had visited; many scenes in fact. In the four rolls, a total of four hundred feet, he had over three hundred scenes, an average of one and one-third feet to each scene, about three seconds. Some of

(*Continued on page* 460)

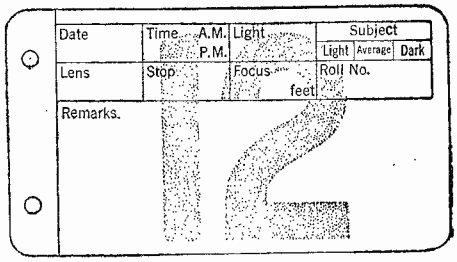
FREE FILM FOR HOME PROJECTORS

A SIX-REEL film, "In the Service of Transportation," has been offered to owners of home projectors by the Stanley Educational Film Division of New York. The film shows the many activities of the great American Car and Foundry Company and at many places reaches dramatic peaks when huge pieces of white hot metal are crunched into useful articles of commerce by powerful jaws.

A lavish use of color has enhanced the value of the film and the amateur will find much to study in this picture. Several of the most interesting scenes were taken with the camera suspended from a crane moving down the floors of shops two thousand feet and more in length. For this sequence, cameras, lights, and crew were transported on a specially built platform and the cables supplying the lights with current followed the crane as it moved along.

The film also shows fabrication of pleasure yachts and other boats in the shops at Wilmington, Del., and scenes taken in Philadelphia show the making of the street car in which you ride to work each day.

Any of our readers interested in securing this film should write the Home Movies Editor, care Science and Invention Magazine, 230 Fifth Ave., New York City, and your letters will be forwarded to the distributors of the film.

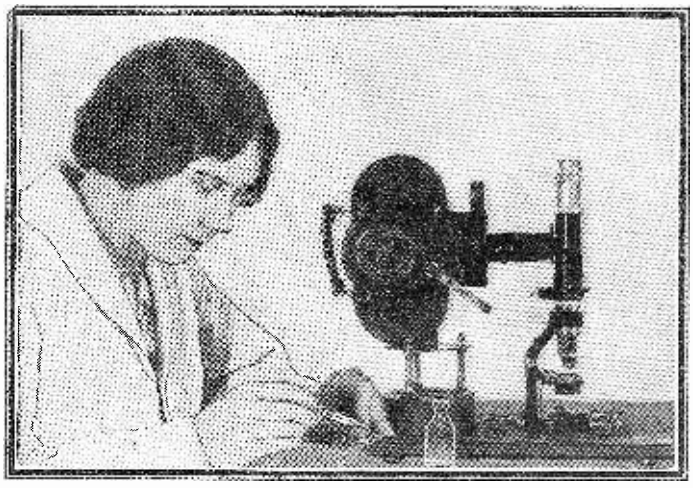


Cards for keeping the continuity correct can be purchased and are filled in and photographed. These are filed away and the various scenes can be thus arranged in sequence after the film is developed.

Movie Microphotography

By HERBERT C. McKAY, A.R.P.S.

An Invisible World Now Placed Upon the Screen



At the left—focusing the microscope. Note the camera mounted upon its stand with reflecting focusser in place of the usual camera lens.

WHILE the home motion picture can never become commonplace, it has become common. We have reached the stage in the development of the home movie where the novelty is gone and we now demand quality, amusement, information or other definite quality in the films shown in the home. In view of this fact, as well as in consideration of the field of interest of the readers of this magazine, it appears to be particularly appropriate to review one of the most recent advances in making the home motion picture serve a purpose of definite value.

Most of my readers are familiar with the wonders revealed by the compound microscope—those who are not should by all means secure one of these instruments, particularly as really excellent ones are obtainable at very low prices—and many of these are, in turn, familiar with photomicrography, the photography of objects as seen through the microscope.

The writer has had considerable experience in still photomicrography, including color separation, making three-color record negatives for natural color reproduction, stereo-photomicrography with the binocular microscope and other phases of this fascinating field, and from some particularly bitter experiences he can say that photomicrography is not easy—however, it is a surprising fact that motion-photomicrography has been made so simple that any owner of a 16 m/m camera may venture into this field with full assurance that his efforts will be successful.

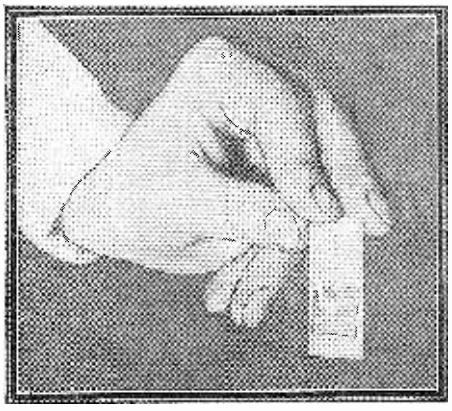
This may appear incredible, yet it must be borne in mind that a great many amateurs who have never truly succeeded in still photography have succeeded from the first with motion photography. It is a truism that motion photography is easier than snapshot work.

FIRST ESSENTIALS

THE first essential for photomicrography for moving pictures is a motion picture camera from which the lens may be removed and which has the standard 16 m/m lens collar, such as the more popular American cameras have. In fact, it is only a question of a few weeks until all American motion picture cameras using 16 m/m film may be equipped with this standard lens collar at a purely nominal cost.

In addition to the camera the following equipment is needed: a prismatic focussing device which screws into the collar in place of the lens, a little device known as a "microphote," a compound microscope and a suitable source of light, the conventional microscope arc light being preferred.

The camera with the prismatic device is placed upon a suitable support, such as one of the disc supports obtainable in any photographic supply house. The microphote is placed over the eyepiece of the microscope, with the prism outlet directed toward the opening in the prismatic focusser. The arc or other lamp is then lighted and the fullest possible illumination arranged. A ground glass screen should be placed between the arc condenser and the microscope mirror; otherwise the heat would soon cook the object being photographed.

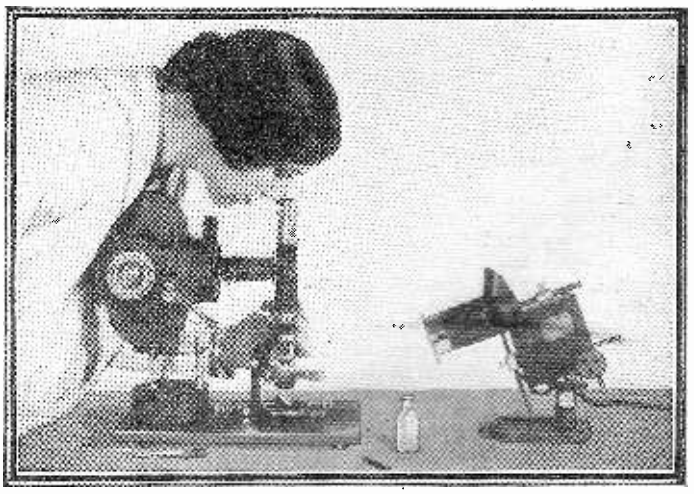


A drop of water upon the microscope slide, covered with a cover glass.

The microphote is adjusted according to directions supplied with each instrument, so that the prism lies in the plane of the pupil emersion point, which lies from five to ten millimeters above the eyepiece lens.

HOW TO FOCUS

AS the 16-millimeter camera has a gate too small to allow direct focussing upon a piece of ground film, the prismatic focusser is used to secure the utmost critical focus. When this is done, the field is watched through the eyepiece of the microphote, and the subject being under constant observation may be controlled by moving the slide. As only about 1 per cent of the light goes to the ocular, the other 99 per cent going to the film, the light loss is negligible.



At the right we see a drop of pond water being examined on a microscope slide.

It will be borne in mind that as there is no camera lens used, the exposure, once determined, will remain constant.

It will be noticed, also, that the farther the reflecting prism is from the film the larger will be the object's image. As the film is subjected to approximately 100 x enlargement in projecting upon the usual 30 x 40-inch screen, it is suggested that the output tube of the microscope be placed about 1/16 inch from the prismatic focusser tube, the junction being covered with a roll of black paper.

The microscope should be equipped with a substage condenser for the best results, but this is not essential.

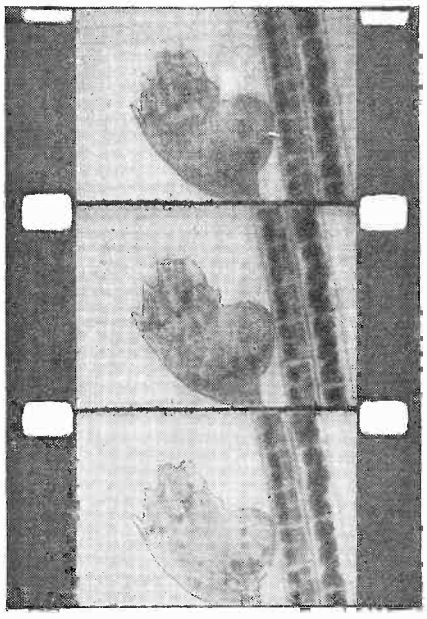
WHAT TO PHOTOGRAPH

THE subject may be a drop of water from any nearby stagnant pool. In the heart of New York the writer finds it easy to secure unlimited material in the nooks of the public parks. The microscopic animal life in such water has furnished him with ideal subjects.

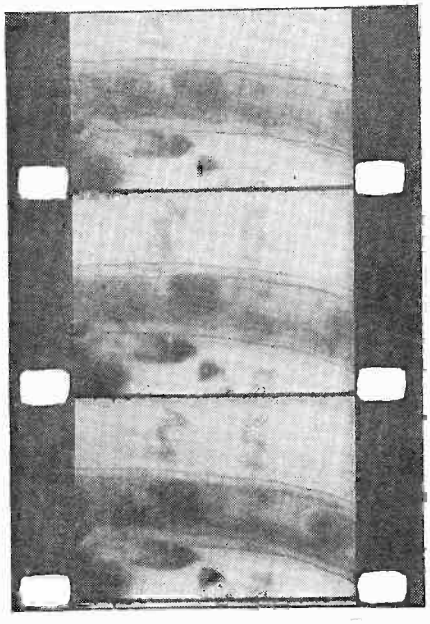
The slide bearing the object is moved about until the subject is found. When this is done, the iris of the condenser is closed to its smallest aperture. This brings out the full detail of these small subjects in a truly remarkable manner, when it is remembered that these tiny creatures are transparent. After this the field of the camera is observed in the prismatic focusser telescope. Looking into this eyepiece the subject is focussed sharply, regardless of the focus obtained in the ocular of the microphote, as this device shows the actual camera field. When this is done, the focus of the microphote ocular is adjusted to give a sharp image, *without changing the focus of the microscope itself*. This brings the observation and camera foci into simultaneous adjustment.

IF THE SUBJECT MOVES

DURING all of this time the subject has perhaps moved. It is again centered in the field of the microscope, the arc carbons are brought into correct adjustment if the arc is of the hand-controlled type. The position of the slide is given a final adjustment. The prism of the focussing device is removed from the path of the light and the control of the camera pressed home and locked. The hands are thus left free to control the slide. A mechanical stage is convenient, but not at all necessary. The writer



One microscopic animal feeding upon another.



A huge water worm is shown above.

uses a small folding microscope without such a stage and has had full success.

The slide is moved just sufficiently to keep the subject within the field of the camera, the movement being as slow as the movement of the subject will permit, as a rapidly moving background is distressing in any motion picture.

THE writer has found that with the four-ampere arc, equipped with a colorless ground glass screen, placed at twelve inches from the mirror, and with the smallest condenser iris aperture, using an initial (microscope) magnification of 150 diameters, full camera speed with negative (not reversing) film gives a very good exposure.

Using this method and similar equipment the amateur will have no difficulty in engaging in this fascinating field of moton picture photography. In closing, let us sum up a few vital points.

The camera will register no more detail than is visible to the eye.

Don't jar either camera or microscope during exposure.

Use full-speed automatic drive. Don't try to hand crank the camera.

Have the reflecting prism directly in the plane of pupil emersion of the microscope. This point is determined by holding a piece of ground glass or film above the eyepiece. The point of pupil emersion gives an image as a tiny, round spot of great brilliancy and with sharp edges. Measure from this point to the eyepiece lens. Then set the prism at this height above the eyepiece lens by means of the calibrated scale on the microphote.

Do not forget to pull the prism of the focusser out of the light path before starting the camera. Control the object by watching it through the ocular of the microphote.

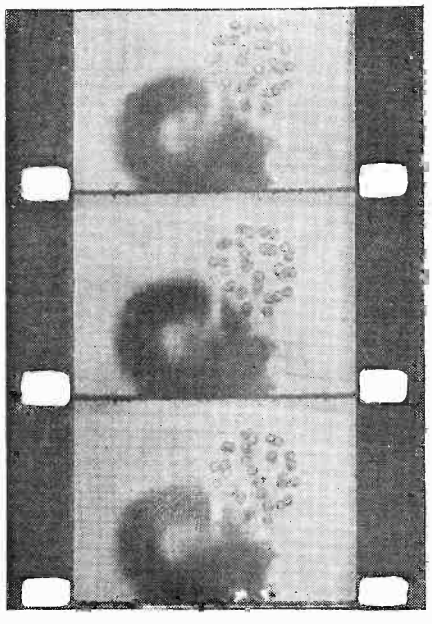
Do not use too much water or the subject will have room to swim up and down out of focus. If this occurs, stop the camera, do not try to refocus while the camera is running. You will only waste film.

Always use a cover glass over the droplet of water, for the reason above mentioned.

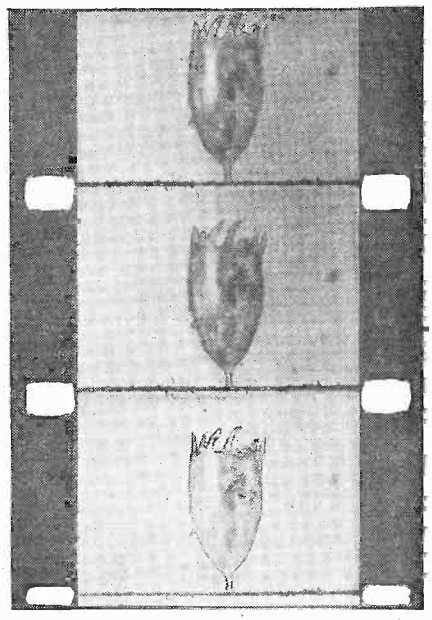
Use a substage condenser whenever possible. The improvement in results will repay the slight additional expense.

If your first film has faults, determine the cause before making the next. With apparatus designed for different purposes, with no guidance except still photomicrography and with no knowledge of others' experience in this field, the writer had gratifying success with the first film exposed.

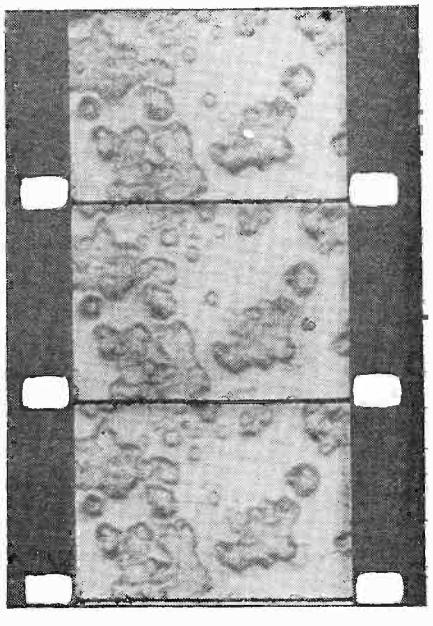
Names of manufacturers of special equipment supplied on request.



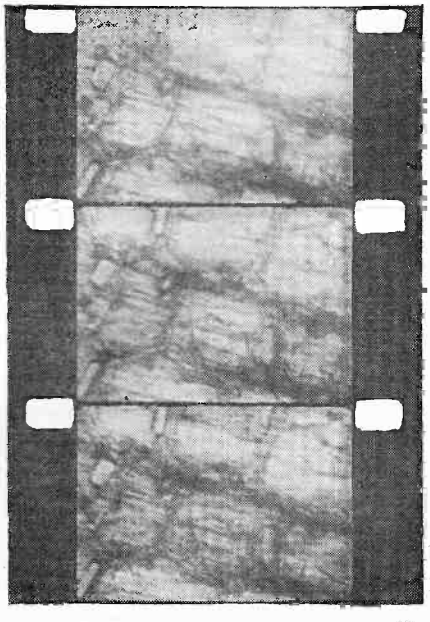
One of the beautiful forms found in pond water.



An animalcule ingesting food.



A solution of salt crystallizing.



Above—a section of onion skin.

ATTENTION, BOYS!

Announcing a new event of interest to you youthful readers, with especial interest for young inventors, chemists, machinists or workers of every type. Every boy has ideas or possibly realized plans for some time or labor-saver which the world is waiting for. In this way you can put your pet schemes before thousands, and have a chance for outside help.

You are all urged to write of any plans or ideas you may have in regard to the amazing inventions of the future. Regardless of size or possibility your letters are wanted.

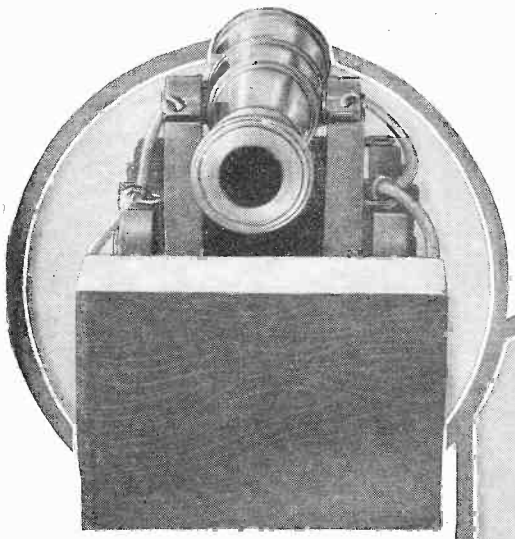
SCIENCE AND INVENTION will publish many of the plans, along with the opinion of an expert on them which will be of value to you.

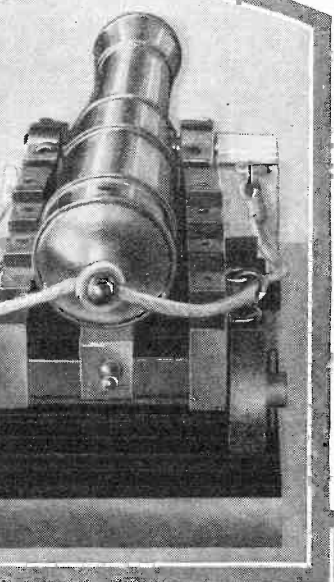
Address all communications to the Editorial Department of Science and Invention, 230 Fifth Avenue, New York, N. Y., Dept. X.

Model Department

Constitution Gun Model Wins Cup

Model of the 24-Pounder Carries Away the Award for Alexander Malcolm, of Elmhurst, Long Island

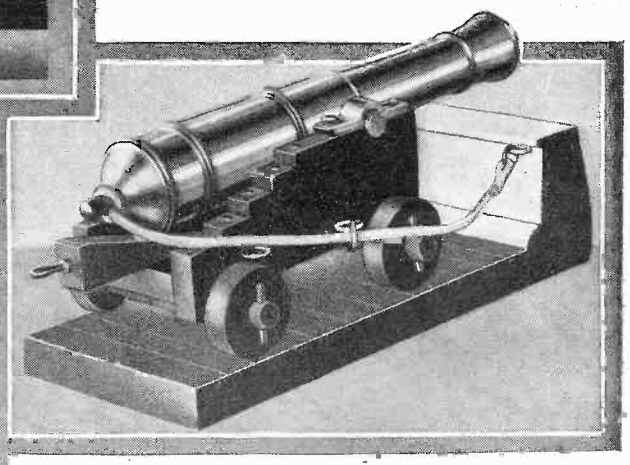




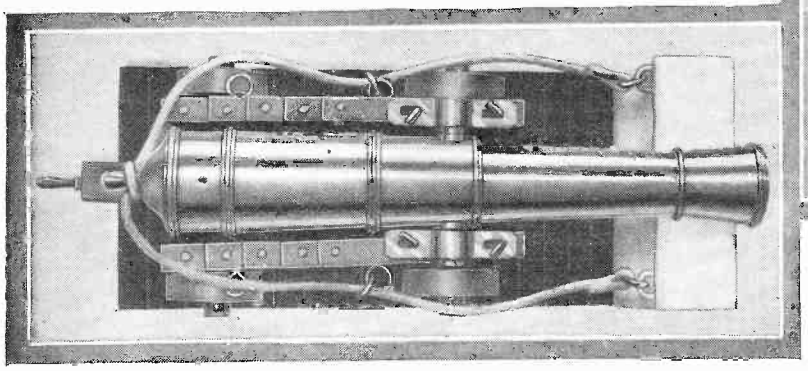
THE above photograph shows the SCIENCE AND INVENTION model trophy award, a duplicate of which is given monthy to the individual submitting the best model. This month the prize was awarded by the judges to Alexander Malcolm for his model of a 24-pounder gun. This gun is the type used on the U. S. S. Constitution. The barrel of it is made entirely of brass, and the bore is drilled all the way in to within a short distance of the breach. The trunnions are then also made of brass and fitted into the sides of the gun in a press fit.

We would urge model enthusiasts to submit their specimens to the judges of the Model Trophy Contest. The rules of this contest can easily be met. They will be found in detail in the present issue on page 465.

THE readers of SCIENCE AND INVENTION Magazine already know of the Model Contest which for several years has been conducted by this publication. Every month a model trophy cup is given away for the best model submitted during the month, and it does not make any difference what that model is, whether a ship, an airplane, a submarine, or what not. The construction of the model is an important consideration. Model engineering is an enthusiastic sport. From models some of our greatest sciences have developed.

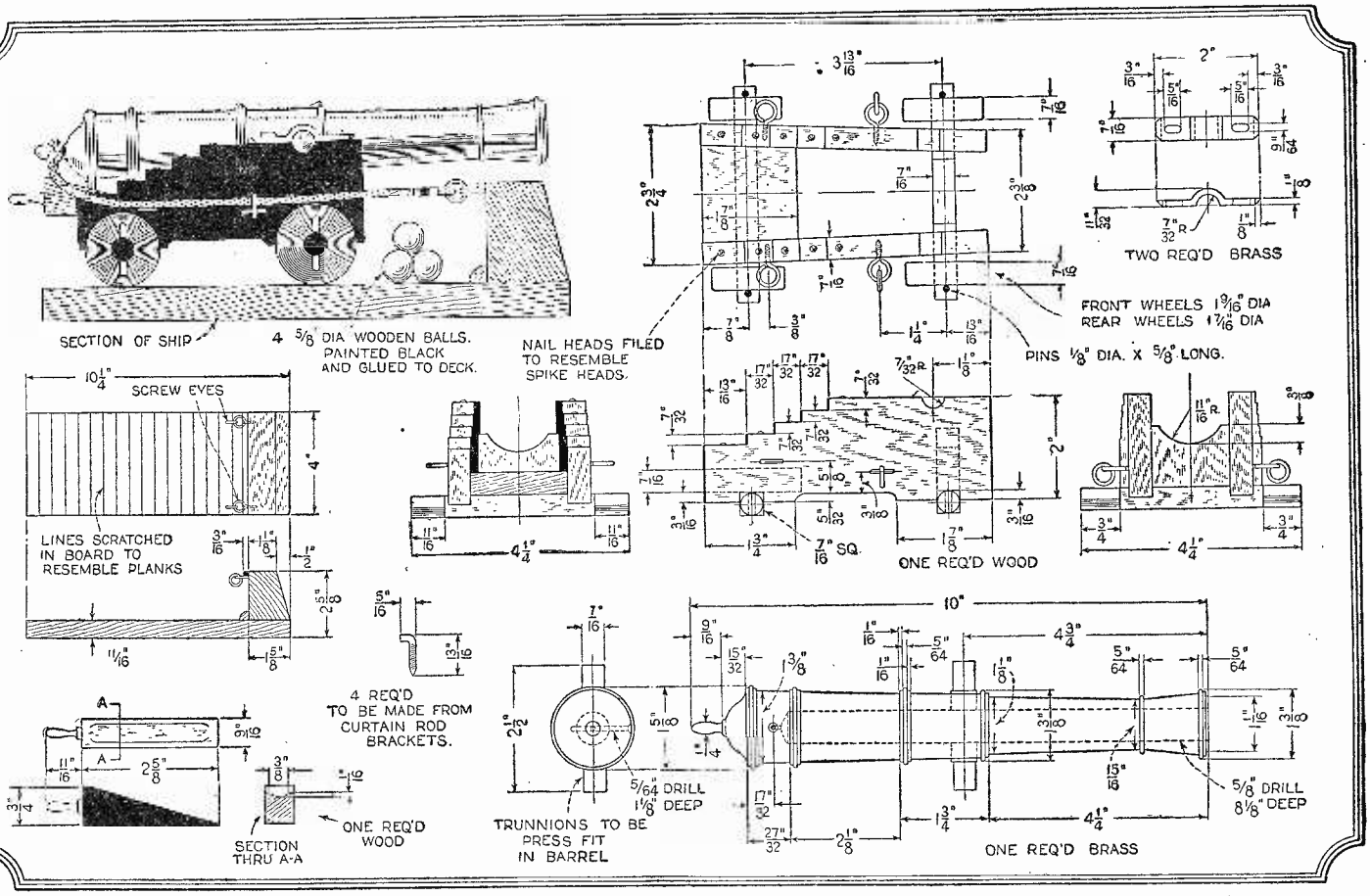


Above there is a rear view of the cannon such as that used on the U. S. S. Constitution, otherwise known as "Old Ironsides." This cannon presents an historical interest, aside from its quality as a well finished product. Its ease of construction is great, so much so that any model enthusiast can easily and quickly duplicate the model by following the drawings on the adjoining page.



Above we have a side view of the cannon as mounted on what ostensibly appears to be a cross-section of the ship, and at the left there is a top view of the 24-pounder gun. The other views on this page show the front view and the back view of the finished article.

CANNON DETAILS

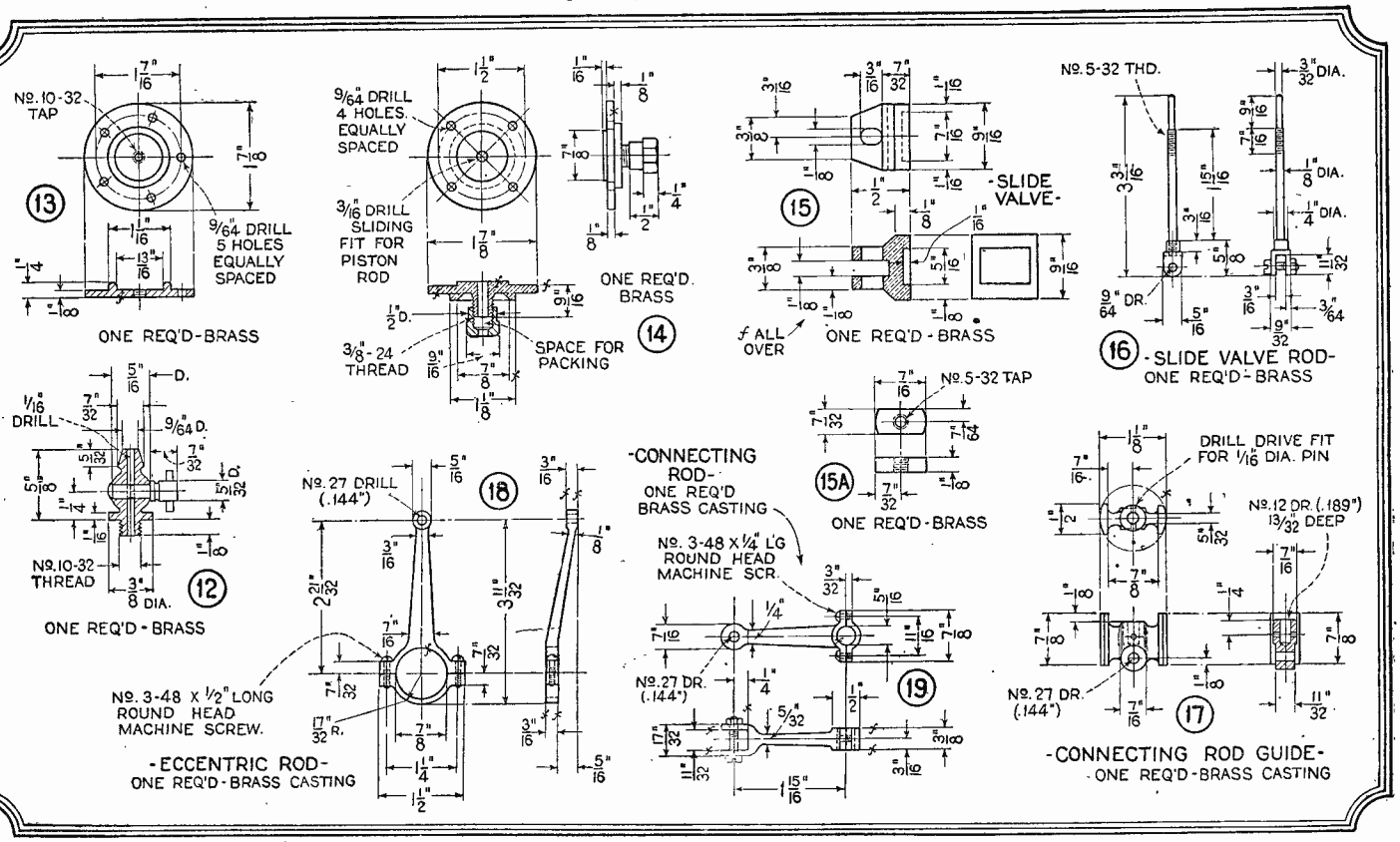


The diagram above gives full constructional details for duplicating the cannon which won the cup in this month's trophy contest.

The section of the ship is made of wood, the cannon is of brass, easily turned on an ordinary lathe.

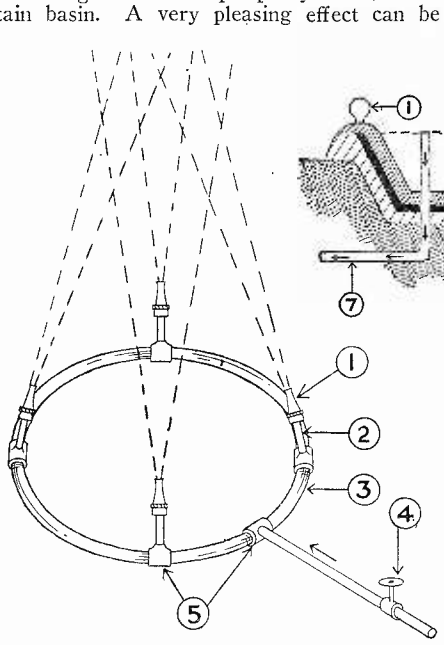
STEAM ENGINE DETAILS

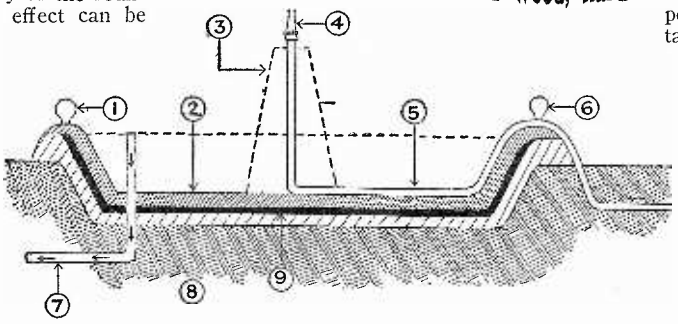
Completed from the Last Issue

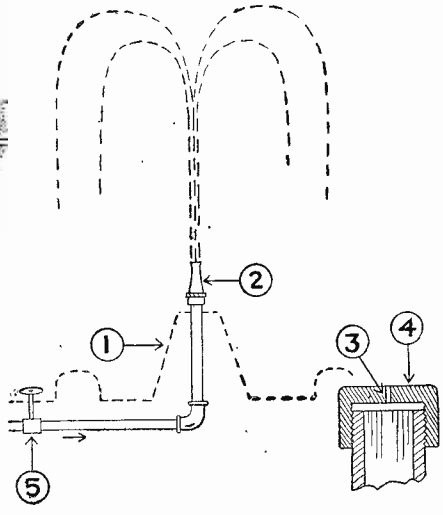


The above diagram represents a few of the details which were not included in the diagram of the steam engine which won the prize in the last issue. It will be remembered that these details were promised. Finished dimensions are indicated above.

reaming. The usefulness and beauty of the fountain can be greatly added to by the addition of colored lights. Colored or white light, with flood projectors, if desired, can be arranged about the periphery of the fountain basin. A very pleasing effect can be obtained by arranging them in a circle as illustrated, having three red, three white, and three blue lamps. Connections to these lights are also shown in the illustration, the respective colors being designated by R, W, and B. A small flasher for turning each of these groups alternately on and off may be built or purchased and is operated by an electric motor. Discs of hard wood, hard rubber or bakelite carrying metal contacts are placed upon a shaft as illustrated. As each of these revolves, contact is made with a brush or piece of flexible metal, completing the electrical circuit and causing the lights to flash on and off. Two flood lights can be arranged at the base of the nozzle support as illustrated and may be fitted with colored bulbs or colored celluloid. It is important that all electric wiring in the fountain should be well protected from moisture, and rubber-covered cables placed in a lead sheath are probably the best for use in this work. In the case of the lights, which are attached to a circle made of pipe, the wire can be led directly into the pipe, as shown at 3 in the drawing. The electric motor used should be protected from the weather.







Above is a cross-sectional view of a fountain with an outlet provided, so that the water will always remain fresh, permitting goldfish to be kept in the basin. Numbers 1 and 6 indicate lights; 2, upper layer of cement; 3, support, 4, nozzle; 5, water pipe; 7, outlet; 8, bottom layer of concrete; and 9, waterproofing material (tar and tar-paper).

The illustration at the right shows the details of a home-constructed nozzle, and the arrangement of water supply. 1 is the upright support, 2 is the nozzle, and 5 the valve. 3 indicates a small hole drilled in a pipe cap, and 4 is the cap used as nozzle.

In the illustration at the left, 1 is a nozzle, 2, nozzle upright; 3, circle of pipe; 4, regulating valve; and 5 indicates tees. A pleasing effect can be obtained by pointing each nozzle inwardly as shown.

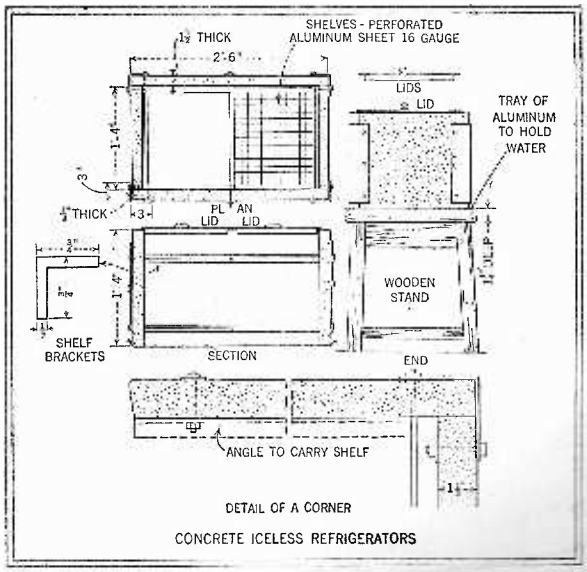
Building an Iceless Refrigerator

By I. J. LOVETT

IN making this refrigerator it calls for a clear departure from the usual practice in making concrete. At first though it may seem an easy accomplishment to make waterproof concrete but porous concrete has its own proper technique, for in this case it would be a great failure in effort if partly porous and partly impervious concrete were made. Porous concrete can only be made exactly in proper quantities to achieve results; the proportions and type of aggregates and cement used must be exact for successful working. The controlling idea in using a porous concrete for an iceless refrigerator is that if water is supplied at stated intervals according to the heat of the weather, then evaporation of the water takes place, quickly or slowly, and produces coldness by extracting heat from the interior of the vessel containing the water, the greater the heat the greater the evaporation and the coldness, which then cools the materials in the vessel. From these premises it is possible to design a vessel of porous concrete that will give the quickest evaporation for the degrees of heat surrounding the vessel, in this case, at the room temperature. In the hot air of a room—say, at 80 degrees F.—that is well ventilated, water in a porous substance that will absorb it will evaporate as much as one gallon in five hours, and reduce the temperature in the vessel down to about 45° F.

The detailed drawings give full particulars of the construction. The four slabs may be made in moulds of 3 in. by 1½ in. dressed timber, held together by clamps or stops and wedges laid over a level floor covered with a single sheet of canvas that has been soaked in paraffin oil. The concrete must be mixed just wet enough to ball in the hand when squeezed, for at this dampness it can be tamped into the mould and be leveled off with a straight-edge, and smoothed.

The aggregates used for making porous concrete are pumice-stone, porous slag, or light cream-colored brick, tile and pipe waste, all of which may be crushed to pass a ¼-in. mesh sieve and be retained on a No. 16 sieve, or a coarse, clean sand of the same grading may be used, but the former are best. The brick, tile, or pipe waste can be cheaply bought from some works, nearly all of whom have kiln-damaged goods which they sell for concrete work. With the sand extra care must be taken to grade it so that it does not make a really dense concrete, and is uniformly porous. The aggregates of clean brickyard waste give the best results, because these materials are usually porous and absorbent in themselves, and give the most pleasing color to the concrete. The combination forming the iceless refrigerator consists of four precast pervious slabs, a metal tray or base to hold water, a cover or lid, shelves and binding angles shown in the drawings. A further detail is the stand, which may be of wood. The metal parts are preferably made of aluminum, as this metal is light, rustless and of good appearance. The four slabs will weigh about 90 lbs., and the metal parts about 10 lbs. The standard plant shown calls for two side concrete slabs 30 in. by 16 in. by 1½ in. thick, and two slabs 16 in. by 16 in. by 1½ in. thick. The holes required may be set out on the mould, and be formed by inserting long, thick screws into the pallet, if of wood, otherwise the holes may be set out on the finished cured slabs. The aluminum angles may be about 3 in. by 3 in. by ⅜ in. thick, the nearest stock size to this will do, and they may be plain faced, or pierced in a design if a fine finish is required. The sixteen bolts of the same metal will be 2 in. long from the inside of the head, so as to hold the angles carrying the shelves, the shelf angles are ¾ in. by ¾ in. on each face, and the four long bolts 24 in. by ⅜ in. diameter. The shelves are four pieces of perforated aluminum sheet of 16 gauge, the tray is of the same metal and stock pattern about 1¼ in. deep and with tapered sides. The cover must be loose fitting, and is best made in two halves, for convenience, so that the whole of the interior is not exposed when in use. When the refrigerator is assembled all that is necessary is to fill the base pan full of clean water.



Details for the iceless refrigerator which is described in the text are given above. The refrigerator uses the evaporation of water as a cooling medium.

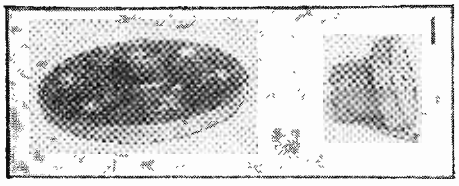
Wood Turning for the Amateur

No. 3 of a Series

By H. L. WEATHERBY

FACE-PLATE TURNING

FACE-PLATE turning opens up a new field to the craftsman who has a lathe, and if the cuts, as explained in previous articles, have been mastered, no difficulty should be experienced in face-plate turning; and many are the useful articles of furniture that can be turned, using a combination of spindle and face-plate turning.



Face-plate and screw-plate.

THE TOOLS

THERE is nothing new or different in the way of tools used, excepting the face-plates themselves. One should have a small face- or screw-plate with a single screw hole in the center and a larger plate with several screw holes near the outer circumference, for larger work. With reference to the cutting tools themselves, only those used to date on spindle work are necessary.

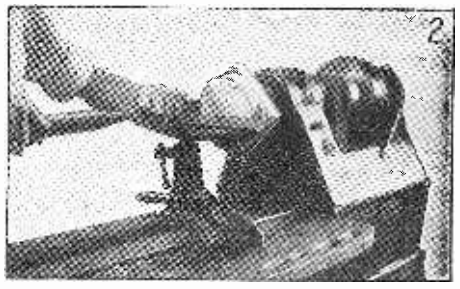
When fastening pieces to the face-plate, short screws of large diameter are needed, and for smaller work, which is attached to the screw-plate, we use a single screw long enough to care for the job at hand. The writer, from his own experience has found that the tendency of the work to turn on this single screw may be overcome by drilling two additional holes in the outside of the screw-plate for short screws. Where this is found to be impracticable, a folded piece of sandpaper, with the sand side out, placed between the plate and the work, will usually prevent the block from working loose and turning.

There should be no end play in the spindle of the lathe, and where this exists, adjustment should be made, if good work is to be the result.

The position of the tool rest will vary with the cuts being made, and with the tool used, but as in spindle work, it should be as close to the wood as possible at all times, and at such a height that the cutting edge of the tool, when it is held parallel to the bed of the lathe, will fall on a center line across the piece of work.

THE EXERCISES

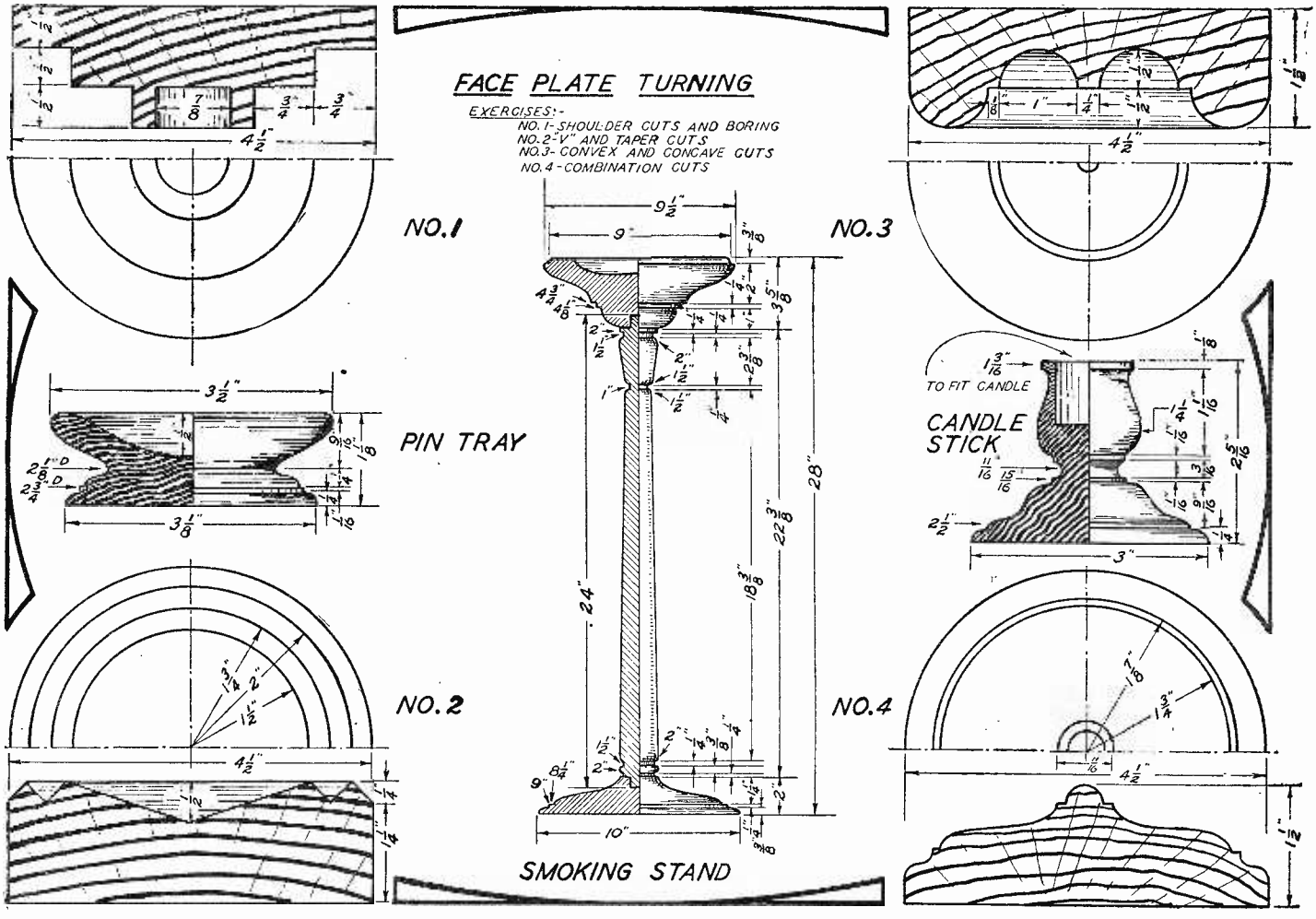
OUR work this month will include several small useful articles of furniture, but for the sake of practice, and to acquire skill in the use of the tools, on face-plate work, we will start off with several exercise pieces. To begin these, cut several blocks of wood about 1¾" x 5" x 5" from poplar or other close-grained wood and fasten one to a screw-plate, using the folded sandpaper as suggested, or else drill the two additional holes in the plate before starting. Now, for cutting off the corners, we set the rest at right angles to the bed and at a height for use with the large gouge. Turning the gouge on edge, and with the lathe in one of the low speeds, push the tool into the outside of the revolving stock at an angle, making a shearing cut. Do this until the corners are removed from the piece.



Roughing off the corners on the lathe with gouge.

With large work or hard wood, it is advisable to saw the corners off before the block is placed in the lathe. When the cor-

(*Continued on page* 454)



Practical examples of wood turning which the amateur will find interesting to make.

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, whether caustic or not. So if you have anything to say, this is the place to say it. Please limit your letters to 500 words or less, and address your letters to Editor—The Readers Forum, c/o Science and Invention Magazine, 230 Fifth Avenue, New York City.

ULTRA-RED RAYS AND THE FILTERAY PAD

Editor, SCIENCE AND INVENTION:

Enclosed find ads of two outfits that are working this vicinity very strenuously at present. The one with the "ultra-red" claims is a new one on me. I supposed we had infra-red, visible spectrum and ultra-violet.

As an inveterate reader of your magazines, I thought you might do some good to possible dupes of this class of advertising.

W. A. ZIMMERMAN,
Huntington Park, Calif.

(The word ultra-red is used at times indiscriminately with infra-red. Both of them are technically the same. The filter pad is primarily an electrical heating pad. Infra-red rays are heat rays and most of the action obtained from a device of this nature, if not all of it, is due entirely to the heat developed. Magnetism cannot be taken into consideration. There is nothing mysterious in the system, other than the way the gullible are made to believe in the rather distorted scientific reasoning. For instance:—"The ultra-red rays such as we generate in this pad do not depend upon heat—but heat goes with them." "Filtered ultra-red rays . . . pass through flesh or bone . . . and perform the chemical change in living matter. . . . "They locate the source of congestion"—all of which is absurd.

It must not be forgotten that heat is very valuable in the treating of certain ailments and conditions. Hence, the pad referred to actually accomplishes something and cannot be classed with the fraudulent devices that merely produce a mental reaction rather than a definite physical reaction.—EDITOR.)

HAS WON A CUP

Editor, SCIENCE AND INVENTION:

Words cannot express my thanks to you for the honor you have bestowed upon me by rewarding me with this splendid trophy cup. I am speaking candidly when I state it is far beyond my expectations. I decided right away after seeing the cup that it was my duty to give your magazine a boost, so in less than one hour after receiving it, I had it put on view in the window of the leading hardware store in the city of Fernie. I intend also to have the cup, model and a few back numbers of your magazine on display at the Calgary Exhibition and Stampede which hundreds of thousands of people go to see every year. You may count me from now on as one of your boosters. I thank you again.

WALTER WALLS,
Coal Creek, Fernie, B. C., Canada.

(We are mighty glad that you like the cup and we trust that for a great many years you will continue to boost SCIENCE AND INVENTION Magazine. We are appreciative of all your efforts.

We hope that you will encourage those of your friends who have been interested in model-making to submit their models in this cup contest.—EDITOR.)

MAGNETIC COMB

Editor, SCIENCE AND INVENTION:

I always read your magazine with interest and pleasure.

In it many frauds are exposed, and thus you do good service for the laymen who always believe anything that is printed and thus waste their well-earned money over such humbugs. I post with this letter an advertisement which speaks highly of the magnetic comb of Dr. May. I am not the subscriber to the paper in which it appeared but I found it accidentally in a grocer's shop.

Once more let me tell you that your magazine is the one I enjoy the most, and whenever I have shown it to anyone, he or she willingly becomes a subscriber.

Wishing to see still more articles in Junior Electrician, I am

H. B. P.
Bombay, India.

(There is nothing of any value in a magnetic comb, in magnetic blankets, magnetic caps, magnetic shoe soles, or any of the many other similar systems that have appeared on the market. Many articles of the ilk of the above have been refused the use of the U. S. mails. However, in certain foreign countries, where mail inspection is not as thorough as in the United States, many frauds are being daily perpetrated. A complete article on the worthlessness of such electro-magnetic frauds was given in the April 1920 issue of SCIENCE AND INVENTION Magazine, under the title of Electro-Medical Frauds.—EDITOR.)

IONACO AGAIN

Editor, SCIENCE AND INVENTION:

Can you tell me if the Ionaco of the John Wanhope, Inc., with offices in Rochester, Syracuse and Utica, N. Y., and Columbus, O., is what it is advertised to be over the radio ?

A member of our family is in need of help and thought that before we would invest—the price is $58.50—we would try to learn if to your knowledge its worth has been proven. We read of similar things in your magazine, and hence are writing you.

Would appreciate any information.

MRS. F. L. BISHOP,
Columbus, O.

(No, Ionaco will not do what many of the advertisements claim it will do. A complete exposé on Ionaco appeared in the October 1927 issue of SCIENCE AND INVENTION Magazine, copies of which you can probably find in your public library. In this article, the Ionaco was conclusively shown to be quite worthless in the treatment of human ills. Testimonial letters are available on any type of apparatus, regardless of its purpose, and many of the Ionaco sales are a result of these testimonials. Essentially, the apparatus consists of a coil of wire which is plugged directly into the 110 volt alternating current circuit. The claim made that there is an electronic effect on the iron of the red blood cells is unwarranted and has not been proven experimentally or otherwise. The iron in the blood being in a non-magnetic form, cannot very well be influenced by the Ionaco. We might just as well try to affect the iron in a bunch of spinach.—EDITOR.)

PHRENOLOGY

Editor, SCIENCE AND INVENTION:

Raboid's Tommy rot of phrenology is absurd.

Clue to personality—The claim of the physiognomist that he is able to judge character by shape, location and texture of the features is absurd. Expression sometimes gives a clue to the personality, particularly if the individual is a grouch, whose face bears a continual scowl.

Dissipation, disappointment and tragedy leave their marks.

A man with fleshy cheeks is usually a heavy eater, and if he has laugh wrinkles about his mouth and eyes, his disposition is sunny.

But such conclusions are obvious and are arrived at without scientific knowledge.

Are your eyes deep set, signifying animal cunning.

Are your ears small, denoting selfishness?

Are you a low brow—with a scanty forehead, which indicates criminal tendencies?

If his ears are large and yours small, it doesn't necessarily mean that he is generous, while you are selfish and niggardly. Not a bit of it.

If he has the hawk-like Roman nose and yours is but a pug nose, there is no reason for believing that he is aggressive, forceful, persistent and imperialistic, while you are meek and without willpower.

Analysis of the character by the shape of the head or a combination of the features is "THE BUNK." It is as scientifically impossible as a trip to the moon in a sailboat.

There is not the slightest semblance of TRUTH in the statement that a wide, high forehead is a measure of intelligence. A "low brow," so far as skull formation is concerned, may be just as intelligent as a "high brow."

Anatomically, the height of the forehead is no index to the gray matter behind it.

The height of the forehead may be due to the size and number of the cavities existing immediately above the eyes and nose. The size and shape of the cranium does not furnish the slightest means of determining quantity or type of intelligence (*except in micro- or hydrocephalic beings*).—EDITOR.

The old deeply cherished superstitions that a long sharp nose indicates an artistic temperament, that bumps over the eyebrows show mathematical ability, that a wide forehead is proof of a broad liberal viewpoint, fall as countless other fallacies have fallen before the swift keen sword of science.

And with them perishes the old adage, "Tell me how you look and I'll tell you what you are."

A comparison with the phrenologist's chart of the motor areas of the brain, scientifically verified by anatomists, reveal some ludicrous discrepancies.

The motor area of the brain controlling the toes, arms, head, lips, etc., compare with "firmness," "hope" and "constructiveness" on the phrenologist's chart, while the vision area compares with "inhabitiveness" and "parental love."

The phrenologist and physiognomist knows that the average practical man abhors statistical tables, and that dogmatic statements can be made without the least danger of a demand for scientific proof.

Such character traits are never sharply defined, and are so general it would be safe to use them on any person.

I characteristically explain away the exceptions by pointing to some stronger trait as a compensating force, and hide behind a logical wall of thought, through which the average practical man, even though he be intelligent, cannot pass.

GYSEL
Toledo, Ohio.

(This letter from Mr. Gysel, a wizard of note, who has through SCIENCE AND INVENTION Magazine been investigating mediums in the interior of the United States, is interesting and his opinion of phrenology is in thorough accord with the scientific stand on the subject. One of the most intelligent men in the United States had a very low sloping forehead, yet wherever the word intelligence is employed, people think of this professor. This is not in accord with any of the precepts of phrenology, or the sys-

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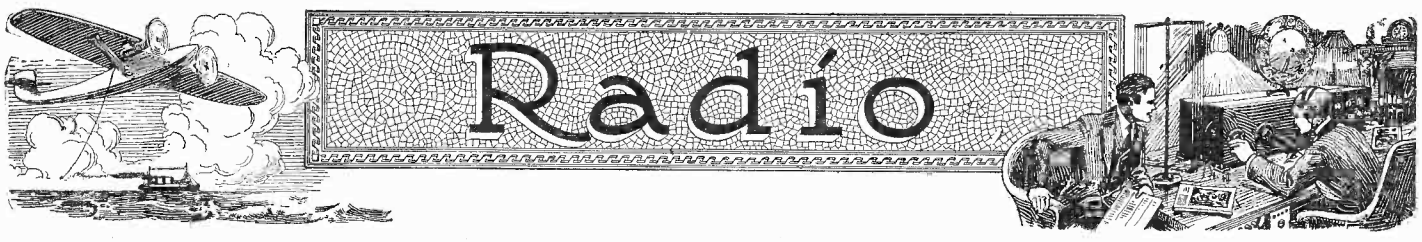
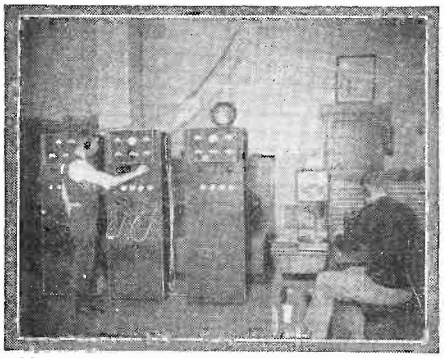


Radio Via Telephone Lines

By S. R. WINTERS

"Wired Wireless" Supplies Radio Programs to Telephone Subscribers



Above is a scene in the control room, where radio programs are sent out over the various telephone lines.

IN addition to neighborhood gossip and the grocery order, the Kellogg Switchboard and Supply Company promises to deliver first-rate musical programs via the telephone route. And this promise is more than a hazy dream of the future, for "wired wireless" has been proved feasible by the Stephenson County Telephone Company, Freeport, Illinois. And the words "Program Service" are an outgrowth of this furnishing of programs by telephone companies over telephone wires to the subscribers; a service that has met requirements in the early Illinois experiments. It has, in fact, become sufficiently important for the banding together of telephone companies furnishing this type of service into the National Program Service Association.

But there were many stumbling blocks in the way of this system when it was first inaugurated. Telephone cables do not lend themselves readily to the transmission of the necessary band of frequencies required in supplying musical programs. These cables, it should be understood, were designed and built for voice frequencies, which cover a considerably narrower band of frequencies than that required for program service. It has been found, therefore, that only two subscribers can be supplied satisfactorily on a cable pair and the output voltage to this particular circuit must be below a certain value or resultant cross-talk would be experienced in the cables. The higher frequencies which must be handled in program service, work "cross-talk" more readily than the highest frequencies which are encountered in ordinary telephone work. Cross-talk, it seems, limits the voltage which may safely be applied to the program service circuits, and makes it necessary to use high capacity rather than high voltage amplifiers. This, in turn, makes it necessary to use a large number of amplifiers.

Experiments made by the Kellogg Switchboard and Supply Company resulted in the opinion that these programs, if furnished over telephone circuits, should be supplied at other than audio frequencies. About this time, Major General George O. Squiers filed an application for a patent covering the possibilities of using high frequencies for supplying programs over telephone circuits. This principle had been tested on electric-light circuits.

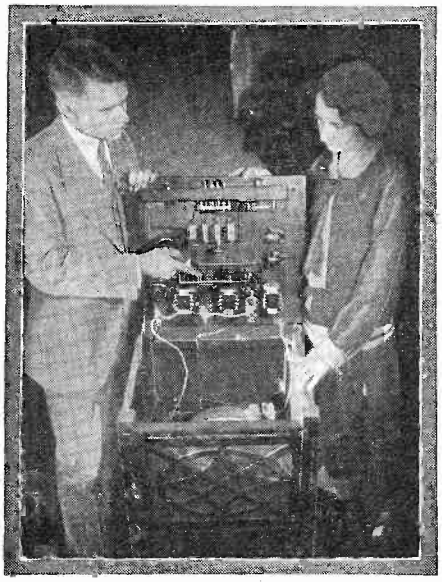
And as a result of Major General Squiers' patent, experiments were started in Freeport, Illinois, to determine the possibilities of supplying program service at other than audio frequencies. Many interesting results were obtained. It was believed that it would be possible to find a band of frequencies over which a number of programs could be simultaneously distributed to all cable pairs in the telephone system through the capacity between pairs in the cable. In other words, it was proposed to excite a cable pair with a group of programs from suitable apparatus; these programs to be distributed to all other cable pairs through the capacity of the cable. Knowing the capacity of the cable, it was possible to calculate approximately the most efficient band under ideal conditions. However, in the average telephone plant, these ideal conditions do not exist.

A large percentage of the cable pairs in the plant may be directly connected to the ground. The cable sheath may or may not be grounded. Losses through common grounded groups such as the returns on common battery line circuits, can be made negligible by inserting impedances of low resistance in these common grounds if high frequencies be employed for program distribution. Investigations showed that if a large group of line circuits were connected to ground on one side, barriers were necessary. In the entire group of experiments this was the only change which was required to be made in any telephone equipment, and in this particular instance it consisted of 5 impedance coils.

Having determined the most efficient band, it was necessary to determine the power required to give satisfactory distribution. It was possible to obtain satisfactory reception at the subscriber's end of any one of the 5,400 cable pairs at the experimental station by means of a simple detector and two-stage amplifier when 22 pairs were excited from a single 50-watt program supply unit. The sensitivity of the pick-up device, of course, determines the size of the program supply unit.

The receiver in operation. It consists of a detector and two audio stages. A grill covers the loud speaker.

The system as finally placed in operation consists of a studio or, rather, a means for supplying programs from which programs are carried into the central office over cable pairs at audio frequencies. To carry in the three programs being supplied, without distortion, it was necessary to balance or equalize these pairs. Three program supply units are installed at the central office, together with the necessary amplifier and modulating systems. The triple unit is connected to the required cable pairs which



The receiving set with top lifted.

A view in the broadcasting studio is shown above.

serve as an antenna system and to the ground for return. At the subscriber's station is a cabinet containing a loud speaker and the pick-up device. This consists of a detector and two-stage amplifier, using alternating current tubes and a "B" supply device. Four connections are required; two for supplying the set with 110 volts, 60-cycle current; one to one side of the telephone circuit and one connected to the ground. The connection to the telephone circuit is through less than 100-micromicrofarads capacity, so that losses to the telephone circuit are negligible.

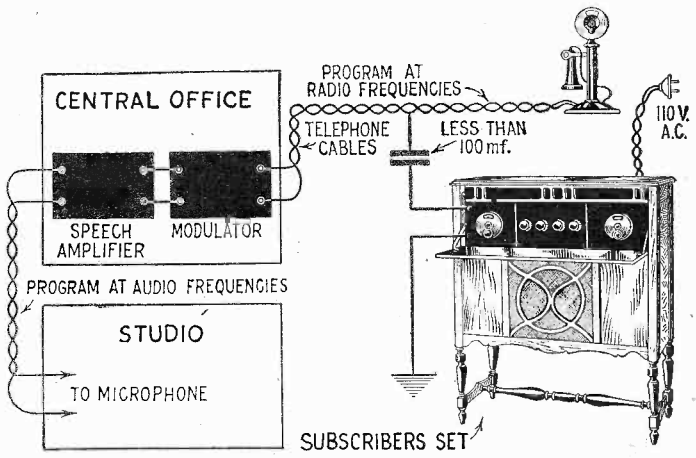
The same telephone wires that carry our daily conversations can thus be used to bring in all types of radio programs—and the conversational use of the telephone is not interfered with in any way. Conversation can be carried on while radio programs are being received over the same wires. Another phase of this service which appeals especially to residents of small cities is the fact that the equipment can be used not only for receiving outside programs and broadcasts, but for putting programs of local interest on the air. At times when there is nothing of special interest to be picked out of the air or received over chain systems, it is possible for the local telephone company to install a high-grade phonograph and broadcast the latest records.

This is being done in Freeport at the present time.

And at the present time 17,000,000 homes of this country have most of the necessary equipment—since there are that many telephone subscribers. The new system simply adds to the use of the present telephone lines which, according to estimates, are now used on an average of less than two hours out of every twenty-four.

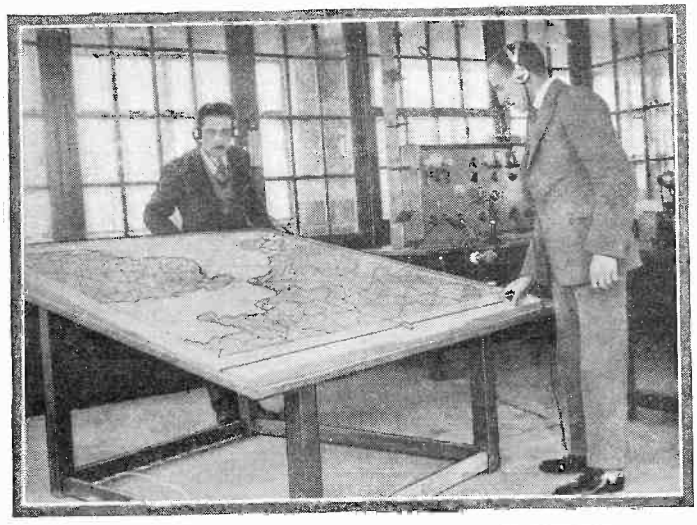
The service is anticipated to be universally available on a monthly rental basis, the fee for which is nominal.

But there is a drawback to this roseate plan. The DX hunter will be relegated to the limbo of forgotten men. And are there enough persons ready to accept "tailor-made" programs, or will the streak of individuality assert itself and refuse to have these programs delivered on a silver platter? This is the fly in the ointment of "wired wireless."



Above, in simplified form, is shown the essential details of the apparatus and method used in the "wired wireless" system described here.

Direction Finding for Planes



Above is the charting room used at the new Croydon airport radio station. Positions of planes can be plotted on the map.

ONE of the finest airports in the world is the Croydon Airport at London, England. The equipment and facilities are of the latest design, including the radio system, by means of which position of planes can be accurately determined and pilots given directions by radio. If, therefore, a plane is lost in the fog, the pilot can be directed to the nearest landing ground, and if the course is to be changed, radio is again used. By means of two or more direction-finding stations using the Bellini-Tosi system, it is possible to accurately plot the position of a plane by the interchange of readings between these stations. After the bearing of a plane is taken at the control station, it is recorded on the map by means of a cord held in position by pins at either end and as the bearings taken by the other stations are received at the main or control station, they are plotted in a similar way. The common intersection then marks the position of the plane. In the illustration, Fig. 1 shows how the position may be determined by two radio direction-finding stations, designated as A and B. Fig. 2 shows the method employed when three stations all take readings. M is the master or control station, M1 is another station of equal size, and C is a check station. At Croydon a man is kept in charge at all times of the day and night in order to control transport vehicles flying hundreds of miles away. A large scale map is employed by the operator and each direction-finding station is shown on it, with the addition of a protractor drawn around it. These scales, placed along the margin of the chart, add to the accuracy with which the cords may be manipulated. The scales of various stations, where they overlap, can be drawn in different colors, in order to avoid confusion. In order to obtain the true bearing of a distant station, it is necessary, in addition to the direction-finding bearing, to know the course of the plane at the instant that the bearing was taken, and considerable skill is necessary in order to get accurate simultaneous readings of these two bearings. The chart shown is situated in the main radio tower at the Croydon field. The large triangular Bellini-Tosi direction-finding loops are atop this building. Remote control of four transmitters is also accomplished from this building. The transmitters work between 800 and 2,000 meters, and are situated 2½ miles from the airdrome. Two or more of the receivers can be operated on different wavelengths for the reception of telegraphy and telephony on the same antenna. The receiving portion of the radio station is remarkably sensitive and was designed by the Marconi Company, of England.

Despite weather conditions, communication with the planes can be established at all times with this efficient radio installation.

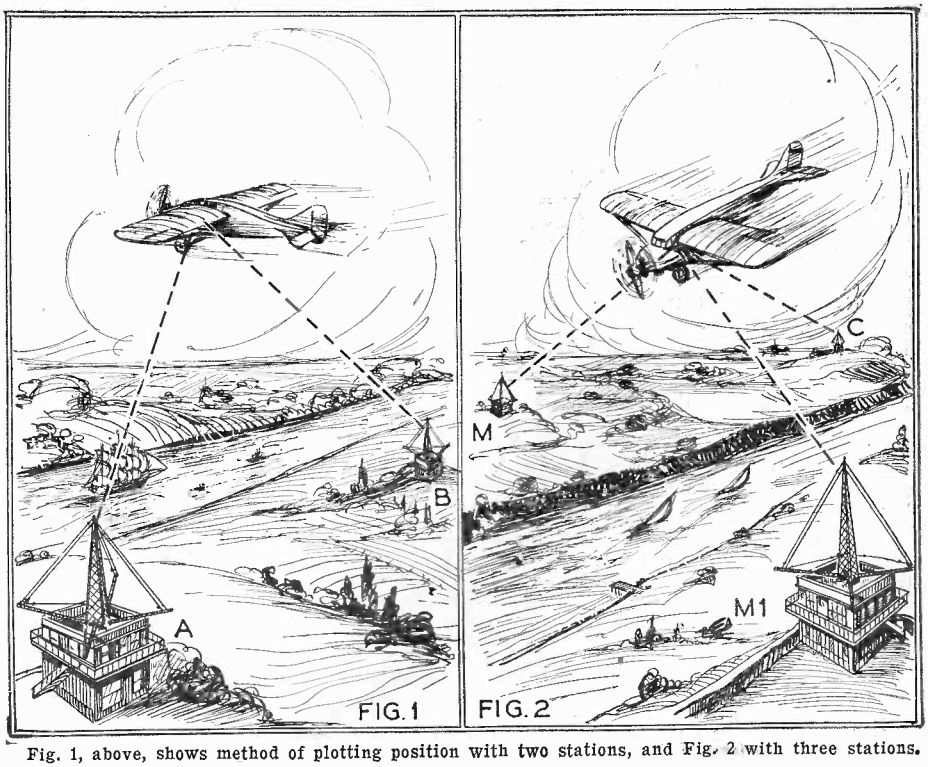
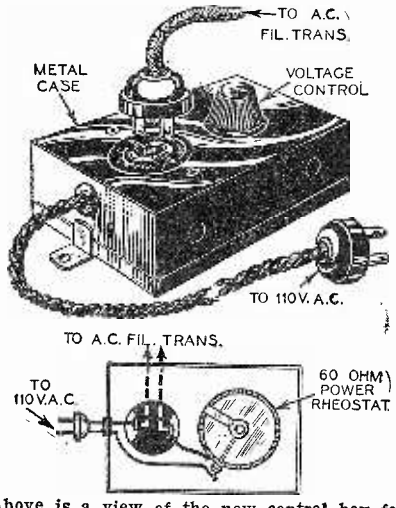


Fig. 1, above, shows method of plotting position with two stations, and Fig. 2 with three stations.

NEW RADIO DEVICES

Accessories Recently Developed Which Will Be of Value with Any Radio Set

CONTROL BOX

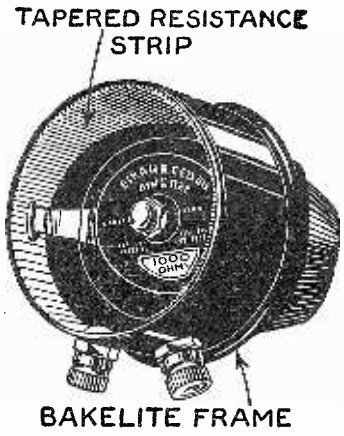


Above is a view of the new control box for regulating line voltage. Internal construction has also been shown.

ONE of the Wisconsin manufacturers has developed a radio control box to be put in series with the filament lighting transformer, so that line voltage may be regulated and the tubes protected. A 60-ohm power rheostat furnishes the necessary regulation. A receptacle on the box provides for attachment to radio set, and a cord and plug are provided for insertion in the light socket. All parts are enclosed in a metal case, with a knob on top for adjusting the rheostat.

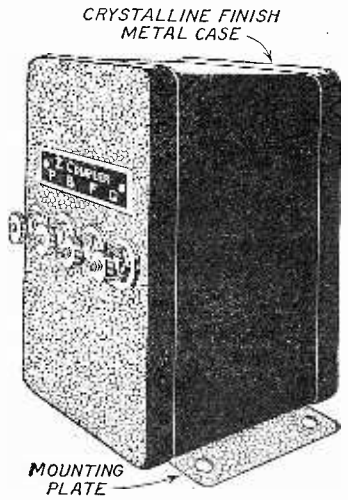
"TAPERED" RHEOSTAT

A RHEOSTAT equipped with a tapered resistance strip which gives the characteristic line, the shape of a parabolic curve instead of the usual straight line has recently been put on the market by a Chicago radio concern. It is of the one-hole mounting type, with winding protected by a bakelite frame. This type of rheostat is admirably suited for circuits where the useful range of adjustment is limited to a small degree of rotation of the adjusting knob.



A view of the new rheostat, showing the tapered resistance strip, appears above. The winding is protected by a bakelite frame.

SCREEN GRID COUPLER



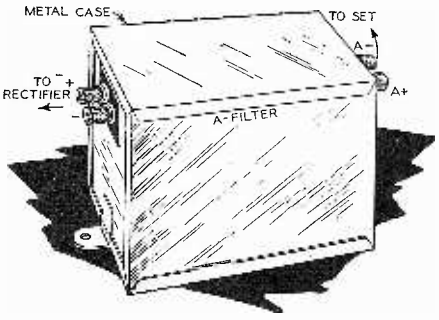
Above is the special audio impedance coupler for use with shielded grid tubes. It can be used with these tubes in all audio stages.

ONE of the prominent Chicago transformer manufacturers has developed a special coupling device to feed the output of a shielded grid tube used in the first audio stage into a power tube. It consists of two impedances wound on separate cores enclosed in a heavy metal case. The primary impedance is high, in fact, somewhat over 450,000 ohms at 60 cycles, and is designed to match the plate impedance of the screen grid tube. The secondary impedance is connected in the grid circuit of the power tube. Using this coupler, it is possible to secure an amplification increase which is equivalent to two or three ordinary stages of audio frequency amplification. The tone quality of an amplifier using the coupler and 222 tube is superior to the average transformer-coupled audio system.

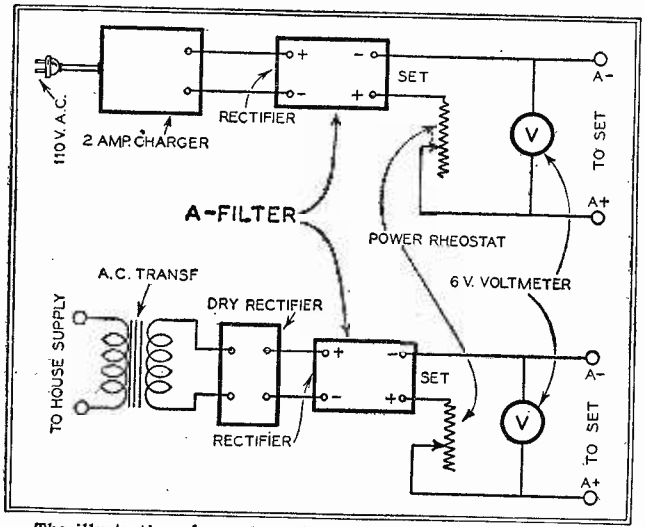
DRY "A" FILTER

ONE of the Massachusetts manufacturers has recently developed a dry "A" filter to be used in connection with filament supply. This device is housed in a silvered metal case and contains a 7,600-mfd. dry "A" block and two large capacity chokes. The maximum current capacity is 2½ amperes and the operating voltage 3 to 10 volts direct current. The condensers should not be operated at over 10 volts, if normal life is to be secured. A single battery charger capable of delivering 2 to 3 amperes and with provisions for voltage regulation, can be used successfully with the filter. Trickle chargers can only be used with sets employing 199-tubes. A great deal of expense and trouble in the electrification of battery type sets is now dispensed with by the use of the "A" filter, which, when once installed, can be completely forgotten, as it is perfectly dry. It can also be used with a dry rectifier as well as with battery chargers, and effectively smoothes out any ripple in the filament supply. Four marked binding posts have been provided so that anyone can connect the filter properly in a moment's time.

With proper rectifiers, it can be used for supplying the necessary voltage to the field windings of electro-dynamic speakers. Its use is not limited to radio, and in many cases it can be substituted for batteries or motor generators when low tension D.C. is required.



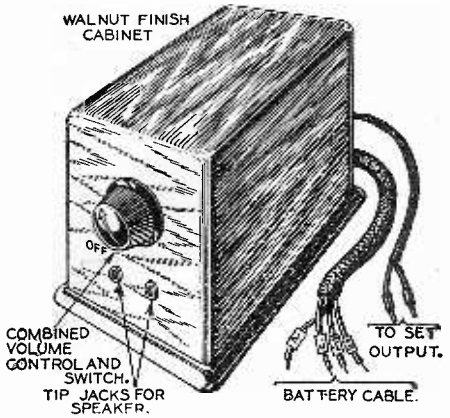
Above is a view of the dry "A" filter.



The illustration above shows two methods of using the filter for "A" supply, one with a charger and the other with a dry rectifier.

TONE AMPLIFIER

A WISCONSIN radio laboratory is now making a tone amplifier which is designed to be connected after the ordinary audio system. Volume is consequently increased and better tone quality is gained by the addition of this resistance-coupled audio stage. It is designed to use a UX-171 power tube, consequently an output filter has been provided in order to prevent any damage to the speaker windings. The amplifier is encased in a walnut cabinet and a volume control knob has been provided.

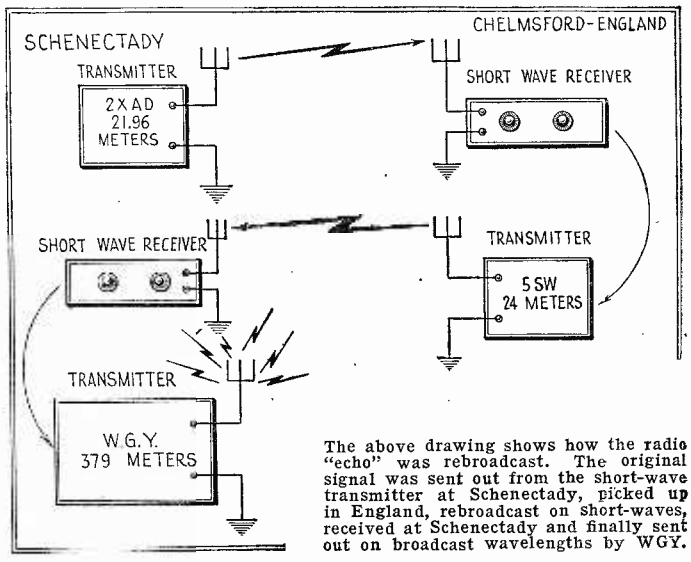


The tone amplifier, which consists of a single resistance-coupled audio stage, is shown above.

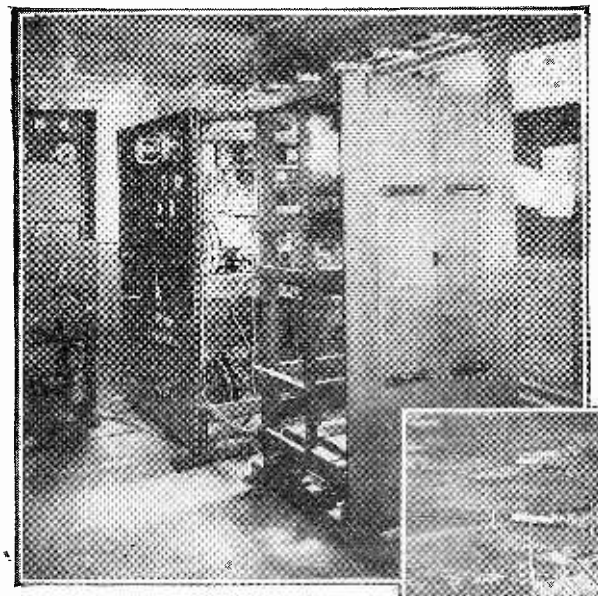
Names of manufacturers supplied on request.

Rebroadcasting a Radio "Echo"

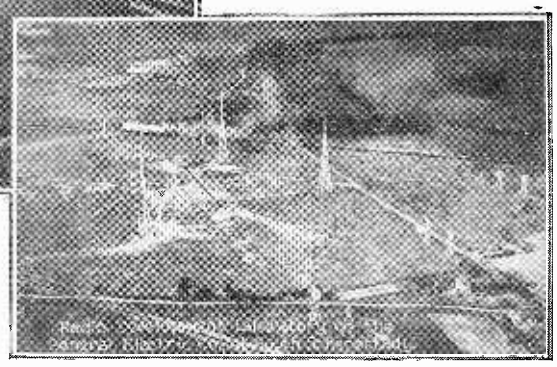
IN an experiment carried on by the General Electric Company recently, phonograph music was sent across the Atlantic, back again and rebroadcast. The signal was first sent out from Schenectady over short-wave station 2XAD on 21.96 meters. This was picked up at Chelmsford, England, on a short-wave receiver and fed into the short-wave transmitter 5SW which sent the signal back to Schenectady on 24 meters. Here it was picked up by another short-wave receiver and retransmitted by station WGY on the 379 meter wavelength. The illustration appearing here shows in simple form how this stunt was carried out. It was a decided novelty for broadcast listeners to listen-in on the radio "echo" after it had twice crossed the Atlantic Ocean. The experiment was carried on between the hours of 11:30 and 1:00 P. M., Eastern Standard Time. The signal when rebroadcast was noticeably free from static and interference due to the fact that it had been transmitted on the shorter wavelengths. The engineers in charge have succeeded in sending over WGY's wavelength, the English rebroadcast of their own short-wave station output successfully a number of times.



The above drawing shows how the radio "echo" was rebroadcast. The original signal was sent out from the short-wave transmitter at Schenectady, picked up in England, rebroadcast on short-waves, received at Schenectady and finally sent out on broadcast wavelengths by WGY.



At the left is a photograph of the short-wave transmitter at Schenectady, New York.



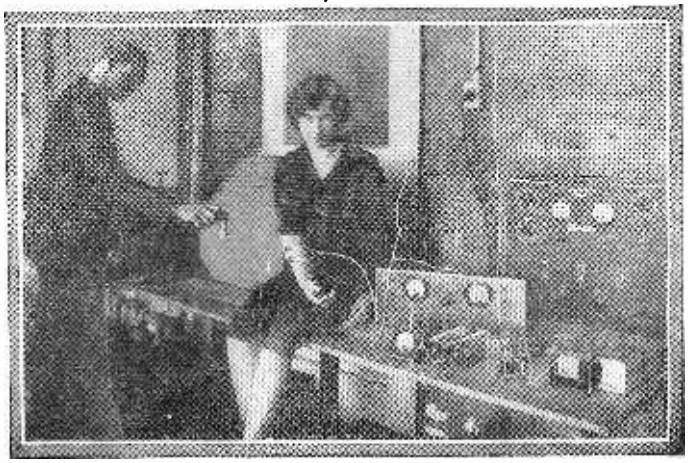
At the right is a bird's eye view of the radio development laboratory at South Schenectady. The numerous masts supporting various antennas may be seen. The short-wave transmitter is situated here.
—Photos Courtesy General Electric Co.

Human Nerves "On the Air"

ON the night of April 15th, nerve currents from a human body were heard for the first time on the air. Dr. Lee E. Travis, and Theodore Hunter, after three years of untiring effort had at last been successful. The sound was something between a loud scratch and a low rumble, if such can be imagined. The experiment was conducted over station WSUI owned by the University of Iowa. Two tiny electrodes were pressed against the muscles at various points on the subject's body, the resulting sound being amplified. The apparatus finally developed to obtain the reflex time in a knee-jerk consisted of a three stage resistance coupled amplifier, a portable three element oscillograph, a mechanical stimulating mechanism and the signal circuit. The stimulating mechanism delivered blows of constant intensity and uniform rate of six per minute. The signal circuit was actuated by discharging a condenser which had been previously charged. The electrodes were German silver plates covered with flannel soaked in a saline solution.

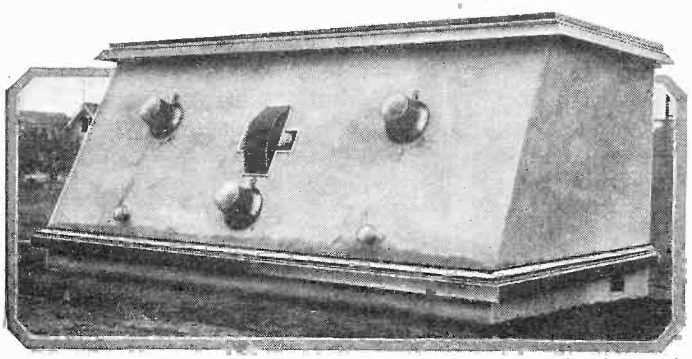
A three-wire twisted conductor was used to connect the input of the rectifier with the electrodes which picked up the nerve impulses. Two of the wires were connected to the input of the amplifier at one end, and to the electrodes at the other; while the third was grounded to the amplifier panel and left disconnected at the other end. This grounded wire served to reduce any induced voltages arising from undesirable sources.

The above photo shows Theodore Hunter, technician, in speech pathology testing the radio apparatus affixed to the leg of one of the students.



At the right, photo shows a young lady having the noise of a nerve current in her body broadcast by radio station WSUI, at Iowa University. This broadcast was the result of three years experiment.

LIFE SIZE RADIO STORE

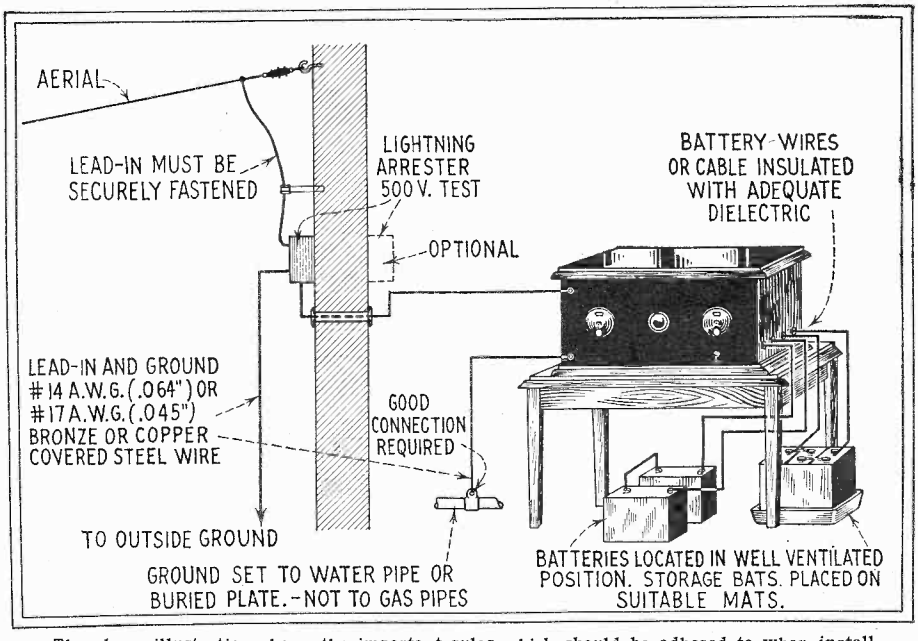


Above is a photograph of a radio store which is built entirely of concrete and is an exact replica of a radio receiver.

A UNIQUE radio store in Portland, Oregon is built as an exact duplication of a radio receiving set. The exterior is somewhat plain and is covered with stucco. It is equipped with two dummy switches, two knobs and a main tuning control, which may be seen in the photograph. Sheet metal has been used in building the knobs and the other controls and the entire structure is built to scale to the set which it represents. The panel slopes somewhat, giving the building an added touch of likeness to the receiver. The roof overhangs the edge, similar to the top of a radio cabinet, and a line of moulding is placed around the base. Below it a cellar has been built. The interior is divided into three luxurious demonstration rooms and entrance is gained by a door placed in the rear of the store. Some idea of the size can be gained by comparing it with the houses appearing in the background. A decided novelty, the store has never failed to attract attention and has added a great deal to the sale of sets and accessories. It is an ingenious advertisement.—*Contributor send name and address.*

RADIO SAFETY CODE

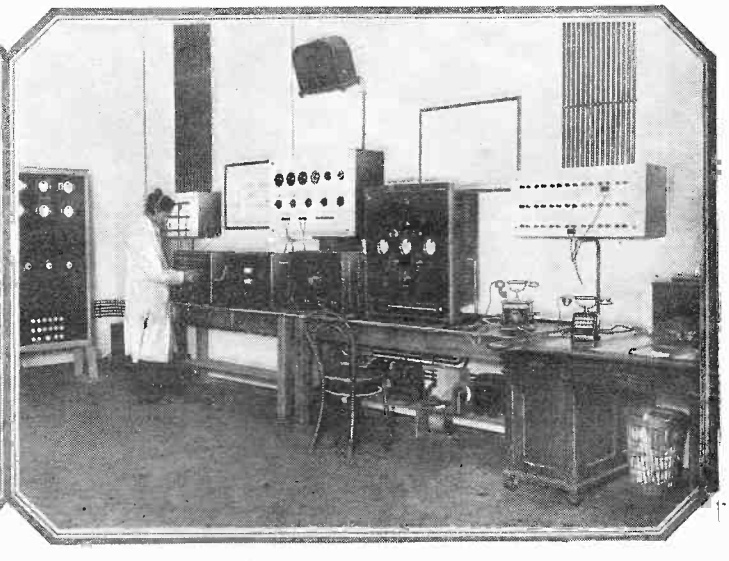
Antennas of receiving sets should comply with the requirements for the construction of communication lines for public use in similar situations. There are no requirements for indoor antennas. The following situations should be avoided in erecting antennas or guy wires: attachments to supply or communication poles, crossing over railroad tracks or public highways, crossings over or under supply or communication conductors. In no way should the antenna conflict with supply or communication conductors. There are no requirements as to the size of wire used for receiving antennas, nor are there any requirements as to the insulators. Antenna-supports should be able to carry the vertical load and horizontal strain, and where necessary should be guyed or braced. Metal poles should be grounded. Lead-in and ground conductors for receiving stations shall not be less than No. 14 A.W.G. if of copper or less than No. 17 A.W.G. if of bronze or copper-covered steel. The lead-in must be securely fastened and enter the building through an insulated bushing. The ground connection may be made to a buried plate or to a water pipe, not to a gas pipe. A lightning arrester should be provided whether or not a grounding switch is used and should operate at a potential of 500 volts or less. It may be placed inside or outside of the building, removed from combustible materials. The batteries should be located in a well-ventilated position if they are of the storage type, and suitable insulating mats should be used. The wiring of the batteries used with the receiver should be made with insulated battery wires or cables.



The above illustration shows the important rules which should be adhered to when installing a radio receiving set. These are in accordance with the National Electric Safety Code, as published by the U. S. Bureau of Standards.

RADIO FOR MUSIC TESTS

The Berlin Conservatory of Music has installed a radio receiver and transmitter for test purposes. Students can thus be trained in the art of broadcasting over the radio. The above photo shows the broadcasting studio.



A check-up can be made upon the students' microphone technique and the faults can thus be corrected. A view of the amplifier, modulator and control room is shown in the above photograph. One of the radio operators is shown on duty listening-in to the program.

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.

SHORT-WAVE TUBE DATA

(638) L. B. Merton, Copper Hill, Tenn., writes:

Q. 1. Will you please give me some information concerning the type 852, 75 watt, short-wave transmitting tube, and also list the important characteristics.

A. 1. This tube, which has recently been developed, is designed for extremely short-wave work, is relatively cool in operation and capable of oscillating at frequencies even below one meter. It is of the round bulb design with three extensions of the glass envelope. The largest or filament arm of the tube is provided with a UX base for use in either the push type or navy type socket. Two heavy stranded leads arranged in parallel are brought from each stem for connection with grid and plate respectively. The double grid and plate leads serve to increase current carrying capacity at high frequencies. The filament, grid and plate leads are brought out of the tube through individual and widely separated seals arranged about the spherical portion of the glass bulb. The internal construction of the 852 tube is simple with its cyindrical plate and grid both supported by two heavy wires. The filament consists of a double spiral of thoriated tungsten wire supported at its mid-point and ends. This simple construction with inter-electrode capacity reduced to a minimum permits excellent operation below 100 meters. It has been successfully operated on wavelengths below five meters and even down to 77 centimeters. This tube will handle normally plate voltages of 2,000 and even up to 3,000 with proper precautions. A.C. should be used on the filament with a center-tapped secondary for grid and plate returns. When it is necessary to use D.C. on the filament, the plate and grid returns should be connected to the positive lead. The following are the characteristics of the 852 tube.

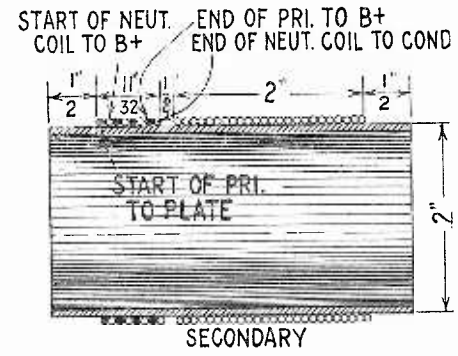
Filament voltage	10 volts
Filament current	3.25 amperes
Filament power	32.5 watts
Plate voltage	2,000-3,000 volts
Input power	150 watts
Maximum safe power dissipation	100 watts
Amplification constant	16
Nominal output	75 watts
Plate impedance	8,000 ohms
Plate current (oscillating)	.075 amperes

NEUTRODYNE DATA

(639) T. Evans, Brooklyn, New York, asks:

Q. 1. Please give me the necessary information for winding neutrodyne coils on a 2 in. form to be tuned with a .00035 mf. variable condenser. Also describe briefly the best method of neutralizing a set with two R.F. stages.

A. 1. On this page you will find an illustration for winding neutrodyne coils on a 2 in. form. The primary and the neutralizing coil are wound parallel as illustrated. Both of these coils consist of fifteen turns of No. 30 enameled wire. The secondary consists of 87 turns of No. 28 D.C.C. wire, close wound. It is important that the primary and neutralizing coils be wound together in the same direction with the turns interleaving as shown. On account of the difficulty of accurately measuring or calculating very small capacities, particularly neutralizing capacities, the proper neutralizing capacities in practice are best determined by trial. A suggested procedure for neutralization is as follows: first, with the filament of the second radio frequency tube cold, and those of the first and detector tube lighted, a strong signal is tuned in and the capacity of the neutralizing condenser of the second radio frequency stage is then adjusted until the signal disappears, showing that no coupling exists between the plate circuit and the grid circuit of the second radio frequency tube. Then, with the filaments of the detector and the second radio frequency tube lighted, and that of the first radio frequency tube cold, the process is repeated with the first neutralizing condenser. On account of the proximity of the radio frequency transformers to one another, and because of the loop formed between the leads of each secondary and its tuning condenser, the actual inclination for zero magnetic coupling may differ slightly from its theoretical value of 55 degrees; hence, the proper inclination of the radio frequency transformers must also be determined by trial. This angle or inclination may be ascertained by employing the following procedure: with all the coils at the same inclination, the two neutralizing condensers are adjusted for zero coupling as described, with the circuits first tuned for a low frequency and then for a high frequency. In general, the settings found for the two frequencies will be different, showing that the capacity coupling which varies with the frequency, is being called upon to compensate for some magnetic coupling. The coil inclinations are then varied together, until the settings of the two neutralizing condensers are found to be the same at the two extreme frequencies. The determination of the proper coil angle need ordinarily be made only once for a given design of receiver, but the adjustment of the neutralizing condensers is made in each individual receiver in order to insure complete stability.



The above illustration gives the necessary data for winding neutrodyne coils.

METHODS OF ELECTRIFYING

(640) T. W. Cressy, Cave Spring, Ga., asks:

Q. 1. Please outline briefly the common methods used in electrifying radio receivers which were originally designed for battery operation.

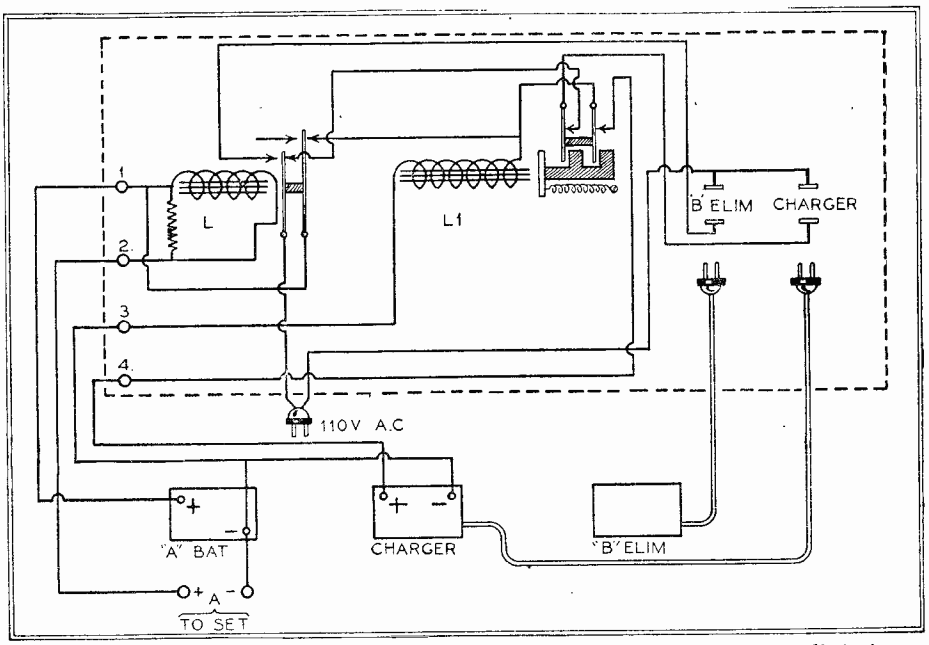
A. 1. One method which many are now using consists in employing an A eliminator which rectifies the alternating current, filters it and steps it down, so that the resulting low voltage direct current may be used for lighting the filaments. With a B eliminator and an A eliminator of this type, a satisfactory electrified set can be made from any of the old storage battery models. Another method consists in connecting the tube filaments in series with the exception of the power tube filament. The filament circuit will, of course, have to be rewired. With series filaments, a B power unit employing a 350 milliampere rectifying tube will have to be used, if one-quarter ampere tubes are placed in the set. With 199-type tubes, a 125 milliampere tube may be used for lighting the filaments. This method is not so satisfactory and it requires one rather skilled in radio to rewire the filament circuit and connect the grid returns to the correct portion of the circuit. Lastly, there are the new A.C. tubes which may be used by rewiring the receiver, or by employing a harness. The last named method is probably the simplest, and any receiver can be converted to socket power operation within a short time.

RELAY DIAGRAM

(641) A. T. Wagnoll, Milwaukee, Wisc., asks:

Q. 1. If possible, please publish the circuit diagram of the Yaxley full automatic relay.

A. 1. The schematic hook-up of this relay is shown upon this page. Coil L is a low-resistance coil in series with the "A" battery and tube filaments. Coil L1 has a resistance of about 200 ohms. The numbers 1, 2, 3 and 4 correspond to the markings of binding posts on the front of the relay. A resistance is shunted across coil L, so that the voltage drop is always kept within 0.2 volt. This resistance is changed according to the current consumption of the receiver and consists of a strip of resistance wire. Two values of resistance wire are furnished with the relay. The action of the relay is such, that when the filaments in the receiver are turned off, the charger is automatically cut in and the "B" eliminator is cut out of the circuit. Furthermore, when the battery is fully charged, the relay automatically cuts the charger out of the circuit. This relay was fully described on the New Radio Devices page, in the July issue of this magazine.



Above is the circuit diagram of the Yaxley full-automatic relay, for use with B eliminator, A battery and charger.

OSCILLATION TROUBLE

(642) A. L. Starett, Jersey City, N. J., writes:

Q. 1. I have an Abbey model Splitdorf receiver which worked excellently until a week ago, when it suddenly broke into violent oscillation, which I have not been able to correct. Some trouble-shooting hints will be appreciated.

A. 1. In the service manual for Splitdorf receivers, the following causes for oscillation in this set are mentioned: The antenna may be open or grounded, and we would suggest that you inspect the aerial system for possible breaks in the wire, and also be sure that it does not come in contact with any metal work. The "B" voltage on the radio frequency tubes may be too high. The one-half mf. by-pass condenser may be open or disconnected from the circuit. Another cause may be poor tubes or the ground connection may be poor or open. The angle at which the radio frequency coils are placed is also important. Also, these coils may have too many primary turns. The correct number of turns is 13½. There is also a possibility of the grid resistor being shorted or the shield bushings may be short-circuited or missing.

Scientific Humor

SHOULD HAVE SAID SOUND OF GIANT SPEAKER FILLS THEATRE

(Headline in SCIENCE AND INVENTION for June 1928.)

Where do they put the people?

—*George A. Vondermuhll, Jr.*

ALC OR PSYC

MRS. SMITH: "And how is your husband today?"

MRS. HOLMES: "Oh, very poorly. He's got such an expensive disease. The doctor says he must be kept in good spirits."

—*Ben Heller.*

THEN FIND THE DAMAGE

TUBE: "How are you getting along with that correspondence course on how to be a radio repairman?"

CRYSTAL: "Oh, I've found out that all it amounts to is that while you're supposed to be fixing one part, you must be sure and break another!"—*Henry A. Courtney.*

DON'T TALK TO THE MOTORMAN

Farmer MacHay was taking his first ride in an elevated train, and in spite of the sign over the motorman's head, proceeded to chum up sociably with that responsible mechanician. He watched operations for a few minutes, and then, from the height of his own experience in the driving of a flivver, he remarked, rather loftily, "That job's a lot easier than drivin' an automobile!"

"Easier, you say?" asked the motorman, his eyes on a curve ahead. "Not so you'd notice it! Why, when it comes to steering alone, a chauffeur's got the whole road to run in and he generally does it, too!—but here I've got to steer this train of cars right on these two rails, and if I should run off the least little bit, 'way up here in the air, oh boy! Don't talk to me!"

And the countryman got off at the next stop.—*Margaret Ullmann.*

USE THE MILKY WAY

CO-ED: "Airplanes will never be popular among the smart set."

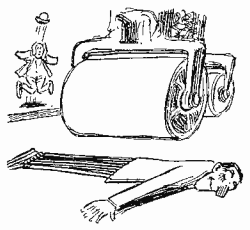
PILOT: "Why?"

CO-ED: "There is no place to park."

—*V. J. Hermel.*

FIRST PRIZE $3.00

LEFT HIM FLAT, TOO!



"Hear about Macgreggor's accident yesterday?"

"No—what happenned?"

"He fell in front of a steam roller—but he had presence of mind to turn on his side so his pants would be pressed for the funeral!"—*Clyde Baker.*

RIGHT

FIRST: "What is the best cure for seasickness?"

SECOND: "Give it up."

—*Walter M. Egel.*

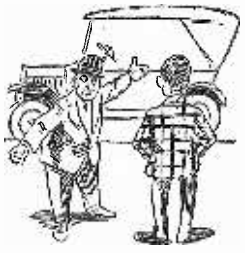
ALL jokes published here are paid for at a rate of $1.00 each; $3.00 is paid for the best joke submitted each month.

Jokes must have a scientific strain and should be original.

Write each joke on a separate sheet of paper and add your name and address to each.

Unavailable material cannot be returned.

A "FLIVVER" THAT DIDN'T "FLIV"



The man who bought a second-hand flivver took it back. "What's the matter with it?" asked the seller.

"Well, you see," said the disgusted owner, "every blamed part of it makes a noise except the horn."—*Walter M. Egel.*

SHOULD USE CIGAR LIGHTER

FRIEND: "Why are you writing your jokes on tissue paper?"

WRITER: "The editor wants some light humor."—*John H. Spicer.*

INVISIBLE ART

ART CRITIC: "What do you mix your colors with?"

ARTIST: "With brains, sir?"

CRITIC: "Ah, so you paint miniatures!"

—*Henry A. Courtney.*

TELEVISIONAL ROMANCE

"Say, Bill, I sure seen a swell girl last night."

"Who is she? What's her name?"

"I dunno, Bill, but say, dya s'pose if I'd call up Walkover 6502, Central'd gimme the same wrong number she gimme last night?"—*Gleason Pease.*

STAYING UNDERCOVER

JIM: "Did any spirits show themselves at the séance last night?"

WILL: "No, there was a prohibition officer present."

—*John H. Spicer.*

WHEN SCENTS IS CENTS

SNIFF: "You say a few cents enabled him to make a fortune?"

SNIFFER: "No, I said that with the aid of a few scents he has grown wealthy. He is a perfume manufacturer."—*H. A. Courtney.*

MOSS-T ASSUREDLY

VEXED PARENT (to one of our seniors): "You know, my son, a rolling stone gathers no moss!"

SENIOR (who has studied English): "I comprehend, but you must understand that if the velocity is sufficiently increased, the stone must necessarily acquire a polish whose value is relatively the same."—*J. Rubin.*

WHAT A LIFE-TIME

FIRST TWENTY-FOUR-HOUR BUG: "What's this big, round thing?"

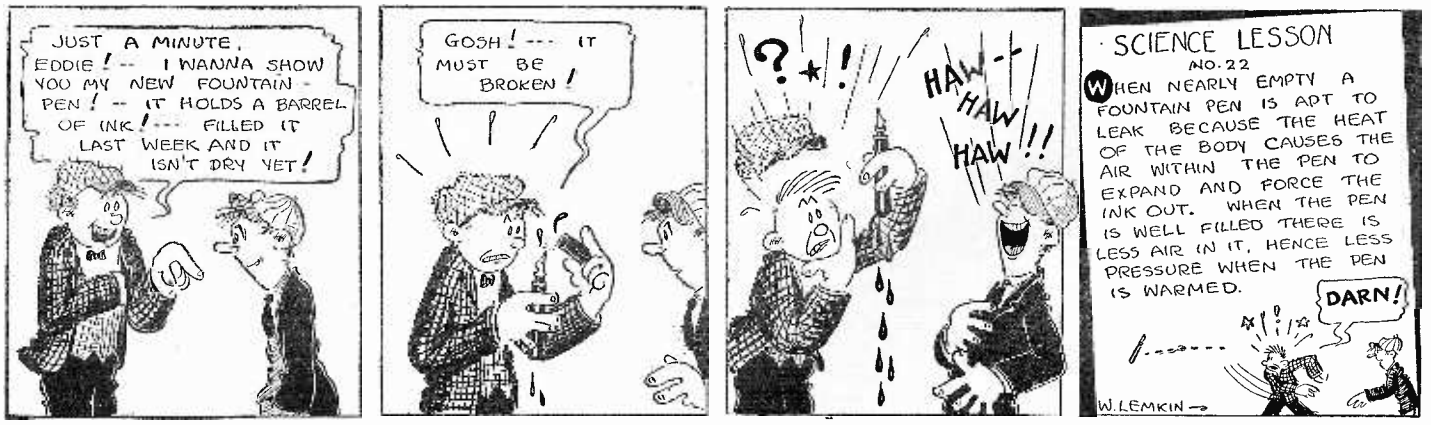
SECOND TWENTY-FOUR-HOUR-BUG: "Oh, that's a fountain pen and they say it'll last a lifetime.—*Gleason Pease.*

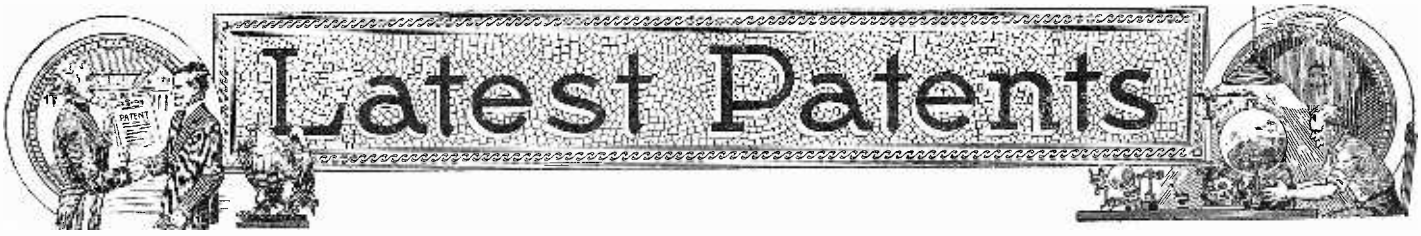
SCIENCE AGAIN

"How did you get this keg of alcohol past the customs?" asked the drinker.

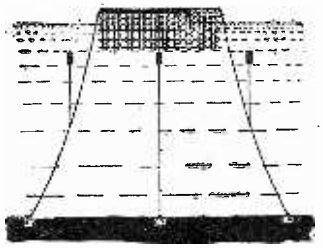
"We put some zoological specimens into it," explained the bootlegger.—*John H. Spicer.*

SCIENTY SIMON, Scientist



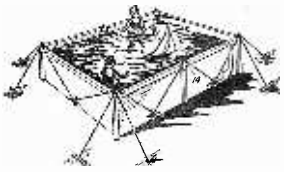


SEA AIR PORT



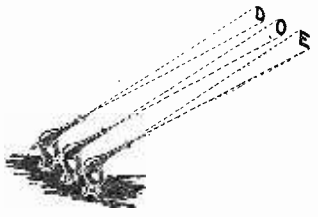
No. 1,670,524, issued to Gustave M. Sachs. This invention comprises a number of separable floats which may be easily assembled in mid-ocean to form an airplane landing platform. The construction is such that the lowermost floats extend below the surface to such a depth as to be unaffected by waves, wind, or storm.

PORTABLE SWIMMING POOL



No. 1,664,887, issued to Philip Kirkham and Gustave A. Scheel. This pool is made of flexible waterproof material, such as waterproof canvas. The construction is such that the container can be quickly filled and emptied, be quickly set up, and can easily be taken down and folded for storage or transportation. The container is emptied by means of a flexible tube, preferably made of the same material as the container.

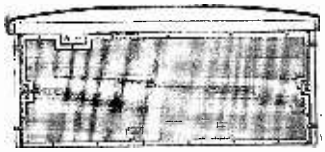
PROJECTION APPARATUS



No. 1,664,038, issued to Luther B. McEwing. This optical projector is a means for using light for signalling, advertising, producing amusement, or for other purposes of similar nature. This projector may be used even when there are no clouds within range, by focusing it and directing it on cliffs or walls. The construction is such that the above operation is easily performed. In localities where small separate clouds are generally available, it will be advantageous to use a battery of projectors as illustrated. The image may be rotated so as to place it right-side up for observers at any location within range, even when the projection is made near the zenith.

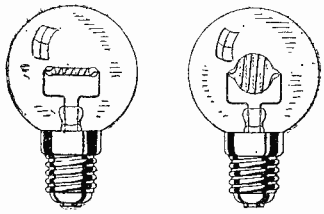
WINDSHIELD SCREEN

No. 1,666,580, issued to John Henry Park. This wire gauge screen is for use immediately behind the windshield of an automobile when the windshield is open, thereby preventing the ingress of dust, bugs, etc. The construction is such that it may easily be placed in position or removed. The frame for holding the screen is made of sheet metal. The frame has offset portions to permit easy access to the windshield adjusting brackets.



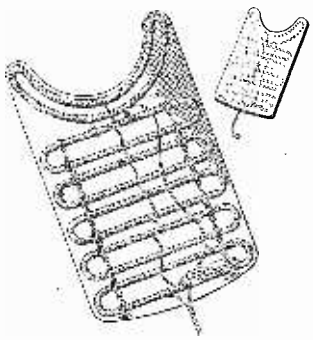
COLORED GLOW LAMP

No. 1,659,749, issued to Franz Skaupy. The light from this lamp is emitted from a transparent body having the desired color, this body being heated to incandescence by contact with a heated electrical conductor.

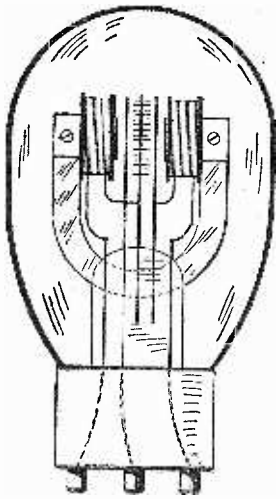


ELECTRIC HEATING PAD

No. 1,660,518, issued to Thomas H. McComsey. This pad is intended for therapeutical treatment of the human body. The pad is anatomically shaped, so as to closely conform to the shape of the body, with the result that the heat will be uniformly distributed and applied over the body. The coil of resistance wire is wound as shown to obviate sharp angles in the wire, which tend to breakage. The temperature of the pad is controlled by a thermostatic switch, which maintains uniformity of temperature and prevents overheating.



THERMO MAGNETIC VACUUM TUBE

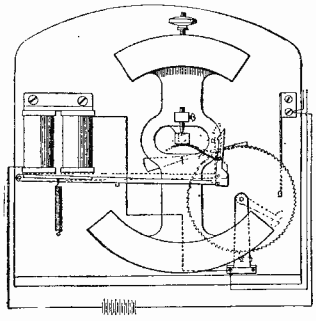


No. 1,666,858, issued to Augustus Henry Jahn. The object of this vacuum tube is to utilize a permanent magnet and an electro-magnet to assist the action of the grid and plate elements by means of their magnetic fields. The tube has the usual four-prong base. One of the coils is in series with the grid, and the other coil is in series with the plate.

ELECTRIC FLY TRAP

No. 1,664,027, issued to Dominik Fillier. This trap uses food as a bait to lure flies into contact with the electrocuting elements An electric light is used to lure night swarming insects.

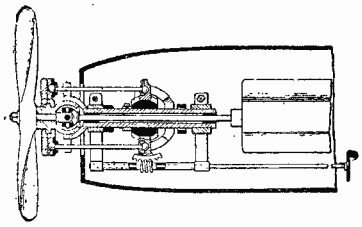
COMPOUND-PENDULUM CLOCK



No. 1,638,917, issued to Thaddeus S. Casner. This invention provides an accentuating mechanism which is so constructed and arranged that it will energize the pendulum and compensate for the windage and friction, without interfering appreciably with the free swinging of the pendulum.

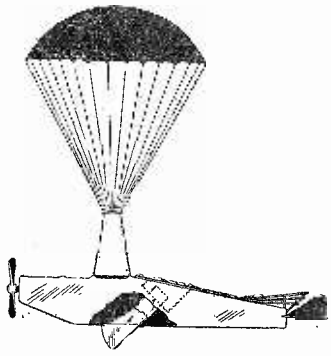
STEERING PROPELLER

No. 1,670,923, issued to Felix Arnold. This propeller makes possible the control of the horizontal and vertical components of airplane travel without the use of the usual control members. This propeller need not eliminate the rudder and elevators entirely, but may be used to assist them. This propeller may also be adapted for use on dirigibles, helicopters, submarines, etc.



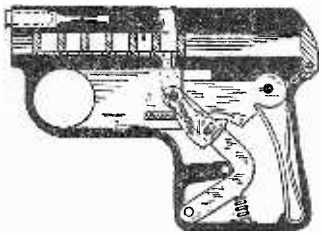
PARACHUTE CONTAINER AND EJECTOR

No. 1,666,456, issued to Joseph La Porte. This apparatus is built into the fuselage of an airplane in such a way that the parachute will be ejected by an air blast. This blast is always available due to the motion of the airplane through the air.



SHAM PISTOL

No. 1,66,579, issued to Franz Moller and Martin Moritz. This invention refers to scaring or frightening sham pistols, to be used as a toy or as a means of frightening outlaws and burglars. The construction is such that the pistol can be made at a small cost, and at the same time be foolproof. The deceptional character of the device is accomplished by exactly imitating the shape of the usual small calibre pistol.



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, as it is practically impossible to obtain up-to-date addresses. —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:

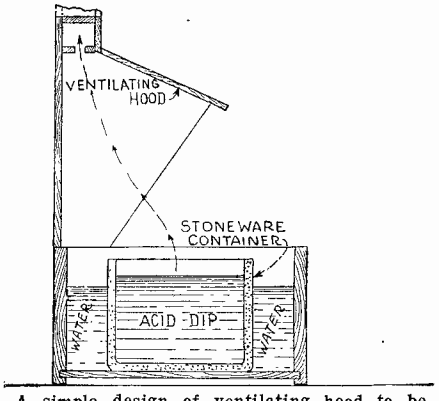
1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink; no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by 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 calculation, a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

ELECTROPLATING

(2268) F. J. Walsh, Ferndale, Michigan, writes:

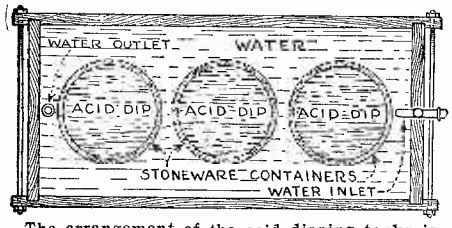
Q. 1. Kindly give me details for a bright dipping tank and ventilating hood to be used in conjunction with a small electroplating plant.

A. 1. In the electroplating process, foreign matter may be removed from the surface of metals by dipping in acid. This process is usually called bright or acid dipping. Large tanks are seldom employed in small plants because of the cost of



A simple design of ventilating hood to be placed over the dipping tank is illustrated above. It is made entirely of wood.

the acid. For your purpose, stoneware containers set under a hood and placed in a vat of warm water should prove satisfactory. A view of this arrangement is shown here. One or more acid containers can be used according to the requirements. The wooden vat is similar to the plating and pickling tanks, with the exception of the water overflow. This overflow is merely a pipe passing through the bottom of the tank with an inside height equal to the desired depth of the water. During this process, poisonous fumes will arise from the acid. A ventilating hood is therefore necessary, and one of simple design is illustrated on this page. The hood is placed over the dipping tank and is constructed entirely of wood coated with asphaltum paint. As the fumes are highly corrosive, the exhaust pipe should not be constructed of metal but of wood or tile. The dimensions of course are dependent upon the space available.



The arrangement of the acid dipping tanks is shown here. Stoneware containers are used for the acid dip and are placed in a tank of warm water.

GREEN RAY

(2269) Herman Dice, Elk Falls, Kansas, writes:

Q. 1. What is the cause of the so-called "green ray" which is sometimes seen when the sun sets over the water?

A. 1. The "green ray" is a brilliant green coloration which the sun sometimes assumes just before it disappears below the horizon. The cause of the "green ray" is generally supposed to be that the light rays are bent when they pass through the earth's atmosphere. This enables us to see the sun for a short time after it has actually passed below the line of the horizon. The red and orange rays disappear first behind the horizon because they are bent the least. The blue, green and violet rays, however, are still visible. Blue and violet affect the eye much less strongly than green does, and therefore the green color is most impressive. Dr. Wood, of Johns Hopkins University accepts this theory, but proposes to explain why the green ray is not always seen at sunset. At the time when it appears most strongly, the air and water are at approximately the same temperature. When the ocean is warmer than the air, it is not seen at all. When the water is warm and the air cool, the layer of warm air in contact with the water would cause the light rays of all colors to be bent less, and the sun would set early. When the air is warmer than the water, the curvature of all the rays would be increased, and so the atmospheric refraction that causes the ray would have a longer time in which to act.

CAFFEINELESS COFFEE

(2270) R. W. Porter, Nashville, Tenn., writes:

Q. 1. Will you please outline a process for producing coffee free from caffeine.

A. 1. Coffee can, of course, be rendered free from caffeine by means of extraction apparatus but, as this process is expensive, new methods have been developed. The new process is adapted to withdraw caffeine from whole coffee beans by the employment of a pressure of about fifteen atmospheres in an autoclave with the assistance of a solvent, such as a hydrocarbon, such as benzene, toluol, or else carbon tetrachloride, a compound of the haloid class. Various substances of the hydrocarbon group can be employed. The caffeine can also be withdrawn from the coffee beans under high pressure by means of other compounds, mesityloxide, diethyl-ketone, or any of the other ketones. Caffeine may also be withdrawn under high pressure by means of the secondary alcohols, such as, allylalcohol or propylalcohol. The withdrawal of caffeine by means of hydrocarbons, ketones or alcohols, can be effected with or without the addition of substances having an alkaline reaction under pressure. The withdrawal of caffeine can also be effected by treating the coffee beans by certain organic acids or their compounds. It is possible to use salicylic acid, or esters separately or in combination.

TANK PROBLEM

(2271) Ernest Dillard, Bowdon, Georgia, writes:

Q. 1. In your answer to the cylindrical tank problem in the June number of SCIENCE AND INVENTION, you state that there would be no general displacement of the tank. In view of the fact that there is a slightly greater pressure of water against the bottom of the tank than that on top, would there not be a displacement of the tank in the direction faced by the boys? The principle that applies here seems to be the same as that on which the rotor ship operates.

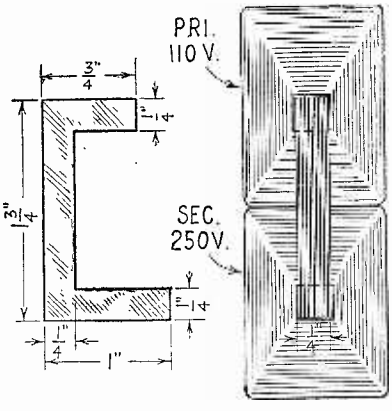
A. 1. We are indebted to Mr. E. K. Chapin, who conducts the Scientific Problem and Puzzle Dept., for the following explanation. He writes as follows: "I cannot agree with you that the cylindrical tank problem in SCIENCE AND INVENTION for June is similar to that of the German rotor ship. The rotor ship will move only when the wind is blowing, that is, when it is in a stream of air. But in the tank problem we are assuming that the water is stationary except for any motion which the rotation of the tank might give it. As for the pressure of the water being greater at the bottom than at the top, I cannot see how this will affect the matter, for the pressure at every point is perpendicular to the surface of the tank and hence will not tend to make the water "stack up" more on one side than on another.

FLY KILLING TRANSFORMER

(2272) Ed. Marion, Helena, Montana, writes:

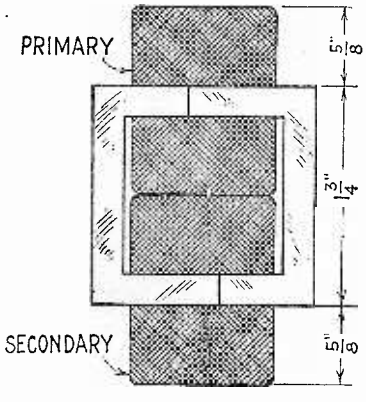
Q. 1. Will you please tell me how I can construct a transformer for electrocuting flies?

A. 1. The design of a suitable transformer with a 250 volt secondary appears upon this page. Thirty-four laminations of No. 28 gauge silicon steel will be required for the core of the transformer. The primary winding consists of 1,156 turns of No. 26 D.S.C. wire.. The total primary winding will take 24 layers, each having 49 turns of wire. The secondary winding consists of 2,634



Laminations for the fly-killing transformer should be made according to the above specifications. A sectional view of the transformer is also shown here. The secondary will deliver about 250 volts.

turns of No. 32 D.S.C. wire. The total secondary winding will be 37 layers in thickness, each layer having 72 turns. The windings will be 1⅛ in. wide and will just fill the transformer window, as each are of the same thickness. The cross-sectional view shows the assembled transformer and the windings. In order to use this transformer, it is probably best to make a parallel winding of bare wire upon an insulated form connecting the windings to the secondary leads. When a fly bridges the gap between the two windings, he is immediately electrocuted. For attracting the flies, molasses, honey, sugar and water, and the like may be used.



The above cross-sectional view shows the width of primary and secondary windings and how the transformer will look when completed. The window will be completely filled by the windings, which are both of the same thickness.

From the Earth to the Moon —via Rocket

(*Continued from page 393*)

a velocity greater than that of the molecules of gas surrounding it, all of which constitutes additional trouble. The mechanical energy of the molecules would be as it were directly absorbed by the shell of the rocket car.

Finally, for a velocity of two kilometers a second, the heating of the air in front of the projectile (adiabatic compression) would rise to 150°C, whatever the rarefaction of the air might be. If the projectile comes into equilibrium with this temperature, it will become rapidly uninhabitable. At 3 kilometers a second it would be heated up to 266°C; at 7 kilometers the thermometer will pass 500°C; at 10 kilometers—it will attain 754°C.

And we have already said it will have to obtain a speed of 10 kilometers a second. This must be given as late as possible, at a minimum above the altitude of 200 kilometers. It is above this altitude that the air will be sufficiently rarefied, for the projectile to radiate into space, as much heat as it absorbs by the compression of the air.

What proves that this will have to occur is this: shooting stars or meteorites only appear to the vision at a less altitude than 120 kilometers. The mechanical balance which is established between the radiation from their mass, and the absorption of the enormous heat which they develop in their progress, preserves meteorites from becoming incandescent too soon.

The problem will be studied thus: the rocket should not attain this maximum velocity below the altitude of 200 kilometers. Now, the best form of rocket case, the cylinder, does not conform to this desire. The conical rocket or again a third one, the exponential rocket, corresponds thereto, whose ejection compartments get smaller and smaller as the combustion goes on, and consequently as it advances. The maximum velocity of these two last rockets is only attained at an altitude of 1800 kilometers. This gives a good margin.

The dangerous atmospheric zone can be theoretically traversed. Now, we have a fine problem of theoretical physics solved for interplanetary navigation.

WHERE IS THE EXPLOSIVE?

TO obtain the general results which we have given above M. Esnault-Pelterie only took into consideration relatively slight accelerations on departure, never exceeding twice the terrestrial acceleration, that of gravity, which is indicated by the letter g. He believes that acceleration exceeding twice g should be left out of consideration even for a projectile containing no living beings. It would burn up before passing through the atmosphere.

For the rocket could first be thought out and experimented with as a simple experimental projectile, carrying registering apparatus.

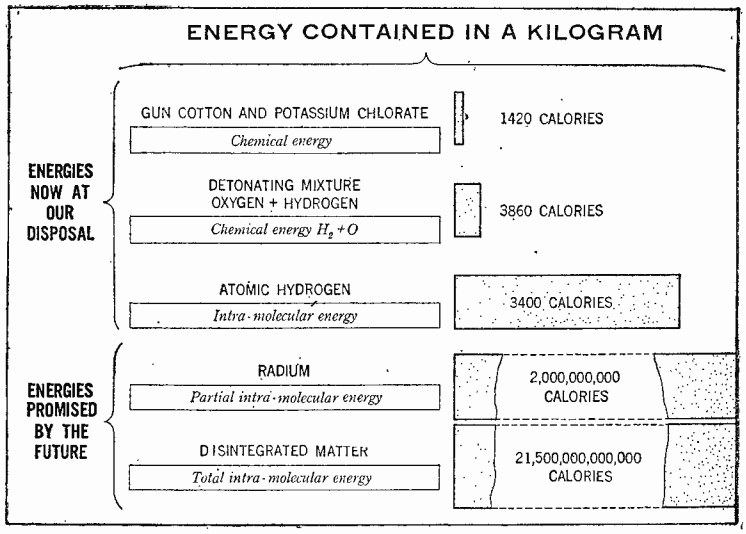
From a more radical point of view, the American professor Goddard, of Princeton, recently studied the sending of a kilogram of Victor powder (containing magnesium) to the moon, whose brilliant explosion will be perceived on the earth. Now to transport this kilogram of matter outside the zone of terrestrial attraction, Prof. Goddard had to picture a charge of combustible for propelling the rocket, equal to six hundred kilograms without counting other weights, the shell, etc., at least 50 kilograms.

To burn 600 kilograms of explosive to bring to its goal a single kilogram of load, would never be anything but a brilliant sportive achievement, but calculations show

(*Continued on page 442*)

FROM THE EARTH TO THE MOON—VIA ROCKET

(Continued from page 440)



The illustration on right is a comparison of the different known or hypothetical physical energies. If the most modern theories on the constitution of matter are not greatly modified, tremendous energies may some day be at our disposal.

that it can be done; it depends upon what propelling combustible we have in mind.

Professor Goddard establishes his calculations on a powder composed of gun cotton and potassium chlorate, developing 1,238 calories per kilogram.

A new element of the problem comes into play; the useful coefficient of the combustible. Calculations show the maximum of efficiency corresponds to the highest acceleration which it is possible to give to the rocket. But we have seen that the acceleration should not be too great, if we do not wish the projectile to volatilize before passing through the atmospheric layer.

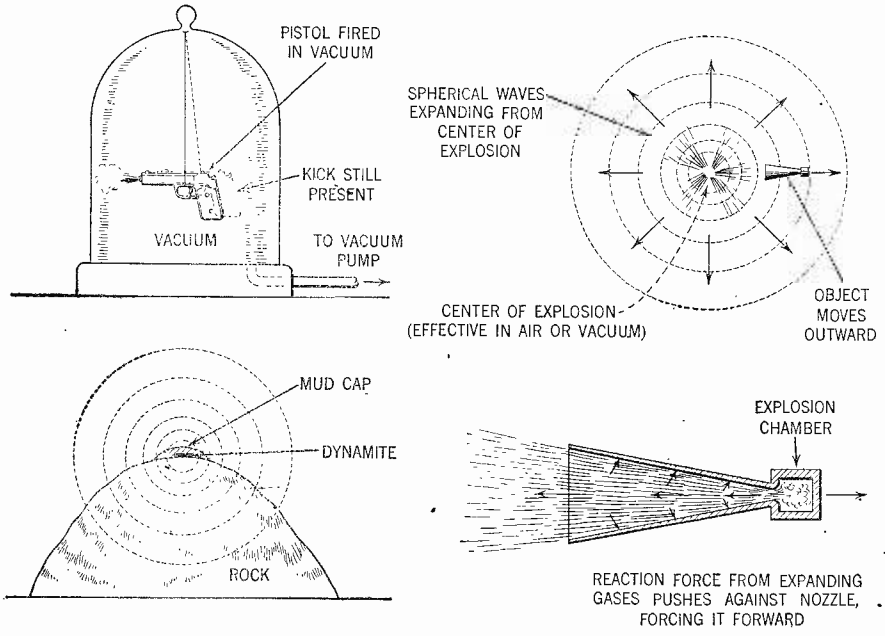
On the other hand, the propelling combustible is limited in weight; 600 kilograms of powder for 1 kilogram of load. It cannot then be wasted, accordingly its combustion should be regulated and utilized as far as possible from the explosive region. Without this we would have a cannon shell exploding, but this time without any cannon. We conclude therefore that we must reduce the velocity of ejection of the gas but then the efficiency is deplorable.

The physicist did not avoid these difficulties. The Goddard rocket is found to require an acceleration ten times greater than that of gravity g, for reaching the limit of velocity required to escape from the earth, but with such an acceleration, it would have been burned up before leaving the atmosphere.

M. Esnault-Pelterie has considered that which would come to pass, if the Goddard powder was replaced by a mixture of oxygen and hydrogen whose kilogram furnishes 3,800 calories. The velocity attained by the projectile will not exceed 3,400 meters per second. And now it would have to operate with an acceleration five times that of g! Such a rocket would not be able to leave the earth, but we could contemplate sending it very high up in the atmosphere supplied with registering apparatus. For this limited voyage, a very interesting one, it could rise with only sixty-three kilograms of combustible, and one kilogram of useful load.

But now Professor Langmuir has developed an explosive more powerful than this mixture of hydrogen and oxygen, as he has succeeded in making atomic hydrogen in the nascent or activated state.

If it could be stored, or better yet liquified,



In the illustration above, we see how it is possible for an inter-planetary rocket to progress through empty space. An analogy may be drawn to a pistol fired in a vacuum where the kick is still present. Spherical waves move outward from the center of explosion and are effective in air or in a vacuum. Thus, the proposed space rocket would be propelled regardless of the density of the air. The reaction force from the expanding gases pushes against the cone-shaped nozzle, forcing the craft forward, as illustrated. Contrary to popular belief, the explosive force of dynamite is equal in all directions and not only in a downward direction, the spherical waves expanding equally from the center of explosion.

which in spite of its instability is not theoretically impossible (by mixture with catalysts acting as a chemical brake, such as anti-explosives used for moderating the violence of explosion of volatile carbon compounds), liquid atomic hydrogen would constitute the most violent explosive known, with more than thirty thousand calories to the kilogram. And it is possible to picture to ourselves the construction of a rocket, whose combustible mass would be considerably reduced relative to its useful charge. About ten kilograms of atomic hydrogen would drive one kilogram of useful charge outside the influence of the earth.

Unfortunately the recomposition of atomic hydrogen into molecular hydrogen which here may be taken as a sort of equivalent of combustion, would supply 9,900 degrees of heat. No metal would act as a tuyere or nozzle for passing so hot a gas.

With this exception, the expulsion of the ejected gas, molecular hydrogen, might reach a velocity of 10,000 meters per second, and then we wouldn't have to be content with an acceleration of 2 *g*. The coefficient of efficiency would be very acceptable. Theoretically and only theoretically a projectile of one ton driven by ten tons of atomic energy could leave the earth.

Practically M. Esnault-Pelterie hardly believes that the difficulties of dealing with atomic hydrogen will ever be overcome.

In spite of this disappointing conclusion, it is a good intellectual sport to study systematically interplanetary travel. I have spared you, however, equations, those narrow doors, which we have to pass through, if we wish to follow the rules of the game.

IN the short treatment which we have given, it is shown that the means for interplanetary travel are not superabundant. and that it would be unsafe to count on the best explosive actually existing.

But everything would change if we could get the mastery of and regulate this source of inexhaustible energy which modern physics promises us, perhaps a little boldly, if we may see, and that nature offers to us (as a sort of phantom) radium, the disintegration of matter.

Every material body, simply because it possesses weight represents an energy which the new physics evaluates as a product of its mass by the square of the velocity of light; according to this one kilogram of matter would contain 21,500 milliards of calories.

Assume that you could extract this energy, make it drive a rocket, like common chlorate powder, and you will be in possession of a kinetic energy, which, by reaction, would enable you to attain (*tres commodement*, very conveniently, says M. Esnault-Pelterie) all desirable velocities. It would be the protons and electrons which make up matter, which on their release would propel you. As the velocity of escape would be measured by

tens and hundreds of thousands of kilometers per second it will be enough if your rocket would utilize an infinitely small fraction of the expended energy, for it soon to attain velocities absolutely formidable.

Thanks to this source of energy, which is practically inexhaustible, you would not have any need of exceeding the limting velocity of eleven kilometers per second. You could sustain the acceleration.

And we shall see that this might not be a useless luxury.

SPACE SICKNESS

SUPPOSE then that you started with an acceleration of eleven-tenths that of terrestrial gravity, you would have the sensation of weighing eleven-tenths of your normal weight. But if you make available only the velocity attained then all acceleration ceases. You are in the position of a person in an elevator going down, as far as sensations are concerned. You will have a certain sickness. The man who, according to my view, is best acquainted with these troubles, is an American officer who jumped out of an airplane at 8,000 meters of altitude, vowing that he would only open his parachute at the very last possible moment. He could not prolong his free fall beyond 600 meters. In this particular case the air acted as a brake. How would it be with him if he had to fall for several days? And here is the remedy.

The enormous margin of available energy which this disintegration of matter would furnish would make it possible in preserving acceleration to preserve also the sensation of weight, but now, at the end of several hours, velocity increasing constantly would go from two hundred to 400, to 500, and to 800 kilometers per second. Under these conditions the voyage from the earth to Venus would be accomplished in 35 hours and 6 minutes, while the voyage to Mars would only require 49 hours and 49 minutes.

All the energy necessary for braking would also be at the command of the travelers in the radio active rocket.

THE DREAM OF MODERN ALCHEMISTS PROBABLY IMPOSSIBLE OF REALIZATION, BUT SUGGESTIVE

CAN we seriously count upon disintegrating matter?

Personally I wouldn't say it was impossible, even if it applies to our most remote descendants.

Nevertheless, you will say nature gives us radium whose spontaneous disintegration would be only partial, already sets free about the ten thousandth part of the energy theoretically contained in the total mass. This partial disintegration of radium as we know requires about two thousand years for its accomplishment. It would be enough to find some way of accelerating it at will, to obtain a quantity of energy immensely exceeding that of all chemical explosions.

Let this be. But 300 kilograms of radium would hardly be enough to drive a thousand kilogram rocket to the planet Mars, preserving the acceleration we have described. So radium would enable us to at least reach the nearer planet, and yet the mysterious metal remains insensible to all our efforts for controlling and directing its disintegration. The course of the radioactive phenomenon is so regular, that Pierre Curie suggested its adoption as a standard of time. Curie considered that it had a regularity superior to that of astronomic cycles.

But now the objection can be raised that Rutherford succeeded in disintegrating nitrogen and also aluminum with the production of intra-atomic energy. Here we find ourselves face to face with the liberation of energy included in matter.

But to start with, Rutherford used radium as the source of his operative energy, which in industrial practice, would be a true vicious cycle. Finally he arrived at this deceptive result, that a gram of radium employed to bombard aluminum liberates only one-thousandth of a milligram of hydrogen per annum. The energy liberated corresponding to this trifling disengagement of hydrogen is almost null. Nothing, absolutely nothing, seems to give any hope that the experiment of Rutherford, whose interest does not go beyond the scope of an individual atom, could ever extend to a ponderable quantity of any matter.

A philosophic examination of the problem, free from mathematical theories, tends to make us think that it is Utopian to hope to transform freely into energy any kind of matter, which all the studies of the past tells us, that today it is only the ashes of an ancient exhausted energy. The sun in full radioactive evolution spreads before our eyes the creation of matter in its different development, and the radioactivity of radium is not perhaps more than the final phosphorescence of some terrestrial matter reaching the ends of its evolution.

MUST WE ABANDON THE MAGNIFICENT DREAM?

MUST we then, since intratomic energy would seem indispensable to carry out his ideas, renounce the beautiful scientific dream proposed by M. Robert Esnault-Pelterie?

Not at all. The most beautiful problems are those which are never solved, but which are transposed by carrying them to a new plane. It is thus that, referring to radio activity, we could picture the mechanism for the industrial accumulation of electricity in enormous quantities in a small volume of matter, and this would be a discovery of immense revolutionary import.

Let scientists then study intensively all the conditions of interplanetary travel including the disintegration of matter. This research could be as rich in result as the search for the philosopher's stone has proved itself to be in bringing us eventually to modern chemistry.—*Jean Labadie in La Science et la Vie.*

Have you become a "HOME MOVIE" fan yet?

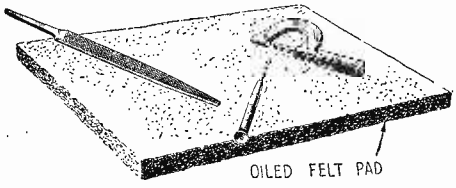
Turn to page 417

Hints for the Mechanic

Mechanics' needs have caused us to start this new department—"Hints for the Mechanic," in which we intend to publish wrinkles useful to mechanics in general. You can help us with this department by writing a brief description of your favorite shop wrinkle and sending this to the editor of this department, together with a pencil or pen and ink sketch of the wrinkle. The ideas published herewith will give you some idea of what we want. Our draughtsmen will make the necessary mechanical drawings, so you need not send us finished drawings. We will pay $10.00 each month for the best Wrinkle or Hint sent in; others published will be paid for at space rates. Address all letters to Editor, Hints for the Mechanic Department, in care of this magazine.

FIRST PRIZE $10.00

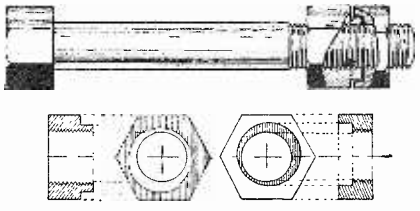
CARING FOR TOOLS



An oiled felt pad is used for protecting expensive tools, as shown above.

When expensive tools are in daily use, they can be protected by slightly oiling a piece of felt and laying the tools on it when not in use. Tools with a sharp edge can be tossed upon the pad without injury. The oil keeps them from becoming rusty.—*G. F. Stillwell.*

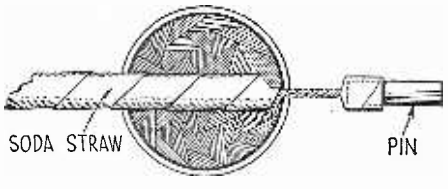
LOCK NUT



Details of the improved lock nut are shown above.

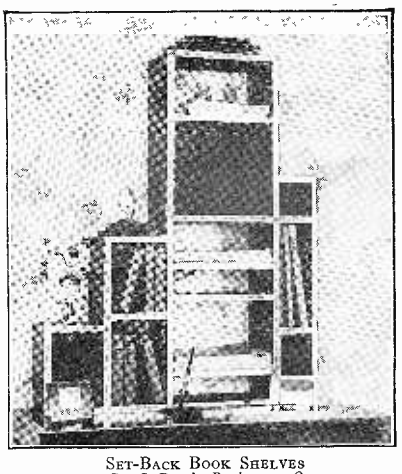
A double lock nut which will not become loosened can be made as shown. Both the rim and groove are cut a little off center. The two nuts are lined up and screwed on to the bolt, after which the outer nut is given a slight twist in order to bring added pressure on the band and obtain a double locking effect.—*C. N. Cook.*

SETTING VALVE PINS

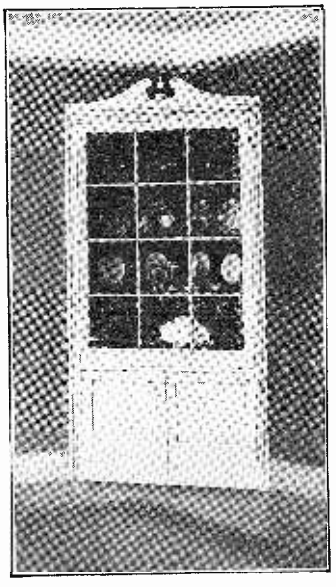


A valve pin setter for straight pins is illustrated here.

A soda straw pinched tightly near the end can be used for inserting straight valve pins. The straw is used as an extension for placing the pin in the hole, the pinched portion preventing the pin from sliding into the straw.—*E. A. Porter.*



SET-BACK BOOK SHELVES
See LePage's Book, page 9



PLYMOUTH BUILT-IN CHINA CLOSET
See LePage's Book, page 6

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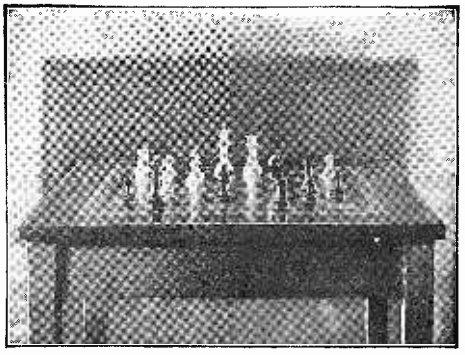
16 Sheraton Writing Desk
17 Sheraton Desk Chair
18 Colonial Hanging Book Shelves
19 Smoking and Reading Cabinet
20 Colonial Mirror
21 Tea Wagon
22 Telephone Cabinet
23 Stool for Telephone Cabinet
24 Manual Training Work Bench
25 Home Worker's Tool Cabinet
26 Spanish Galleon
27 Vanity Table



CHESS AND CHECKERS TABLE
See LePage's Book, page 15

LE PAGE'S NEW BOOK
will show you how to make 20 attractive pieces of furniture

Yes, a *New* Book, just printed, the third in the series of LePage's Home Work Shop Books. New and better designs. Made by an expert. Complete, easy-to-follow directions for making 20 attractive pieces of household furniture. Any man handy with tools can easily make these handsome, useful articles right at home.

Big Improvement

The first Le-Page's Home Work Shop Book, two years ago, sold 30,000 copies. Last year the second book sold 55,000 copies. That's popularity for you. An enormous quantity for books of this kind. Now the third new book is better yet. Of its 20 complete projects, 17 are entirely new and never offered before.

Each project is presented in three parts—a photographic illustration of the finished project, a complete dimension drawing of its parts, and simple easy-to-follow, step-by-step directions.

This year the designs are divided into three groups. One group is based on famous old colonial pieces. Another group follows the furniture in popular demand for American homes of today. The third group is known as modernistic furniture, showing the influence of the modern skyscraper set-back architecture of New York City. To buy 20 such pieces would cost about $1000. You can make them for a fraction of that. And yet be the owner of truly fine furniture.

Designed by Expert

All the designs, dimension drawings, actual pieces and photographs were made by William W. Klenke, Instructor in Woodworking, Central Commercial and Manual Training High School, Newark, New Jersey. Also the designer of the first two LePage's Books. Each project and the directions for making it are perfectly practical.

In addition to the three pieces shown above, the book includes the following: *Cape Cod Chest of Drawers, Alexandria Nest of Tables, Old Salem Ship's Cupboard, Lady Washington Sewing Cabinet, Modernistic Desk, Table, Folding Screen and Fire Screen, Smoking Table, Caned Side Chair, China or Book Cabinet, Book Trough and Magazine Stand, Magazine Carrier, Vanity Case, Book Stand, Fernery Stand and Folding Sewing Screen.* Where else could you get complete directions for making all these for only 10 cents?

Send 10 cents for this NEW LePage's Home Work Shop Book

Simply use the coupon below, sending it to us with 10 cents in coin or stamps and we will at once send you a copy of LePage's New Third Home Work Shop Book, postage paid. Address: LePage's Craft League, 626 Essex Ave., Gloucester, Mass. Tear out coupon, so you won't forget it.

MAIL THIS COUPON

LePage's CRAFT LEAGUE,
626 Essex Ave., Gloucester, Mass.

Gentlemen: Enclosed please find 10 cents (coin or stamps) in payment for LePage's New Third Home Work Shop Book. Please send a copy of this book to:

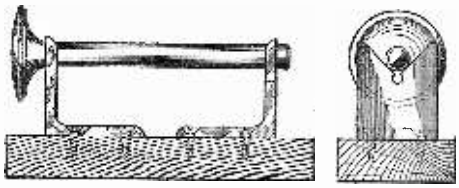
Name .....

Street .....

City ..... *State* .....

Please also send the following Job Plans ..... (indicate by number those you want. See column at left), for each of which I enclose an additional 10 cents.

VALVE TESTER



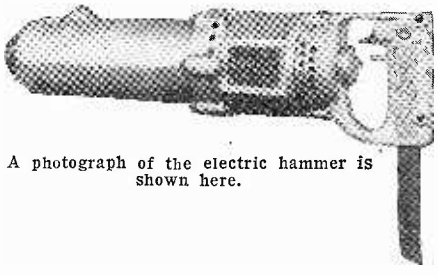
The above illustration shows a side and an end view of the device for testing valves for warpage.

A valve tester can be made from a block of wood and two pieces of angle iron which form V blocks. To test the valve, hold a piece of chalk against the stem and rotate slowly. A mark will be left on the high side of the stem.—*C. T. Schaefer.*

ELECTRIC HAMMER

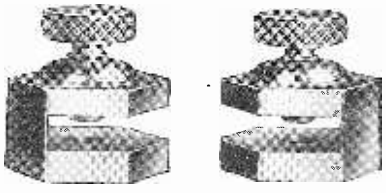
Above we see the new electric hammer in use.

A new product which will lessen the labors of the mechanic, is an electric hammer which strikes hard blows at the rate of 2,300 per minute. It will drill through concrete and brick, chip steel and drive punching tools. It weighs only 15½ lbs. and has an overall length of 18 in. It is equipped with a pistol grip and trigger switch. A heavy coil spring absorbs the shock of the reciprocating mechanism at the end of the stroke.—*Name of manufacturer upon request.*



A photograph of the electric hammer is shown here.

SCALE SLIDER



The above illustration shows two of the new metal scale sliders which save time in measuring.

The time required in making a number of measurements can be greatly reduced by empoying scale sliders such as those shown above. These are made of metal and are fitted with set screws for holding them in any desired position. They can be slid along the scale, whether it be of metal or wood, and will save much time when measuring articles of a similar size.—*Name of manufacturer furnished upon request.*

Explosive Concrete Piles

(*Continued from page 397*)

structures, riding in the cars one seems to feel a sort of vibration and trembling, as if the road was unenduring.

Putting in pile foundations in such difficult soil is a slow affair, requires much time and costs much money. Within a recent period a better way of carrying out the operation has been evolved. In the last decades, the development of concrete piling has given the desired means to take care of swampy soil.

As good wood is very expensive, concrete piling has been used for some time as a matter of economy, in which case, if the concrete piles are to be driven by a pile-driver, they are provided with steel reinforcement and are cast in wooden molds at the place where they are to be used. In another process a wooden pile, slightly conical, is cased in sheet steel and the two are driven down into the soil. Then, the wooden core, as it may be called, is drawn out after the driving has been completed; the iron casing remains in place and is filled with concrete, reinforced, or without reinforcement, as the case may be.

The last described method is the starting point for the development of the explosive concrete pile. A steel tube, provided at its lower end with a heavy steel shoe, receives a wooden pile. A driving cap is put on top, and the two are driven down into the ground. When this has reached a sufficient depth, so as to rest upon an adequate supporting soil, the wooden pile is drawn out and then an exploding tube is introduced, which carries an electric conducting wire and at whose lower end a blasting charge with a detonating apparatus is secured. The steel tube is then drawn up a little ways and the space left empty is filled with liquid concrete which, just above the point for the explosion, is reinforced with steel bars. If now, the explosive charge is detonated by an electric battery, the gas of the explosion drives the earth aside and away from the place; theoretically, the action of the charge would give a wedge shape or roughly conical opening, but in practise, a sort of an ellipsoid is produced. As the gases consist principally of carbon dioxide, which is quickly dissolved by the water in the moist soil, the concrete pile is soon sucked down into the somewhat vacuous space, and by it is made more secure than before. The iron reinforcement goes down with it. Next, by putting a piece of piling on top of the concrete kept in place by a sort of sleeve, the density of the concrete can be increased by blows of the ram. The steel jacket is drawn up and the concrete left to set. The pile stands with its mushroom-shaped head spread out over the soil, and the rammed concrete gives a good resistance. Half way up to the surface, by a second explosion, a layer of higher resistance can be formed around the piling, which further increases the supporting power. The same tubes and wooden cores can be used for a number of drivings. All that is lost is the steel shoe, which disappears in the explosion.

In this way, piles can be driven to carry a very great load. For example, five such exploding concrete piles can be driven so close to one another, that the areas of the explosions intersect each other, so that one single mass of concrete results by carrying out the process, and gives one single flat foot, while the upper ends at the surface give a wide footing over the building.

The development of this method has, in a short time, brought about a valuable assistance in the building art. By using explosion concrete piles, we are now able to produce sub-soil foundations quicker and cheaper than before. This way of building insures also reliable foundation works in earth which is to carry the building, which soil formerly we had to regard as weak and unadapted for carrying its load.

Sealed Aquarium—A Microcosm

(Continued from page 402)

satisfactory growth is obtained there is no use continuing the experiment, for failure is certain. The height of the water in the bowl should be marked and any evaporation replaced with distilled water (rain water will do) to avoid too much increase of mineral matter. After plant growth is well under way the fish is added. The bowl should not be sealed, however, for a period of at least two weeks to allow the fish to become adapted to its new surroundings and to learn whether these surroundings are going to be agreeable to the fish.

CUTTING THE GLASS BOWL COVER

WHILE the fish is getting used to his new home, you can provide a circular piece of glass to cover the bowl. It is not difficult for anyone who has even the slightest acquaintance with a glass cutter. You probably can pick up a large enough piece of broken window pane. Near the center of this fasten a spool with a bit of sealing wax. Around the spool loop a piece of wire and provide a loop at the other end to hold the glass cutter. When you have adjusted this loop to the right length, lay off a circle on your glass, pressing the little cutting wheel firmly to the glass. The circle will not usually break out, so with a ruler for a guide, cut a number of straight lines clear across the glass and just touching the circle. Then place one of these lines along the edge of a board and tap the projecting glass, along its entire length, several times with a pencil or light stick. If you are successful, the glass will break after several smart taps, cleanly along the line. In this way, break away the glass along each line you have cut. Then, using the notches in the glass cutter, carefully chip away the corners, working gradually in to the circle, until the cover will fit fairly close to the top of your aquarium. The job may be somewhat rough, but sealing wax will hide a multitude of jagged edges if they are not too large.

You are now ready to fasten the lid on with sealing wax. This requires a good deal of care. The glass needs to be warm for the sealing wax to adhere well. I warm the top of the bowl with the flame of a Bunsen burner or an alcohol lamp, keeping the flame constantly moving, and taking care not to heat the glass too much. I always stop when I get the glass moderately warm. Then melt the sealing wax with the flame and distribute it along the edge of the cover and the top of the bowl. A hot case knife can be used to spread the wax and to melt it into the crack between the cover and the top of the bowl, but I find a better tool for this purpose is an electric soldering iron. It will furnish plenty of heat to spread the wax evenly, at the same time transmitting enough to the glass to cause the wax to adhere firmly.

If you have carried out these operations successfully, you have an aquarium as beautiful as any and far more interesting than the ordinary fish bowl. And you will be able to observe an interesting experiment, illustrating the interdependence of the different forms of life, and the continued operation of the carbon dioxide and nitrogen cycles, without which life, as we know it on our planet, could not long exist.

Finally, the question at the beginning of this article is almost invariably followed by another: "How long will the fish live sealed in that bowl?" I do not know. I do not know how long a gold fish is expected to live. But I expect my fish to live to a reasonable old age.

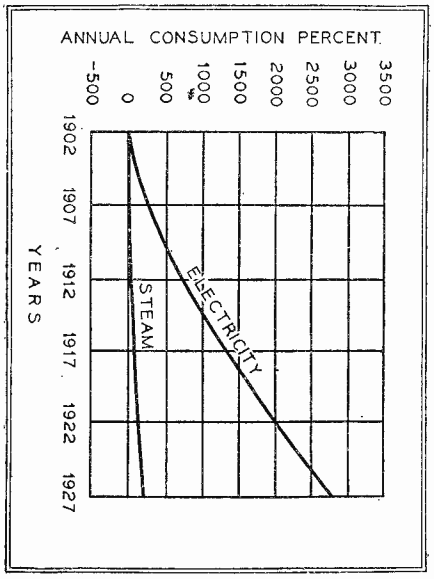
Heating Your House with Atmospheric Air

(Continued from page 407)

This air at the 140°F. utilized by a "heat changer," that is to say, a radiator, will heat again a current of fresh air coming from outdoors. This fresh air reheated, will be taken into the apartment by the vitiated air (and cooled by the exchange) will be passed out into the street.

To untangle the magic trick, it is only necessary to understand what follows: In the "heat changer" (which I have defined as a "radiator"), the air at 140° F. as long as it's compressed is passed through a governor which reduces it to the atmospheric pressure, before it goes out into the street. Now, this governor involves a loss of heat. The loss finally brings the exhausted air to the temperature of 13°F. below zero.

It appears then that final operation is completed by the discharge of a quantity of very cold air (—13°F.), into the external air at 32°F—which, in Winter is very simple. Definitely speaking, it is the air of the street which is cold, just as I said, for



The above graph shows the amounts of steam and electricity consumed in a period extending from 1902 to 1927.

the benefit of the interior atmosphere of the habitation.

In the operation which we are going to describe, you will never come upon a source of heat analogue to an incandescent filament constituting a center of high temperature. All this goes on within the smallest thermometer range, recalling exactly the slight difference of level which supports the water from the bathtub.

In fact you have transformed a very small energy of high degree (the electricity from your circuit) into a great quantity of energy of lower grade (the temperature representing that of your apartment).

This is not done except by a vigorous appeal to theoretical science.

PRACTICAL APPLICATION OF AIR COMPRESSION "HEATER"

PRACTICAL application as is always the case, is strewn with difficulties, and what is interesting, is the fact that an engineer had decided that the moment had come to realize a theoretical thing as interesting as this, and which has lain dormant for three-quarters of a century.

We have to construct a machine whose

internal friction will not absorb the greater part of the energy to be utilized. Without entering into a discussion of the diagrams, which would not be of much use here, the reader will understand that the solution is inconsistent, with the least technical error. For those initiated, I will say that the cycle represented by the compression and the release to which the heating and cooling of the mass of air in motion, must correspond as far as possible to the famous "reversible cycle" described by Sadi Carnot for his ideal engine.

Compressions which Mr. Lebre gives the air in his machine (of which he has devised several models working on differently arranged cycles) hardly equals 500 grams per square centimeter (7,100 lbs. per sq. inch). This compression carried out adiabatically (that is to say, at so rapid a rate that the heat developed is not lost by conduction through the walls of the apparatus) brings the air up from a temperature of 60°F. or 68°F. to that of 122°F. or 140°F. if we utilize a "liquifiable fluid" as is done for example in the artificial ice stations for "pumping out" the heat contained in the water and freeze the latter (the reader will at once understand the analogy between the two problems), but will have to picture machines working between ten and twenty kilograms (22 and 44 pounds) of pressure. This would be impracticable in a private house and the efficiency would be eight to ten times more feeble, and therefore would be of no interest.

All the technical effort of Mr. Lebre has been devoted to the production of combined rotary compressor-exhaustors (which, if reversed, would become exhauster-compressors), in which the air is acted on with the minimum of economical friction (from the elements of the machine) and the minimum of viscous friction (in the air).

We give here two examples of these apparatus, each of which acts in its own different way: the first expels the vitiated air of this apartment, replacing it by heated air taken from out of doors; the second is for people who prefer to ventilate by their windows; in this case, the apparatus insures the circulation of the air of the apartment in a closed cycle, in the course of which it is heated. The effect produced is like that of ordinary radiators.

It's not necessary to add that the first of the two conceptions is the more hygienic.

The third system carried out by Mr. Lebre is what we may call a compound system composed of the first cycle with the second. In the first case (compressor-exhauster), the air is compressed above the atmospheric pressure and then rarefied to the same amount. In the second (exhauster-compressor), air is taken at atmospheric pressure, is rarefied and then brought back by compression to the atmospheric pressure. We must imagine that these two cycles may be placed in series in one machine.

With all this before us, it will be asked what system has been applied?

A fourth one, which I am not permitted to describe until its production is brought to the manufacturing scale and to which end the inventor is now working. A new machine takes, as its ideal, Carnot's engine; that is to say, a reversible engine where the work is accomplished between minimum difference of pressure working by graduation. The compressed air is expanded, recompressed, re-expanded by degrees, each as small as possible. The process is that of a person going upstairs first three steps of the stairway, then going down two, then going up three, then going down two, etc., in this way, he will come to the top with a great deal of fatigue. But in thermodynamics this curious progress gives maximum efficiency.

ANTICIPATED EFFICIENCY

PRACTICAL tests give good results. The machine will be practical: the kilowatt-hour working with (dry air) would give

4,000 calories—and more, if, as is always the case, the air operted on, contains water vapor or humidity. Under the best conditions, the thermic energy recovered, should equal 50% of the energy represented by the coal in the central station. To put it otherwise, 100 kilograms of coal consumed in the central station by theoretic combustion would give, if there was no waste, as much heat as 50 kilograms of anthracite would be in your own apartment. This efficiency is about that of the furnaces in private houses as at present operated. The advantage of this system is in the convenience of electric distribution, the regulation being the work of the central stations and energy will be taken during the hours of least consumption and finally because electricity can be produced by inferior fuels and even from white coal, which means the power of water falls.

Thanks to electricity, Lord Kelvin's miracle seems to be attainable.

COOL AIR FOR THE RESIDENCE

LET us add that the mechanism described is reversible. Suppose the cold air produced is sent into your apartment and the warm air out into the street and you will realize how central station heating can, as is desirable, yield its place in summer to the cooling of your habitation from the same central station.

An evident moral is to be found in all this. Let us develop to the extreme the proper use of coal. That is to say, its distillation, delivering the gas for private consumption.* The coke and excess of gas for electric central stations with oil, tar and ammonia, would have a destination more logical than the furnace grate. The intensification of production and the use of electricity is at the base of all economic progress.—Jean Labadie in *La Science et la Vie.*

* The consumption of gas for heating in smaller central stations could also be investigated. Let us add that the thermic motor, used according to Kelvin's paradox, furnishes, according to the calculations of Mr. Lebre, a high efficiency of heating. A gas engine could furnish twice the calories represented by the gas which it consumes.

Motor Hints

Conducted by GEORGE A. LUERS

(*Continued from page* 414)

The chief concern the owner should have is that of methods to prevent the headlights getting out of adjustment.

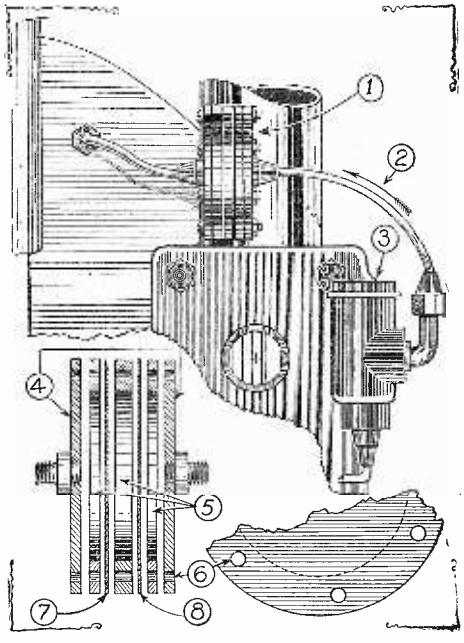
The reason for this is usually due to the vibration of the lamps, which shifts the lamp on the bracket, the reflector in the lamp and the adjusting means.

Illustrated in the attached sketch are the means to prevent this vibration, which latter results in the lamps losing adjustment every few weeks.

A diagonal brace, of the type shown, was adopted to especial advantage by one owner to prevent vibration, which feature has advantages that others can easily obtain. This is made from a bar or iron strap. It is secured at the ends by the radiator splash shield bolts on the spring horns. A center bolt on the cross bar completes the installation.

Not only the brace, but the support bolts for the lamps, must be solidly tight. The rim in front of the glass should be screwed or fastened with the means provided to prevent shake. The gasket under the glass must be in place to hold the glass. Finally, the adjusting screw should be a good tight fit in the lamp socket fastener. If the threads on the screw are worn or stripped replace it with a perfect one.

With these means, lamps once adjusted can be expected to remain so for a long period.



Above—1, screen filter; 2, direction of oil flow; 3, oil pump; 4, metal discs; 5, metal washers; 6, holes for screws; 7, filter mesh screen wire; 8, fine mesh.

MAKING A SIMPLE SCREEN FILTER FOR ENGINE OIL

At this season, when the car is most used, more attention should be given to changing of engine oil. High speeds result in the formation of hard-crusted oil under the piston heads, which flakes off and mixes with the oil. The cutting and wearing action of this burnt oil can only do the engine damage beyond repair, making some filtering means highly desirable.

For the mechanically inclined owner, a

simple filter is shown in the attached sketch, which can be added advantageously as a safeguard for the engine. This idea was worked out in practice by one motorist, and the accumulations in the filter was evidence of its effectiveness.

The filter consists of three washer-shaped spacing discs, two end discs, two oil pipe connections and two fine mesh brass filter screens.

These parts are assembled, using heavy paper gaskets between the discs.

The filter was about four inches, outside diameter. The plates were about one-quarter inch thick.

The filter should be installed between the pump and the outlet pipe into the engine. To clean, the screws are readily removed and the discs are broken down.

EXPOSÉS of SCIENTIFIC SWINDLES

appear often in

Science and Invention

If you know of some hocus-pocus scheme being used to swindle the public—write the Editor about it.

LIGHTNING FROM CLEAR SKY

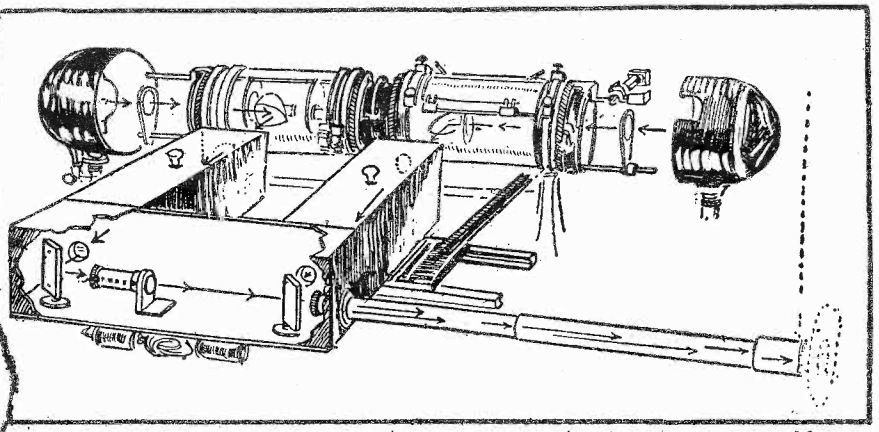
On July 2, 1927, Stanley Lukens, a forest ranger, was supervising the opening of the Gold Peak lookout on the Missoula National Forest. While Lukens and his assistant were setting up the fire-finder they aimed the alidade at various prominent topographic features to check the orientation of the map. As they were making one of these test observations toward a point southeast of Gold Peak both men saw a flash of lightning strike the ground almost on their line of alidade sight, and about 15 miles from them. This flash was followed by four others within the next few minutes. The first strike started a forest fire, the others did not. The phenomenon was most peculiar because all of these strikes descended almost vertically, apparently out of a blue sky, the nearest clouds being about 15 and 25 miles, respectively, from the area struck.

Both Lukens and the lookout, a Mr. Wertz, were greatly impressed by this condition because their general impression was that at that time, 2:30 p. m., the sky was practically clear. A small thunderstorm had passed over Gold Peak between 7:50 and 8:15 a. m. that day, then the sky had cleared. Mr. Lukens remembers, however, that at the time of these "bolts from the blue," there were two small cumulo-nimbus clouds south and southwest, 30 to 40 miles from Gold Peak. These lightning bolts, all of which struck within a small area not over half a mile in diameter, appeared to descend almost vertically, and they were not between the two clouds, but in a northeasterly direction and over 15 miles from them.

No thunder was heard from these flashes, and no further bolts were seen. About half an hour after these strikes the clouds which had been south of Gold Peak passed over the struck area and delivered sufficient rain to extinguish the fire, which had been smoking appreciably. This cloud is reported by Mr. Lukens to have been about one to one and a half miles long by one-half to three-quarters of a mile wide, and was of the cumulus type.—H. F. Gisborne, in U. S. Monthly Weather Review.

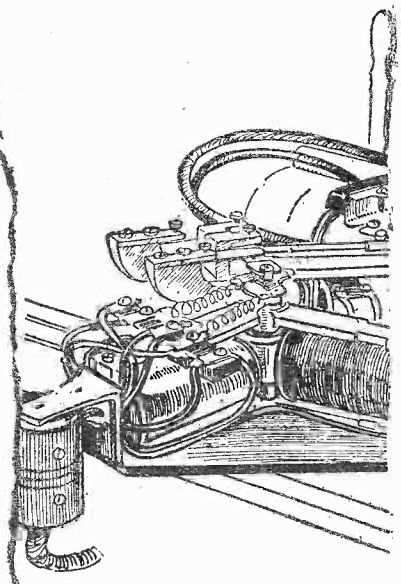
ransmission of Photo's by Radio

RANSMISSION OF PHOTOGRAPHS BY RADIO—Various methods have been devised and are now in use for the transmission of photographs by radio. Among these may be mentioned the systems of *Belin* (q.v.), *Baird*, and *Jenkins*. The principles underlying the Jenkins system are explained under the heading of *Television*. Using the system developed by Capt. R. H. Ranger, photographs were transmitted by radio from Honolulu to New York, a distance of 5,136 miles. Recently commercial picture transmission service has been inaugurated between New York and London using the Ranger apparatus. Two distinct methods have been applied for analyzing the picture in the process of transmission. One arrangement consists of producing an image as a non-conducting deposit upon a metal foil which is traversed by a stylus, while the other method makes use of an opaque image deposited upon a transparent film which is traversed by a beam of light, the light interruptions being recorded by a light sensitive cell. The Ranger system makes use of this latter method. The image is photographically recorded upon a cell[illegible] accordingly.



A pencil of light traverses the picture which is attached to the glass drums and is analyzed by a slow rotating action as well as a backwards and forwards movement of the carrier.

the electron flow constitutes a discharged circuit, so that the grid becomes less negative. The first amplifying tube is a direct current potential amplifier, and is resistance coupled. The grid and plate connections of the amplifier are connected across a condenser which becomes discharged with the fall in the grid to plate resistance of the valve brought about by the grid potential fluctuations. A charging circuit is connected to the condenser and is controlled by a valve, the grid circuit of which operates by variations of the potential across the condenser. The charging current is fed through the plate circuit of this valve, in which a relay is connected, which working through other mechanical relays in cascades, controls the radio transmitter. Wave trains from the transmitting station after detection and amplification, are applied to the picture recorder. The recording mechanism, in order that it may be sensitive to exceedingly small currents, comprises, a small moving coil, in a magnetic field created by three electromagnets. The coil of wire, in moving in the field, as the received fluctuations



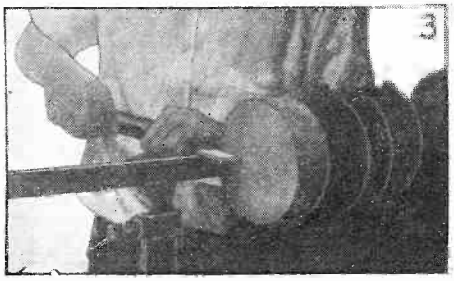
recording mechanism of the receiver. Th which a moving co

applied through its windings, ates a stylus while travelling ss the surface of the paper. The us traverses the paper in perfect chrony with the carriage of the nsmitter, the paper being lifted

Wood Turning for the Amateur

By H. L. WEATHERBY

(*Continued from page 426*)

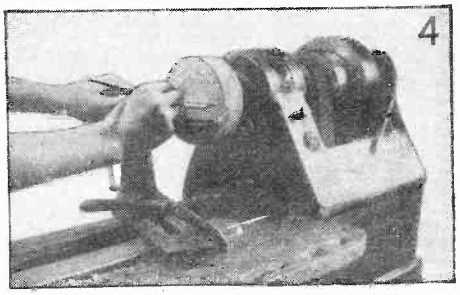


Smoothing face with skew chisel.

ners have been removed, the rest may be turned parallel to the bed of the lathe, and the tools used as in spindle work, not only for roughing off but for smoothing as well.

To smooth the face, leave the rest as in the last named position, and with the large skew held flat on the rest and the point of the chisel pointing toward the center, push the tool across the face of the wood, taking a small cut at a time. Roughing may be done on this face, using a gouge, by placing the rest crossways of the bed and cutting as in the other gouge cuts.

In the first exercise, that of cutting shoulders, the shoulders should be roughed out with the ¾" gouge and smoother to the



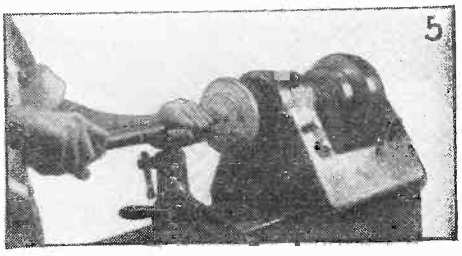
Measuring for cuts

line with small skew chisel, used as in squaring the ends of a piece between centers. It may be necessary to turn the rest at an angle in order to keep it close enough to the block during a part of these operations.

For boring the hole, the small skew may be used, holding flat and pressing in at right angles to the face and to the depth desired. For large holes the opening is cut with the gouge, pushed straight in; and smoothed out with the skew.

In the second exercise, that of the "V" cuts, the operation is identical with the same cut on spindle work, and no difficulty should be experienced.

With the convex and concave cuts, as in spindle work, a little more difficulty may be found. Both are turned with the gouge. It is best to use only a single screw in attaching the block for this exercise, since one is

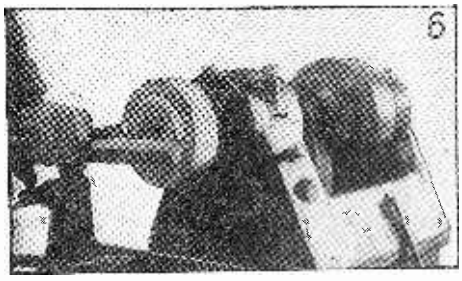


Boring with skew chisel.

likely to cut into the screws when making the concave cut, if they are placed near the circumference of the screw-plate.

The last exercise is a combination of the previous practiced cuts, and will bring into play considerable skill in handling of the tools, if good curves are secured.

Face-plate work lends itself particularly



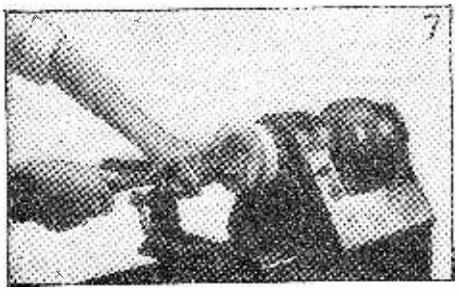
Making the "V" cut.

to scraping, but the tools mentioned to date are all cutting tools, and the scraping cuts should be avoided.

THE PROJECTS

LITTLE trouble will be had in turning the Pin Tray or the Candle Stick. Although the blocks are mounted on face-plates, the work is very similar to ordinary spindle turning.

In the case of the smoking stand, it is well to turn the upright standard first, allowing a round tenon on each end to insert into the top and base. The base is plain face-plate work. Both the base and top should be



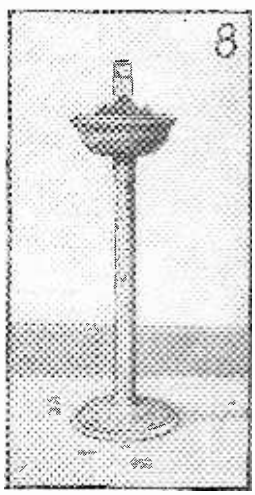
Concave and convex cuts made with the small gouge.

sawed approximately round before turning is started. The top piece should first be hollowed out on the top side to fit an ash tray, previously purchased at any five-and-ten-cent store. Then the next step calls for the removal of the face-plate and recentering and attaching to the cut out side of the block, in order to turn the bottom of the block. The only trouble likely to occur here, is the possibility of not getting the plate properly centered, the second time that it is attached. After careful work and sanding, the different parts are glued together.

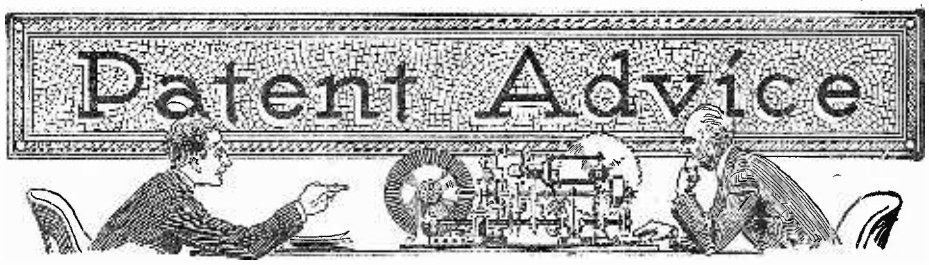
Cut out places, or bore large holes in the bottom of the bottom piece, and pour melted lead into these cavities to prevent the stand from being top-heavy.

The writer suggests that the candle stick

(*Continued on page 460*)



Useful smoking stand.



CONDUCTED BY JOSEPH H. KRAUS

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.

COLOR PRINTS

(1110) Thomas Agnello, Brooklyn, New York, claims to have produced a tissue which when acted upon by light through a black and white film, will reproduce the photo in its natural colors. He wants to know what to do after patenting the system.

A. 1. The idea which you have advanced for making colored photographs is not clearly explained, but it would seem to us that it is remarkably good if it works in the manner you describe.

There are several ways to market the idea, one of which might be to demonstrate your system to large photographic film manufacturers and tell them that you are desirous of having them purchase the invention for motion picture negatives.

The second method would be to market the tissue. In this way you can probably force the interest of the market. As soon as the various photographic houses learn of this product, they are going to place orders with you, and in this way call the attention of those higher up in the field to your particular product.

Marketing finished prints can also be accomplished, although this will by no means give you as great a return as in the previous case.

We certainly would advise you to proceed with this idea if it is anywhere near as good as what you claim. There is no doubt but that colored photography is far superior to the pure black and white, and a chance to portray color is always desirable.

Here's wishing you every success in your venture.

AUTOMOBILE ENGINE

(1111) August Schaefer, New Rochelle, N. Y., says he has designed a new type of automobile engine, but he has not the necessary capital available for its construction. He wants to know what he can do with the suggestion.

A. 1. The proposition which you have on hand is very difficult to do anything with. You claim that the construction of a model is impossible on account of the expense. Yet without such a model you could not interest any capitalist of large means. Many automobile engines work very well on paper. Some of them even work well in a model, but the greatest difficulty of all is to place them before the buying public or to induce some automobile manufacturers to use them. There have been many automobile engines patented that have never seen the light of a successful market. We consequently advise no further action in the matter.

BANK PROTECTION

(1112) B. Sulkowski, Mansfield Centre, Conn., wants to know whether it is possible to protect an idea for burglar-proofing a bank, but makes no mention of the suggestion, giving us but few facts to work upon.

A. 1. It may be possible, of course, to protect an idea in burglar-proofing a bank building, but this depends entirely on the type of idea it is. The best plan is to have a search made by any recognized patent attorney, which he will do at a rate of from $5.00 to $10.00.

You state that you have a plan that will make a safe impregnable. Frankly, there is no such thing. Every safe that has ever been designed, always has a possibility of being forced or opened. Every time an organization makes a step forward in the protection of securities and currency, the thief likewise advances and perfects his means of opening the safe.

An idea of this nature had best be taken up with some of your local banks with a view toward having it installed by them.

VALVELESS STEAM ENGINE

(1113) Ralph Yeakley, Van Alstyne, Texas, asks our opinion of a valveless steam engine provided with ports through which steam can enter and exhaust. The port holes line up with openings in the casing to admit the steam.

A. 1. There is no apparent advantage in making a valveless steam engine as indicated by you because this system is very old and has been employed for many years. As a matter of fact, one of the first steam engines ever built used the same type of gear indicated by you. It is also found on the very cheap toy engines. It does not make for efficiency because the desired cylinder full of steam cannot be induced to enter, nor is the exhaust thorough enough.

FAILED

(1114) J. Leo Vanderheyden, Buckingham, Iowa, was told by a crystal gazer that his inventions would fall flat because of his attorney's attitude of unconcern. He visited astrologers who told him his past about (90% correctly) and his future (now proven about 2% accurate.)

A. 1. Not having given us the name of the crystal gazer about whom you wrote, we can of course not tell you his mode of operation. Suffice it is to say that there never was a crystal gazer that saw anything in a crystal.

We question whether the crystal gazer told the truth, because you probably have never made a real serious attempt at promotion, but even then he is entitled to his guesses as well as any other man.

The chances are that when you tried to promote two of your own inventions which fell flat, it was not the fault of the attorneys, but the trouble lay in the inventions themselves. Probably they were the type of devices that would not meet with public approval unless extensively advertised.

This patent advice department tries to pick out the flaws in an invention. It is better to do so before than after patenting. If the invention is to meet with a favorable market, these undesirable features will be brought forth with surprising force. The purchaser will want to know if the article is necessary, if it will sell, if cost of production is not too great to prevent purchase, if demonstrators are needed, if breakage must be accounted for, if the product will sell with but little advertising or if extensive publicity must be first developed before even one order can be expected; if the device can be made by present machinery, if there is a possibility of repeat orders, and so on—*ad infinitum*.

Just reflect on the astrologer's accuracy. Quite remarkable wasn't it? And not one of several hundred thousand was able to give us an accurate horoscope when even $6,000.00 lay at stake.

WATER PUMPS

(1115) Alvin Shanklin, Gonzales, Texas, submits a design of what he classes as a continuous water pump in which the two cylinders comprising the pump are coupled together by a pipe line.

A. 1. Concerning your system for producing a steady-stream force pump, we would advise that the method designed will not work without valves. The only thing that will occur is that water or air will oscillate back and forth between the two cylinders. With valves, and no other equalizing aid the water will issue in a pulsating flow. We see no particular advantage in this system.

(*Continued on page* 458)

Patent Advice

(*Continued from page* 456)

VACANT SEAT INDICATOR

(1116) George L. Nixon, Charlotte, N. C., asks how he can profitably dispose of an idea for an automatic electric signal panel for theatres, upon which he has recently secured a patent.

A. 1. You are not the first one who has requested us to assist him in marketing an automatic electric signal panel for theatres to show in the lobby or at the back of the theatre, which seats are vacant.

The difficulty is not in constructing such a device, but in getting the consent of some theatre owner or builder to install the same. It might be to your advantage to develop a registering device of this nature and install it at your own expense in your largest local theatre and use this publicity as a means toward securing further orders. The proposition is difficult to "put across," but with proper co-operation, a small investment on your part and a publicity campaign, you might be able to make quite a feature of the idea.

LIGHTING SYSTEM

(1117) Harry Andrew, Ft. Collins, Colo., has submitted a plan for light arrangement on carousels which is to produce the appearance of the carousel standing still (insofar as lighting is concerned) or give the appearance of twice the speed by speeding up the blinking lights.

A. 1. It is extremely doubtful that the system for the arrangement of lights as designed by you for carousels and other circular amusement devices could be broadly protected. The idea for flashing lights is not new. It is further not of great importance as to whether those lights flash twice or three times per revolution, so as to give an indication of an increase in speed, or whether they flash any fraction of those stipulated times. For instance, it would be possible to make them appear to turn at twice, or two and one-tenth or two and one-fifth times the speed of the wheel. This ratio would not, therefore, be a suitable claim for a patent.

Neither is the idea of causing the lights to revolve backward, making it appear that the device is standing still, of importance, because placing the lights on a stationary drum about the carousel would cause them to stand still at all times.

While this suggestion might prove of advantage if someone would undertake its proper exploitation, it is doubtful that you could cover the market so completely as to prevent anyone else from duplicating the effect. We consequently would not suggest patent procedure.

RECIPROCATING SAW

(1118) Henri Del'Jama, Baltimore, Md., asks whether he should patent a motorized hand-saw of the reciprocating type.

A. 1. Why should you be desirous of patenting a motorized hand-saw of the reciprocating type when the rotary type is cheaper to construct, easier to handle, easier to repair, has fewer moving parts and serves the same purpose? What advantage do you think there is in a reciprocating type saw over a rotary type saw? For certain lines of work a reciprocating type might be indicated, but you have not given us either drawings or reason for a more promising outlook on this subject.

HARDENING COPPER

(1119) John W. Cau, New York City, asks our opinion of a system for hardening copper.

A. 1. Hardening of copper is quite an old idea. Contrary to general opinion, this is not a "lost art." Copper today is much harder than that produced by the ancients. Copper can always be hardened when any other metal is added to it to produce an alloy.

We are doubtful that copper, 94% pure and hardened will meet with a great degree of favor. The addition of a small quantity of an impurity does not constitute a claim for a patent, unless one has a new process for the hardening of copper which is involved enough to warrant different practices in its smelting.

We are doubtful that you can protect your suggestion, but advise you to consult an attorney.

PATENT AND MANUFACTURE

(1120) Beryl Claycomb, Monroe City, Ind., asks what he should do with an ignition system he wishes to market as speedily as possible.

A. 1. Regarding your ignition system, we would suggest that you protect your idea by means of priority claims. After this, place the entire matter in the hands of an attorney. He can get a good patent for you at a cost cheaper than you could do it yourself.

You can go right ahead and manufacture the article while the patent is pending, and you can label the article "patent pending," if you so desire. Your full protection does not start until you have actually secured the patent and won infringement cases in the courts.

SPECIAL RULER

(1121) Andrew Barbosa, St. Louis, Mo., has submitted a design for a ruler provided with holes for drawing dot, dot dash and dashed lines. He requests patent advice.

A. 1. Your suggestion for a system for making dotted lines can probably be patented, but whether such an idea would be practical is something upon which we cannot definitely advise. There is on the market today a celluloid straight edge perforated with holes with which it is possible to make dotted, dashed or dot and dash lines.

There are also ruling devices with which such work can be mechanically accomplished. These are generally in the form of serrated disks which are made to roll along the straight edge.

Both suggestions are employed in the drafting trades. We would advise careful investigation before proceeding with the patent.

FOUNTAIN COMB

(1122) Andrew Barbasa, San Antonio, Texas, asks our opinion on a fountain comb with a reservoir for the liquid, a tube connecting to the comb and holes in the back to permit the fluid to flow down on the hair.

A. 1. The suggestion for a comb advanced by you is not at all new. Fountain combs are well known and, as a matter of fact, they are dispensed with certain forms of hair tonic. Instead of having the tubes open between the teeth of the comb, the teeth of the comb themselves serve as the feeders and get the hair dye or hair tonic right down to the roots of the hair.

It is extremely doubtful that you can secure a basic patent on your suggestion. We consequently advise no further action.

Thought Transference?

By BARON MANFRED VON ARDENNE

(*Continued from page* 394)

by F. Sauerbruch and O. Schumann, and more recent experiments of the author indicate. At a distance of several meters with relatively simple means, muscular effects could be shown. The author tried by using an aperiodic intensifier, that with a range of 200- to 2,000,000-wave frequency had the proportionately high grade of intensification of 10,000, if he could show an electric high-frequency field in the vicinity of the head. Fig. 2. The shielding box and the electric connections on the inlet side of the intensifier can be clearly understood from Fig. 3. On the left there is also an apparatus built, that by the assistance of an absorption layer, only registers slow ultra-red rays. Fig. 3 shows the general hook-up, using an intensifier and a very sensitive vacuum tube voltmeter. In these experiments not the slightest high-frequency field due to thought transmission could be detected within the frequency range of the intensifier. It is only by muscular action that any indication appeared in the motion of the vacuum tube voltmeter. After these negative results by a more sensitive apparatus, we might suspect that the frequency of electric waves due to thought would lie outside the band of frequency of the aperiodic intensifier we are desiring—that is to say, they have a still higher frequency. It certainly would be possible in a conceivable time to develop an intensifier in which the frequency of 2,000,000 waves per second would have a good degree of intensifying power. Further experiments will show if with the help of such an intensifier the problems alluded to in this paper can be solved.

Wood Turning for the Amateur

(*Continued from page* 455)

and pin tray be turned from some hard wood, finished natural, with one or more coats of shellac brushed on and followed by varnish, which can be rubbed to a beautiful finish in the lathe. The smoking stand may be finished in the same manner or one of the popular lacquer finishes may be used with very pleasing results. The one illustrated was given a polychrome finish. Later we will take up French polishing on the lathe and other methods of finishing.

Next month we expect to present chucked work and will show the methods used in turning a circular box with lid, and a wooden ball.

Home Movies

Conducted by DON BENNETT

(*Continued from page* 417)

the scenes ran three or four feet, so you can see that quite a few of them were merely flashes. So you see that you can go to extremes. I estimate that the average number of scenes is about twenty-five to a (100 ft., 16mm) roll. This allows sufficient footage for all normal shots and a few feet over for some longer subject that has continued motion."

Jones started the projector again and they ran through the roll to the finish, Jones making a few comments as a scene was good or the exposure was a little off.

"I WOULD suggest, Mr. Blake," Jones said as he threaded up the other roll, "that you get a scene record book to keep track of your exposures. These books are of the loose-leaf type, and each one contains spaces for recording the date, time of day, weather conditions, diaphragm stop used, kind of subject, etc. There is a large space where you can write any comments or a description of the action that will be helpful in writing your titles later. Across the page, in type that reaches from top to bottom, are numerals that can be easily seen in the finished film. To use the scene book you simply hold it in front of the camera after taking a scene, and expose a few inches, then, when you screen your films, you can refer back to the scene book. If your exposure is a little off, you can determine just what the conditions were at the time you took the picture and you will be able to govern later exposures accordingly."

They ran off the second roll of film and Blake was pleased that his first efforts had been fairly successful. Out of the forty or so scenes he had taken, only seven were really bad. "What should I do about these bad scenes. Do you think that they should be cut out and thrown away or should I save them?"

"It will be better to cut them out before you take them home. Your friends will probably be disappointed at not seeing every scene you made, but your reputation as a movie man will be safe. If you'll step over here to my cutting desk, I'll give you a few tips on splicing and editing your films."

(*Mr. Jones' helpful suggestions will be continued next month.*)

MOVIE QUESTION BOX

ENLARGEMENTS

E. A. Jansen writes:

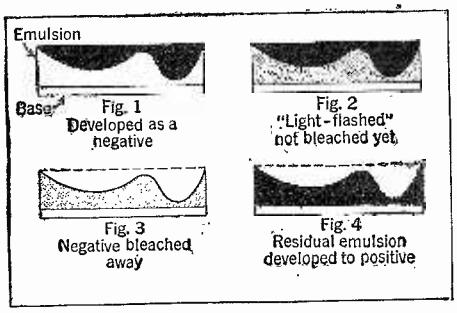
Q. Can I make enlargements from my 16mm movie film? Is expensive apparatus required?

A. The amount of equipment needed depends entirely on the individual desires. It is possible to make enlargements, using your projector or you can use a regular enlarging camera. To use the projector, make a shield to prevent stray light reaching the enlarging easel and pierce a hole slightly larger than the lens to project through. Then take a film holder of the size desired and focus on a piece of white paper inserted in the clips of the holder. When the proper focus has been obtained, shut off the light in your projector and insert a piece of cut film in the holder. Then flash the projector light for a second or so, the correct time to be determined by experiment. "Commercial" film is the best to use for this purpose. Of course the film can be tacked on a board and the expense of the holder eliminated, but better results are obtained by using the holder.

REVERSAL PROCESS

E. F. Murphy inquires:

Q. What is the "reversal process?" Can I finish my films that way?



A. The reversal process is a chemical and physical treatment of the film, either still or movie, wherein the same base and emulsion is used to get the positive image. The negative is bleached away and the remaining emulsion is developed as a positive. It is impractical for the average amateur to attempt finishing his movie film by this process, as the cost of the equipment is out of reach. You can experiment with pieces of still film, and even with short lengths of movie film. Burroughs and Wellcome Reversing Compound has been successfully used as a bleaching agent. The film must not be put in hypo until the positive image has been completely developed. Thorough washing between each step is a necessity in this process. Fig. 1 shows a cross-section of a piece of developed film. The black section represents the developed negative. After thorough washing it is "flashed by light" so that the remaining emulsion is affected. (See Fig. 2.) Then the negative is bleached away as shown in Fig. 3. Again washed, the film is re-developed in a metol developer, fixed, washed and dried. Fig. 4 shows how the residual emulsion has formed the positive picture.

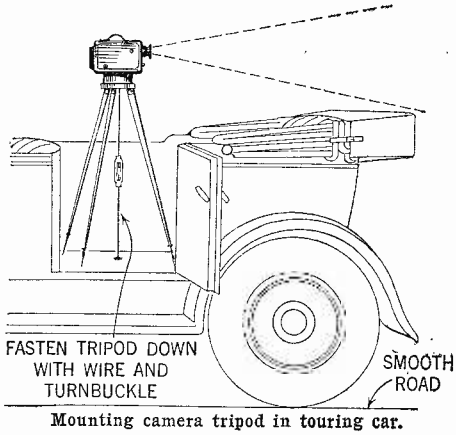
MOVIES FROM AUTO

B. Joy says:

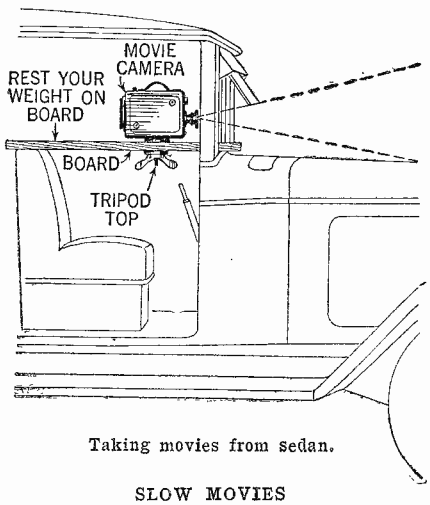
Q. I have tried taking pictures from my car but they are always rough and jerky. Is there any simple device that will eliminate this?

A. The road over which you are driving should of course be perfectly smooth and level. If you have an open car, mount your camera on a tripod and fasten the tripod down with a wire and turn-buckle to the foot-rest bar on the floor of the car. A closed car presents a few difficulties and if the tripod cannot be used, we suggest that you purchase a tripod screw and plate. Mount them on a board long enough to reach from the top of the seat to the cowl.

Fasten the camera to the board by means of this screw and hold the board firm by resting your weight on it. Professional producers sometimes make moving shots by mounting the camera on front of car.



Mounting camera tripod in touring car.



Taking movies from sedan.

SLOW MOVIES

A. P. Bings asks:

Q. How can I make "slow motion" pictures. Is a special camera required?

A. "Slow motion" pictures are made at the rate of 128 exposures per second or eight times the normal rate. A special camera fitted with mechanism to operate at this speed is necessary. One such camera is on the market and several cameras that have combination speed ranges varying from normal to twice and four times normal. We suggest one of these combination cameras as they can be used for all purposes.

SCREEN PICTURE JUMPY

E. B. Sprankle states:

Q. My pictures are very jumpy on the screen. My projector is new and the film itself seems to be perfect.

A. This jumpiness is probably caused by lack of steadiness in the camera while taking the pictures. If you are unable to hold the camera steady, use a tripod or rest whenever practical. It is always good policy to use a tripod as it assures steady pictures. A long stick will do in an emergency, rest the camera on it and brace yourself so that no rocking takes place.

AMATEUR NEWSREEL

One enterprising producer has hit upon the idea of releasing a monthly amateur newsreel containing the high-lights of the theater issues. The first of these was issued over a year ago when Col. Lindbergh made his hop to Paris. Subsequent releases have shown the Pacific Fleet in battle practice, unusual subjects and aviation feats of the last few months. These films are of the 16mm width and fit all amateur projectors.

How "Speedy" Was Filmed

By EDWIN SCHALLERT

(*Continued from page 395*)

pushed along by a street car, and is towed by an automobile through apparently crowded streets. Finally, Lloyd drives a span of horses madly down Broadway in the vicinity of Forty-second Street, and through other crowded thoroughfares.

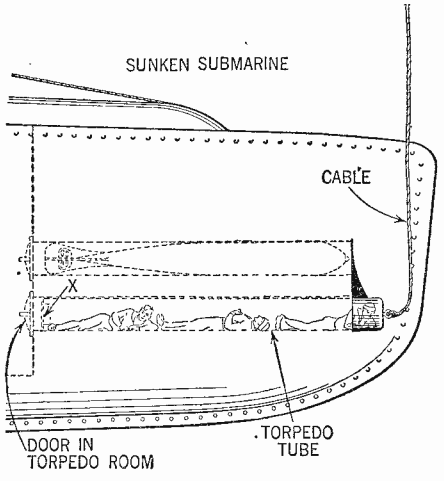
Various locations in New York City were used for these scenes. Washington Square, the Federal Building, and other landmarks are plainly visible at stages of the race. For some of the views of the horsecar in very crowded traffic, double printing was resorted to. View of horses galloping on treadmill in studio was superimposed on background of traffic-filled Manhattan streets.

Two horse-cars were used in the picture—one a regulation affair with iron wheels, for the close-ups; another rubber-tired and lightweight for the long shots, where the vehicle is seen moving at high speed. The camera was cranked slowly to increase the illusion of rapid motion.

Scenes of the street car pushing the horsecar were photographed partly at 116th Street and First Avenue, and partly in Los Angeles. The final scenes, where the horsecar comes off the truck and is dragged along over the right-of-way in the Sheridan district were photographed at the studio in Los Angeles. A view which shows the car colliding with a pillar of the elevated railway was the result of a real accident, and this unexpected happening led to including the gag wherein the broken wheel of the car is replaced by a sewer cover. This accident occurred in the Cooper Union district in New York.

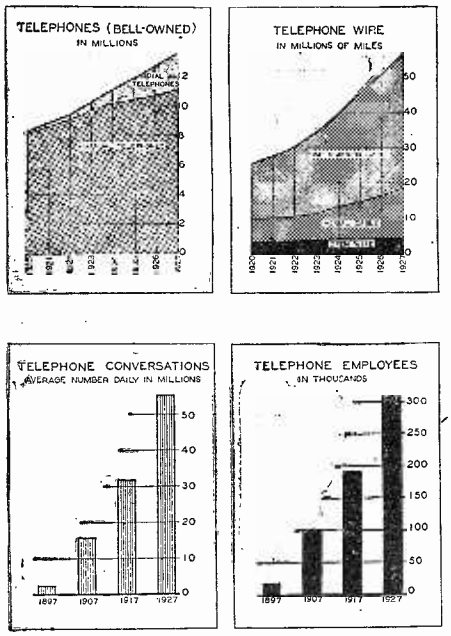
The effect of the taxi driving in crowded traffic was made possible partly through grinding the camera slowly. Some of this was photographed on Fifth Avenue from Forty-second to Seventy-second Street. It was supplemented here and there by scenes secured on location in Los Angeles and in the studio. The camera was placed in the rear of the taxi, which was reconstructed to accommodate it for those shots in which Lloyd is seen at the wheel.

SAVING "SUB" LIVES



A novel and practical idea for saving the lives of men trapped in a sunken submarine is that illustrated above. Here large steel capsules are lowered on cables, divers pushing these steel tanks into the torpedo tubes. The trapped men open the inside torpedo tube door, crawl into the steel capsule, close the door, and on signal are pulled out and thence to the surface.

TELEPHONES



The above graphs show respectively the number of telephones in use, the length of telephone wire, the number of daily conversations, and the number of telephone employees.

Above we see how the number of telephones increased from 1920 when there were only 8,000,000, to 1927 when there were about 11,000,000 manual telephones and 1,500,000 dial telephones. Over 50,000,000 miles of wire are now used in the telephone system. The daily conversations amounted to over 50,000,000 in 1927. The telephone company employs now over 300,000 individuals. In 1907, telephone employees totaled only 100,000.

RULES FOR MODEL CONTEST

(*Continued from page* 421)

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 on: A—novelty of construction; B—workmanship; C—operating 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.

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 drainage in shipment and sent to us 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 September contest must reach us on or before the 25th of June.

7. Address all entries to Editor Model Department, c/o Science and Invention Magazine, 230 Fifth Avenue, New York City.

Readers Forum

(*Continued from page 429*)

tem of character analysis in which the shape of the head and measurements of the skull serve as a basis for arriving at a conclusion. The exact reason for an individual's intelligence has not yet been ascertained. The size of the brain has nothing to do with it, neither have the convolutions. Microscopic examination of the brain has so far revealed nothing. What the real reason for a person's intelligence is, or why one individual is far more intelligent than another and is able to associate and remember things to a greater extent than even his twin brother, is a problem which science is still trying to solve.

No, there is nothing in phrenology,—EDITOR.)

INCREASE PRIZES?

Editor, SCIENCE AND INVENTION:

I have been a reader of your magazine for several years. I have a criticism to make.

The offers of $21,000.00 for proof of the existence of spirits, and $5,000.00 for a working model of a perpetual motion machine are not attracting the attention they should. It's because the prizes are not large enough. Can we expect such men as Sir Oliver Lodge to bother with the $21,000.00 prize, with the chances greatly in favor of the world laughing at him. But, if the prize was a quarter-million, such men as Lodge might produce something—at least they would try.

As to the perpetual motion offer—the prize is much too small. The kind of inventors, or would-be inventors that work on perpetual motion devices are dreamers. They dream of the day when they will have a sufficient income, so that they can work out their ideas undisturbed by having to make a living. If the prize was a hundred thousand or a quarter-million, one of these men might do something.

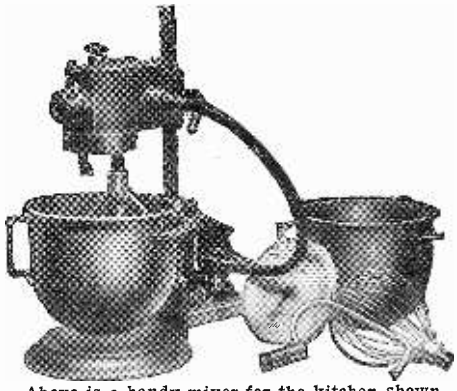
Perhaps you could get the millionaires and other wealthy men of this country interested enough to swell these offers to a million dollars each. It would produce results—someone would collect the money, *i.e.*, as far as perpetual motion is concerned. But, as regards proof of the existence of spirits, all the money in the world could not produce them if they do not exist. But, perhaps they do exist. I firmly believe that man's mind can do anything—if the incentive is great enough.

ROBERT CAREY,
West Point, Ky.

(You have probably by this time noticed that the SCIENCE AND INVENTION Spiritualism Contest award has been increased another $10,000. We are sure that the $31,000 is quite a tempting offer to anyone positively able to produce spiritual phenomena without the aid of trickery. It would easily pay for a few ocean voyages and even for the purchase of a modest home. As to the Perpetual Motion Prize Contest, our $5,000 award is being offered merely for the purpose of permitting us to examine the machine. It serves an additional purpose in that it prevents petty financing in ridiculous combinations of gears and levers. Many inventors claim to have built perpetual motion models and to have tried to finance the patent situation in this and foreign countries by the selling of stock in the mechanism for such patent protection. The $5,000 which we offer will help the inventor to protect his interests throughout the world. Inasmuch as we desire no rights to the invention, other than the privilege of being the first to announce the discovery, it follows that the prize is quite fair. We are merely requiring an examination of the perpetual motion machine, and we will protect the inventor in every way possible, both before and after the examination. Of course, designs cannot be submitted. A working model is the only thing which can be entered. The incentive to a perpetual motion machine inventor should he eventually obtain results, cannot be measured in worldly wealth. In a short time he would become a multi-millionaire and his name heralded from one country to the other, provided of course that his machine bears scientific approval and has a stamp of genuineness about it.

However, we have no objection to anyone caring to swell the amount of our awards, and any organization or any individual desiring to increase the awards in either the Perpetual Motion or the Spiritualism Contest can send the publishers a check or contract to pay.)

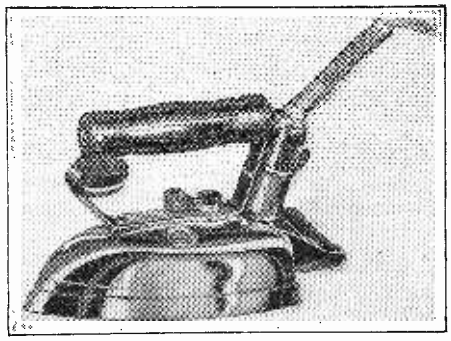
KITCHEN MIXER



Above is a handy mixer for the kitchen shown with the various attachments.

An electric mixer which takes up little space and comes complete with various attachments is now available to the housewife at a small cost. Two sizes of bowls are furnished, together with three types of whipping or beating attachments. A buffer or cleaner is also provided for cleaning the mixing bowls.—*Name of manufacturer furnished upon request.*

AUTOMATIC IRON



The new super automatic iron is shown in the above photograph. Note thumb rest and switch.

An iron entirely automatic in its action has recently been placed on the market. A switch situated on the top of the iron below the handle, provides for temperature regulation which is kept constant by thermostatic control. The iron will maintain a constant temperature at all times. The heating element and base are made as one unit.—*Name of manufacturer furnished upon request.*

$5,000 for Perpetual Motion

The editors have received thousands of different designs of 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.

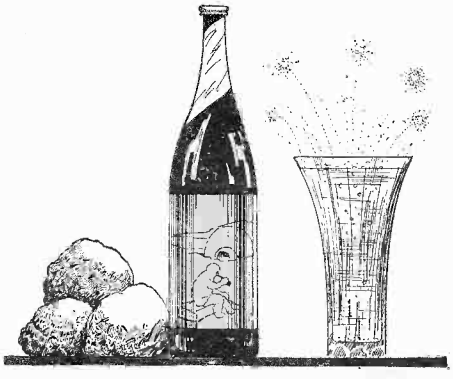
Most of the shares of stocks for these perpetual motion machines are being sold at a rate of $1.00 per share, although some inventors are trying to sell shares of stock at $100.00 per share.

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."

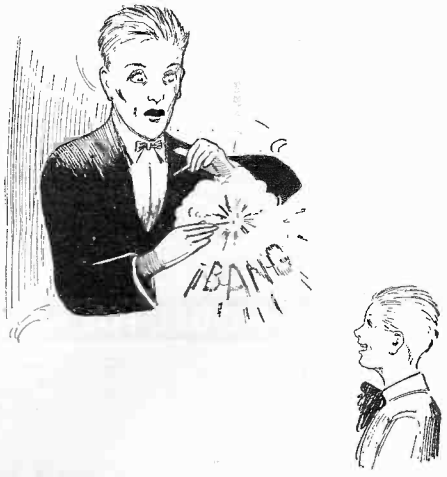
CHEMICAL ODDITIES

By RAYMOND B. WAILES

How is a dry battery related to baby powder? The outer case of a dry cell consists of zinc, and baby powder is composed of zinc stearate, which is produced from zinc.



Did you know that the bubbles of gas in soft drinks come from coke? Coke is burned to form carbon dioxide gas which, after being treated further, is actually used in charging soft drinks with gas, so that they will effervesce.



What precious metal is used in exploding trick matches and similar tricks? Exploding matches contain silver fulminate. Silver fulminate, of course, contains silver, so that silver is actually used in making the matches.

Book Review

THE PROBLEM OF ATLANTIS, by Lewis Spence. Stiff cloth covers, 6" x 9", 237 pages, illustrated. Published by Brentano's, New York City. Price $3.00.

The only book which has come to our attention, containing all the available evidence on the subject of the lost continent, is "The Problem of Atlantis." It seems that the primary purpose of this able work is not so much to demonstrate the former existence of this supposedly submerged continent, but to place the study of this whole problem on a more accurate basis. It is the author's belief that the continent of Atlantis still lies beneath the sea and he has advanced arguments to further this theory. The Atlantis of Plato is dealt with, and the evidence of this lost continent as obtained from geology, biology and pre-history, are all sighted as proofs of the existence of this continent in the Atlantic Ocean which is claimed to be the original home of mankind. Evidences of its existence are also drawn from Egyptian and Peruvian relics and history. It is the opinion of many that the lost continent never existed, because it has only a traditional background. "However, this Victorian assumption is now totally discredited, for by a consensus of opinion among the archaeologists of our time, tradition is now regarded as supplying a clue which, when followed, results in the justification of scores of old legends and in the enrichment of science."—*P. L. W.*

BIRD ISLANDS OF PERU, by Robert Cushman Murphy. Stiff cloth covers, 6¼" x 9½", 346 pages, illustrated. Published by G. P. Putnam's Sons, New York City. Price, $5.00.

The class of books which we review for these columns are not generally to be pronounced of the generally interesting type, but in this description of the guano trade of Peru, the conservation of the birds by the government for the production of guano is vividly described and embodied in the interesting text; from the scientific aspect the ornithological and meteorological data make it a book of true science. Long before it came into the reviewer's hands for a criticism, he was familiar with it, and was greatly impressed by it then. Three or four kinds of birds produce guano on the islands off Peru and are carefully protected by the government, and are a source of revenue to Peru; the guano is used, principally, in that country, largely for the sugar plantations, while several millions of tons are exported. It is profusely illustrated and the pictures of bird life, of the nests, of the great flights of the thousands of Cormorants and other birds over the ocean, form a wonderful series of pictures. It may appear that we have not said much in the way of a clear description of the book, but it is too long and embodies too much picturesque detail for this to be possible. What may be termed a model index and a list of literature used in the preparation of the book add greatly to its value.

$31,000.00 FOR SPIRITS

$1,000.00 was offered by this publication in the June, 1923, issue for spirit manifestations that could not be duplicated or explained by scientific means.

$10,000.00 for spiritual phenomena was offered through SCIENCE AND INVENTION by Joseph F. Rinn in the August, 1923, issue.

$10,000.00 was offered through SCIENCE AND INVENTION Magazine by Joseph Dunninger for spiritual manifestations which he could not explain or duplicate by scientific means under identical conditions.

$10,000.00 is now offered through this publication by Mrs. Houdini for the ten-word message which Houdini promised to deliver.

TOTAL: $31,000.00 for spirit manifestations.

THE INDUSTRIAL TRANSITION IN JAPAN, by Maurice Holland. Stiff board covers, 4 x 6 inches, 51 pages. Published by the National Research Council, New York City

Japan is undergoing a progressive industrial transition. One of the modern methods adopted by Japan is the use and maintenance of industrial research laboratories, which have already proved their value. The author outlines the rapid progress of civil aviation in Japan, the development of fisheries, and describes the remarkable success of the Japanese pearl culture methods. The experiment station which is devoted to the advancement of the silk industry, is but another sign of Japan's adoption of modern methods.—DeW. B.

SIR ISAAC NEWTON, edited by F. E. Brasch. Stiff cloth covers, 6½ x 10 inches, 351 pages. Published by the Williams & Wilkins Company, Baltimore, Md. Price, $5.00.

A description of Sir Isaac Newton's work is presented here in a collection of several essays prepared by a number of notable modern professors and scientists. Newton's contributions to physics, mathematics, chemistry, astronomy, philosophy, and religion are thoroughly discussed. It is a book which every student of science will welcome, and which the non-technical reader will accept with gratitude and enthusiasm. The work deals not only with the scientific work of Newton, but includes much information about his human activities, which enables one to perceive the great diversity of Newton's interests, and at the same time the book is rendered interesting to the ordinary man. The book completely removes the popular delusion that Newton's only important discovery was the law of gravitation. Newton's work in the field of optics is described by Professor D. C. Miller, an eminent physicist of the Case School of Applied Science. Einstein's theory of relativity and the law of gravity are reconciled by G. D. Birkhoff, Professor of Mathematics, Harvard University. The contributions of Newton to theology are discussed in an exceedingly interesting chapter on Newton and Religion, by G. S. Brett, Professor of Philosophy. Newton's work in this field was presented with his identity as author carefully concealed, due of course to the personal danger which attached to those who dared to discuss religion in a scientific manner at that time. It seems that Newton considered science a part of theology, the part which could be demonstrated, and it was he who attacked the ancient tradition of the two worlds, celestial and terrestrial, and established the idea of law in the universe as one and the same throughout.—DeW. B.

FREE AND CAPTIVE BALLOONS, by Ralph H. Upson. Stiff cloth covers, 5¾" x 8¾", illustrated, 300 pages. Published by The Ronald Press Co., New York City. Price, $5.00.

Many books have been written on the subject of aeroplanes, but it sometimes seems as if the older type of aerial vehicle, the balloon, or lighter than air structure, has been somewhat neglected by writers. This exhaustive volume gives a most elaborate account of all the details of these structures; from the valves down to the baskets, suspension nets and tackle—every imaginable detail is included, even to the making of knots for the rigging. The fabric for the envelopes is a particularly interesting subject. The use of Goldbeater's skins is mentioned in its use for balloon fabric and the author promises a treatise on this most interesting subject in a subsequent publication, under the auspices of the Ronald Aeronautic Library. We would be glad if he had said more about it here. The troubles with balloons, of which the principal one, perhaps, is the deterioration of the fabric, is given space, also. An excellent index ends the work.

IN "RADIO NEWS" FOR SEPTEMBER

The Screen-Grid Strobodyne Receiver—By R. E. Lacault

Screen-Grid Tubes as A.F. Amplifiers—By William H. Fortington

How to Build from the Schematic—By Fred H. Canfield

How Much Amplification for Best Quality?—By C. Sterling Gleason

Making Serviceable and Efficient Coils—By Philip H. Greeley

Some Problems of A.C. Operation—By Charles Magee Adams

Successful Television Accomplishments on Broadcast Band

What's New in Radio

Radio Wrinkles

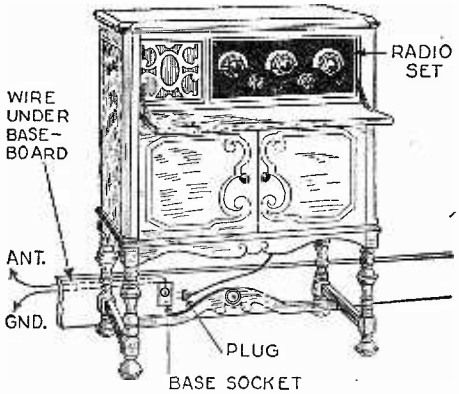
Letters from Radio Home Constructors

I Want to Know

Radio Wrinkles

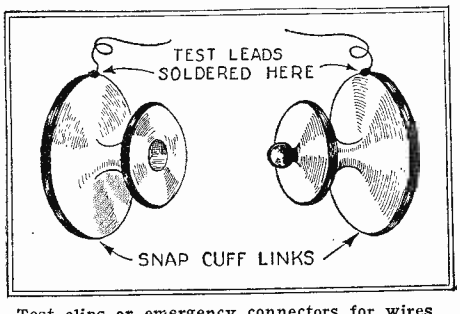
RADIO WRINKLES accepted and published will be paid for at regular rates

CONCEALING ANTENNA AND GROUND WIRES



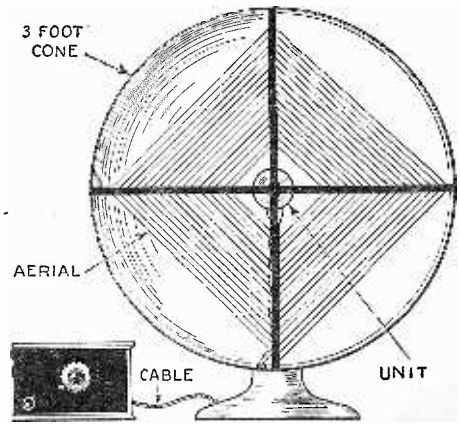
Unsightly wires connecting to the radio receiver, may be placed out of sight by using the simple method shown in the above illustration. A base socket of the plug-in type is used, a plug to fit the socket and a short length of lamp cord. The antenna and ground wires are fastened to the base socket. The aerial and ground leads on the set are attached to the plug. When the set has to be moved, it is merely necessary to pull out the plug from the socket.—Herman R. Wallin.

WIRE CONNECTORS



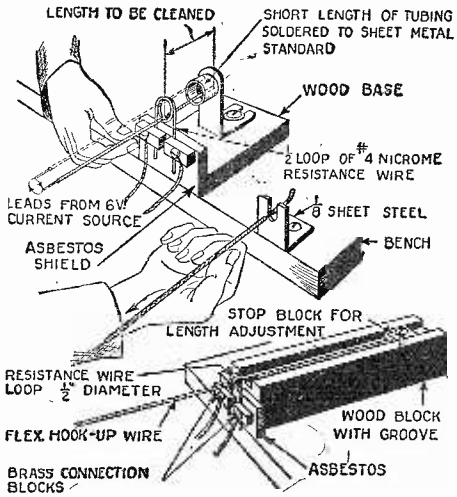
Test clips or emergency connectors for wires of light gauge can be made from a pair of snap cuff buttons. The test leads are simply soldered to the links, one wire on each half. When using fine wire, dress fasteners can be employed advantageously in place of cuff buttons. Cuff links of this sort can be purchased for a small cost at most stores and insure a secure connection, which is not always obtained when using the ordinary test clips. —John A. Wiederhold.

LOOP SPEAKER



An exceptionally novel wrinkle is shown above. This consists in placing the loop aerial inside of a cone speaker. A cable leading from the base of the speaker contains both the speaker and aerial leads. In order that the loop antenna may be of the correct size, a three-foot cone speaker will have to be used. —Contributor please send name and address.

REMOVING INSULATION



Several ways of removing the insulation from flexible hook-up wire are shown above. The insulation is first cut through by heat, which is supplied by a loop of resistance wire connected to a six-volt battery. The severed section of insulation is then removed by drawing it through a piece of steel, as shown. A wooden block with a groove, fitted with a stop block for length adjustment, will also prove very useful. No. 4 Nicrome resistance wire is used for the heating loop.—Acme Wire Company.

MULTIPLE RADIO SETS

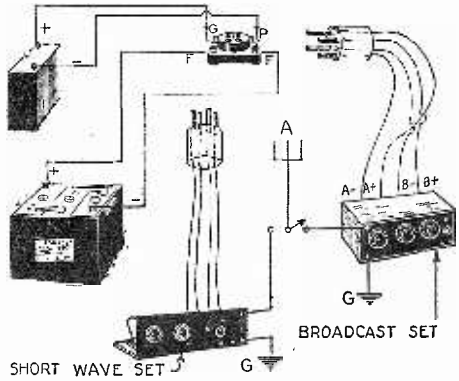


FIG. 1

By utilizing the bases of burnt-out vacuum tubes, the same "A" and "B" batteries may be rapidly connected to any one of a number of radio receiving sets. Hardly a set is built which can cover all the wave-bands now in use. The glass bulb is broken off the old tube and four flexible wires are soldered to the prongs. These lead to the batteries. The four connections may be the positive and negative "A" battery and the positive and negative "B" battery. The uses of a plug of this sort are shown above in Fig. 1. In many sets using a hard detector tube, little difference is noticed when the plate voltage is raised from 45 to 90 volts.

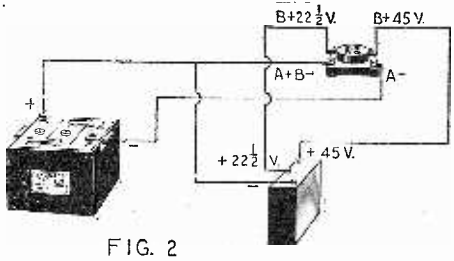


FIG. 2

If a soft tube is used, the set must be wired so that the positive "A" battery connection goes to the negative "B" battery. This leaves an extra prong, so that both 22½ and 45 volts may be taken off the positive "B" battery connection for the detector and amplifier tubes as shown in Fig. 2. A small single-pole, double-throw switch may be used to change the aerial from one set to another. If more than two sets are used, it will be necessary to use a multiple switch to connect the aerial to any set desired. It is very important to test and trace all connections made to the plug.—Lyman F. Barry.

Do Animals Think!

(Concluded from last issue)

IT will be remembered that in the last issue of SCIENCE AND INVENTION Magazine there was featured an article "Do Animals Think?" Accompanying that article there was a questionnaire which contained the following group of questions:

1. Do you believe that animals can think?
2. Name your reasons why you believe animals think.
3. Why do you hold that animals do *not* think?
4. (a) If animals do not think, in your opinion, how do you account for the circus horse that selects numbers called for by strangers in the audience?
   (b) How do you account for the behavior of the German dog that recognizes any one of forty people when they are mentioned by name?
   (c) A hawk tried to get a rabbit; the rabbit ran for the protection of a barbed (single) wire fence and darted back and forth under the fence to a shed fifty feet away. Do you consider this an example of reason, thinking or instinct?
5. Do you believe all the above reactions can be accounted for under the term "instinct"; and if so, define your opinion of "instinct."
6. Do you hold if animals do not "think," they may "reason?"
7. If so, where do you draw the line of demarcation?
8. If a wild animal were bereft of sight, smell and taste, do you think that animal would die of starvation? Or would the first law of nature (self-preservation) make the animal think or reason out a means of procuring food?
9. Have you conducted experiments along any of these lines? What were the conclusions?

Remarks:

We pointed out in the last issue that the majority of scientists answered the questionnaire in the affirmative. Most of them said that some of the higher mammals (excluding man), do think. However, the negative view was also held by scientists who had carried on experiments with animals for many years. At the present time the odds are greatly in favor of those who held the affirmative viewpoint.

The editors hold an absolutely impartial attitude and the discussion is still open so that any of the readers who may have carried on experiments which to them appeared conclusive, can forward their reports. These will be greatly appreciated.

As mentioned before, the majority of scientists have held that the higher mammals are capable of some degree of intelligence. The consensus of opinion is augmented by the letters which came in since then and a few of those follow herewith.

FROM A PSYCHOLOGIST

The following answer was forwarded by Prof. L. L. Bernard, Professor of Sociology of the University of Minnesota:

1. You have not defined what you mean by "think." I believe animals behave to some extent on the basis of response to symbolic stimuli.

2. Behave by response to symbolic stimuli. They respond to words when spoken, if conditioned to them, especially to their names and words of approbation or disapprobation, but their condition is much less complex than our own.

3. I know of no animals which respond to form and symbols.

4. (a) This has been fully and scientifically explained in the literature of psychology. There is no mystery about it. The horse responds to motor cues, does not manipulate verbal symbols.

(b) Condition of name to visual image of the persons, and to motor signals (consciously or unconsciously given) by the demonstrator.

(c) Result of habit—that is, of having become conditioned to observe and avoid obstacles of this sort. Depends on what you mean by reasoning, as to whether I would call it reasoning.

5. NO! See my book on "Instinct: A Study of Social Psychology." Evidently you are not familiar with this book.

6. See below. I suspect that you have some mystical notion of the nature of thinking and reasoning. A cathartic dose of behaviorism here would clear up your system admirably.

7. Behavior is continuous—lines are not definitely drawn; but lower animals use but little inner or neuro-psychic control. They do respond to abstract symbols with concrete meanings, however.

8. I see you are a confirmed mythologist. Will you kindly tell me where I can find the code of the "laws of nature?" It must be a very valuable book.

See the following writings for my views:

"Instinct: A Study in Social Psychology" (1924—Henry Holt & Co., New York).
"An Introduction to Social Psychology" (Holt, New York, 1926).
"Neuro-Psychic Technique," Psychological Review, Nov., 1923.
Article on bases of Culture, Amer. Jour. of Sociology, Sept., 1926.
"Scientific Method to Social Progress," Amer. Jour. of Sociology, July, 1925.
"Objective Viewpoint in Sociology," Amer. Jour. of Sociology, Nov., 1919.
"Invention and Social Progress," Amer. Jour. of Sociology, July, 1923.
"A Classification of Environments," Amer. Jour. of Sociology," Nov., 1925.

I do not consider thinking and reasoning as separate facilities. See my Social Psychology, pp. 162-170.

HAVE INTELLIGENCE

A PROFESSOR of Cornell University, Ithaca, N. Y., whose name was not signed to the questionnaire, answers the questions in the following way:

1. In a limited way.

4. (a) Association of spoken word and given number.

(c) Instinct and attempt to place some obstruction between itself and hawk.

8. The animal would die of starvation.

9. No.

Remarks: I think animals have varying levels of intelligence and use it to their advantage. Whether they think or reason depends largely on the definition of the terms.

YES, BUT BIRDS DO NOT

PAUL GRISWOLD HOWES, curator of Natural History of the Bruce Museum, Bruce Park, Greenwich, Conn., has this to say:

It would be quite impossible for me to answer your interesting questionnaire in a few words, and I am therefore taking the liberty of making my comments on this subject in this extended letter.

In considering question No. 1, "Do animals think?" it is important to understand what living things are meant by the word *animals*. If it means, any living thing endowed with sensation and voluntary motion, then the answer is overwhelmingly No, for the vast majority of animals, as I understand the word, show not the slightest be-

(*Continued on page* 476)

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Free Pants: Finest All-Wool, Made-to-measure pants offered free to first man in each community to write us. Agents given all their clothes free. Chicago Tailors Ass'n. Dep't. 838, Station C, Chicago.

Make $1,000 before Xmas selling exclusive personal Xmas Cards in distinctive steel engraved designs. Expensive sample book free. Wetmore, Jane & Sugden, Dept. PCS, Rochester, N.Y

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Agents—Sell Personal Xmas Cards; 5 orders daily averages $12 commission. The best money-making opportunity from Now until Xmas. Personal and commercial cards, parchments, folders; sensibly priced, with your customers' names. Box Assortments. Now is the time to start selling before your friends buy elsewhere. We deliver-later-postage paid direct to your customers. Experience not necessary, but if you have sold Xmas Cards or other merchandise please so state. Samples Free. "Art-Point" Studios, Dept. A, Sebastopol, Calif. (Oldest and Largest Process firm in the West).

Agents—$300 month. Sell Guaranteed silk hosiery. Must wear 7 months or replaced. New selling plan. We furnish auto. Free silk hosiery for your own use. Write for samples. Betterknit Hosiery Co., Silk 1835, Greenfield, Ohio.

Bang-Up Good New Sideline! Sells Everywhere all Merchants, Banks, Mfrs. Big Comms. advanced daily. Pocket Outfit Free. Carroll, 319 N. Albany, Dept. VA, Chicago.

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Do Animals Think?

(*Continued from page* 474)

ginnings of thought. If, on the other hand, the word refers only to *mammals*, which is the highest class of vertebrates and therefore includes man, and all other animals that nourish their young with milk, then the logical answer would be yes, although not all of them would be meant.

I believe certain animals think because there is no other satisfactory explanation for some of the things that they have done, and it has always struck me as a remarkable fact that most actions, which appear to show an ability to think, are performed by the animals that have been the longest in association with mankind.

In the case of the circus horse that singles out numbers called by strangers, I cannot help but believe that there is a system of signals between trainer and trained, while the horse that is mixed up with many others and then finds its proper place, according to the number it bears, does this simply because it has been taught to travel behind a certain other horse, and experiences a feeling of discomfort behind any other one. The animals in this act keep shifting about until they find their proper places because of constant association with one thing that they learn to know, in this case, another horse. A horse going to its proper position, or to its proper stall, requires no more thinking than when a man goes upstairs to his own bedroom.

In the German dog, I believe that we have a true case and one of the very few, where an animal is capable of a train of thought. To me this dog is the only outstanding, convincing case. This dog does very remarkable things.

In the case of the rabbit, the action is instinct. It is natural for a rabbit to seek cover in an erratic manner by a zig-zag course, in the shelter of whatever is at hand. This rabbit lived in or under the shed and knew the route to safety via the wire fence from constant association with it, but not especially because it was a barbed wire fence.

If animals were bereft of sight, smell and taste, some would perish and others would live. Animals such as cows or horses would instinctively lower their heads to the grass when they felt hungry and would eat, regardless of taste or smell, but the predaceous mammals would soon starve, depending, as they do, both upon smell and sight to successfully capture their food. Among great numbers of the lower forms of animal life there is probably no sense of taste or smell, anyway, and these, of course, would go on successfully.

In conclusion, I believe that some animals (meaning mammals other than man) do think, but that even such highly developed creatures as birds, which are next to the mammals in the ladder of animal life, do not.

As I write this, a robin comes to the steps of the iron fire escape on the museum building with nesting material. There are several dozen iron steps, all alike, and the bird is trying to build a nest on one of them. Each time she comes with material, confusion takes possession of her. She cannot think. First she puts some grass on one step, then upon another, and so on, and the reult is seven nests all in various stages of completion. After a long time she completes one by trial and error, just as the lowest forms of protozoa accomplish things. On each side of the bird her wasted efforts and her stupidity stare her in the face, but a robin does not think and does not care, and thus she is just like the vast majority of animals.

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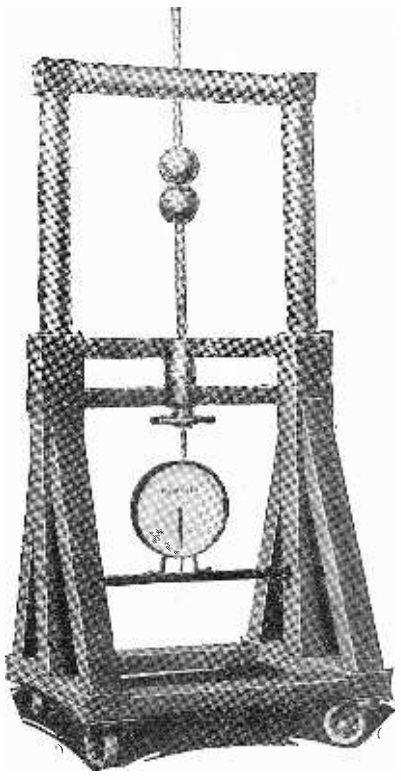

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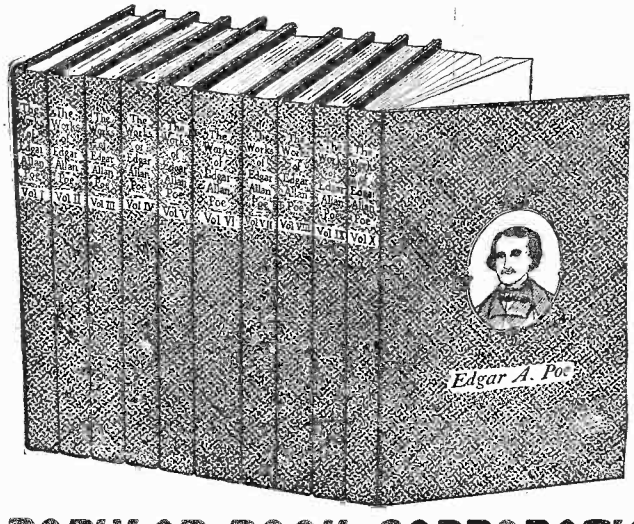

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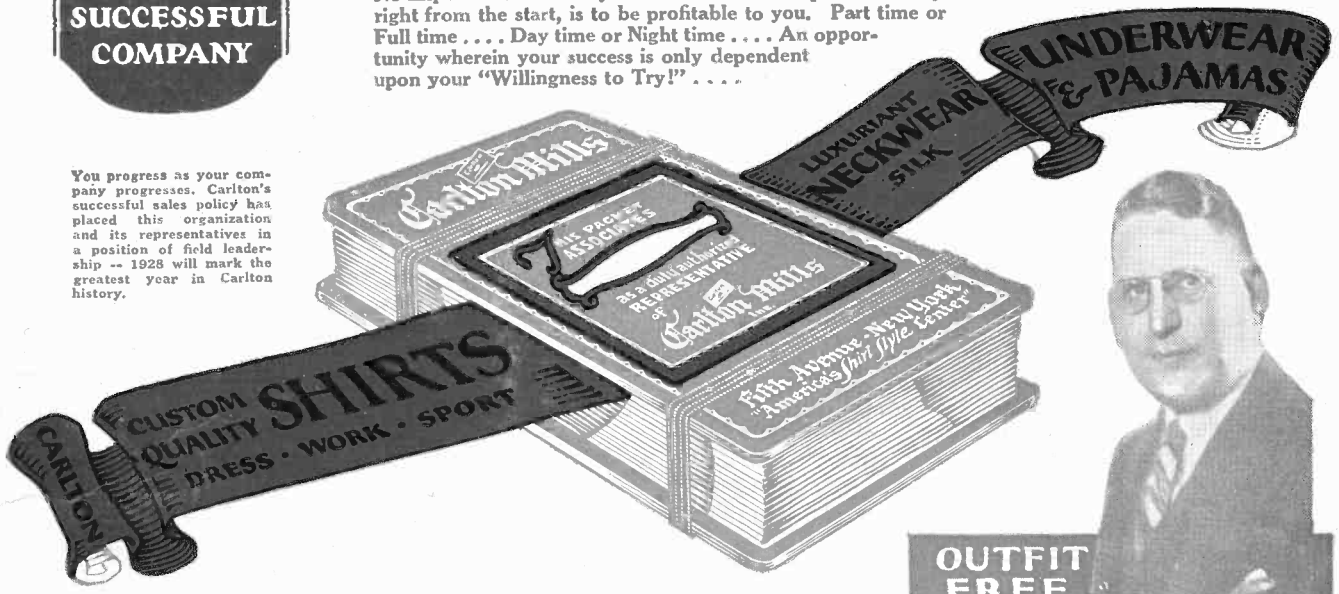

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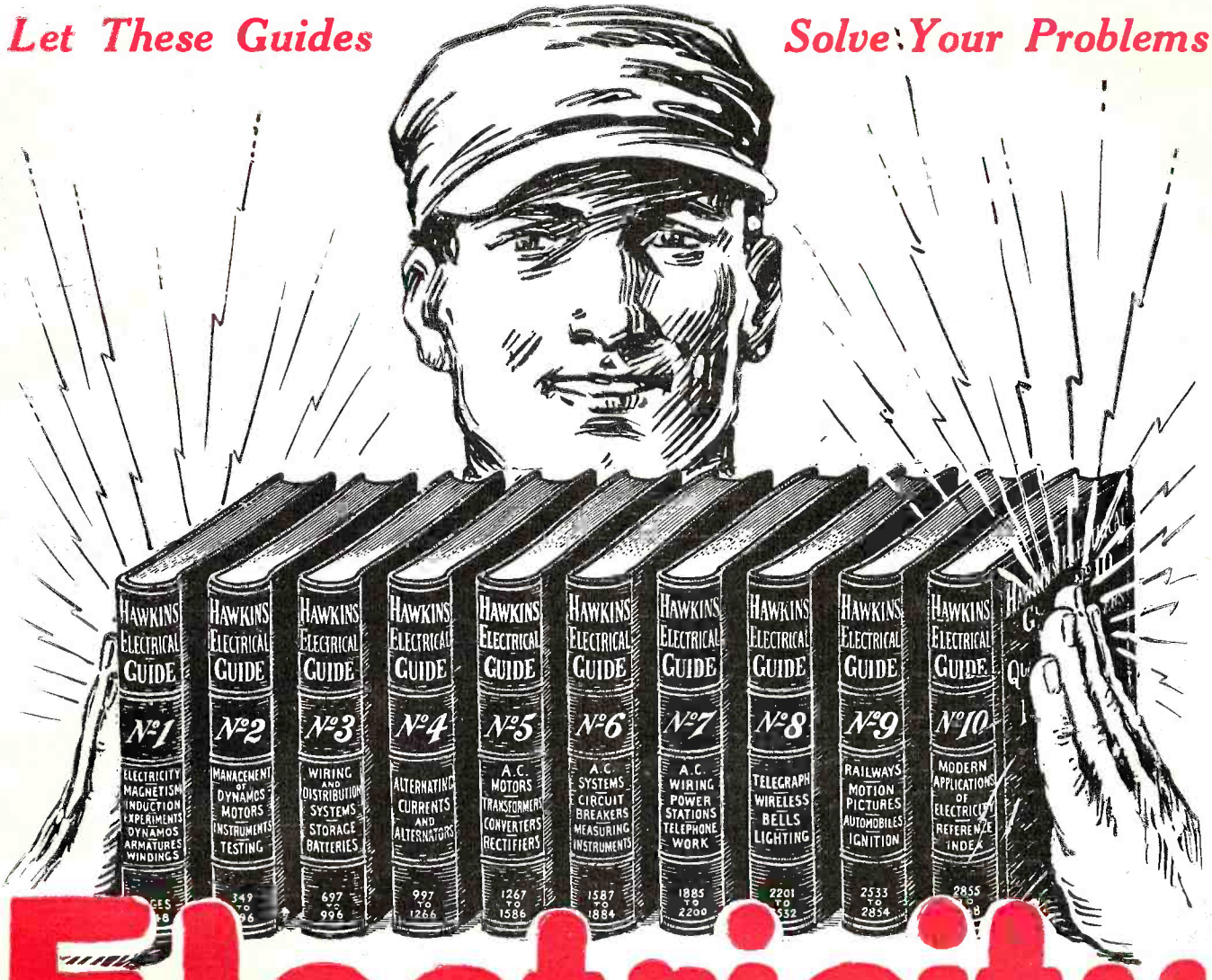

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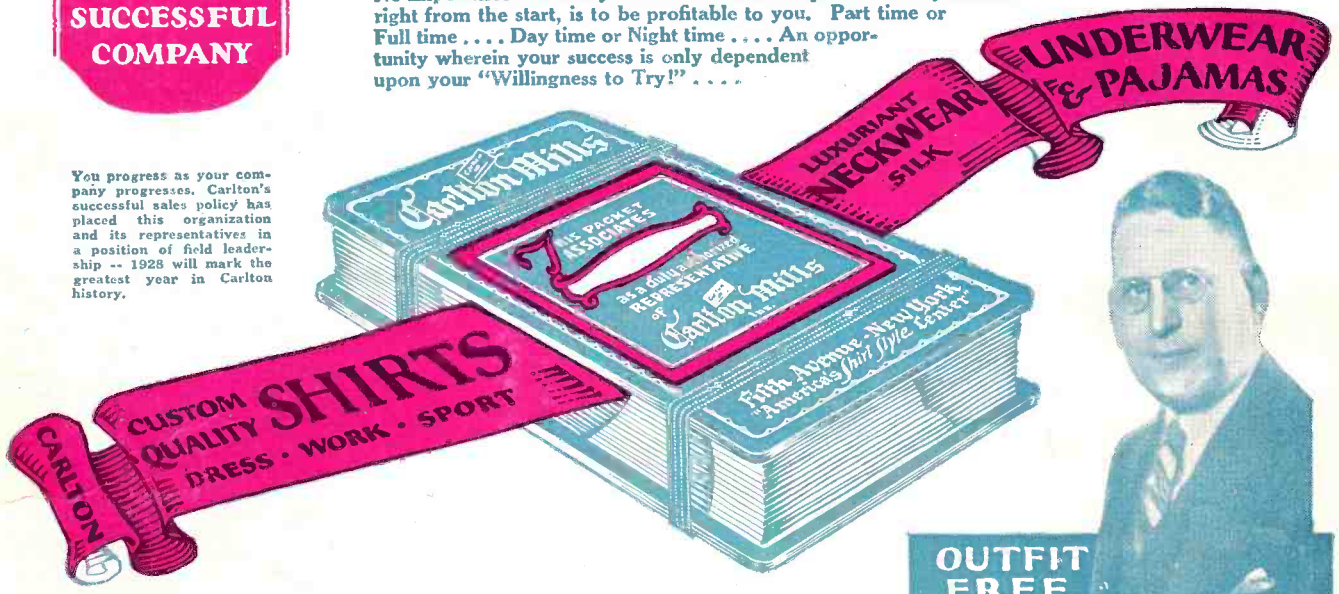

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