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Science and Invention

IN THIS ISSUE
"DIRIGIBLES"
By C. E. ROSENDAHL, U.S.N.
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SEA ANCHOR
FOR AIRSHIPS

See Page 14

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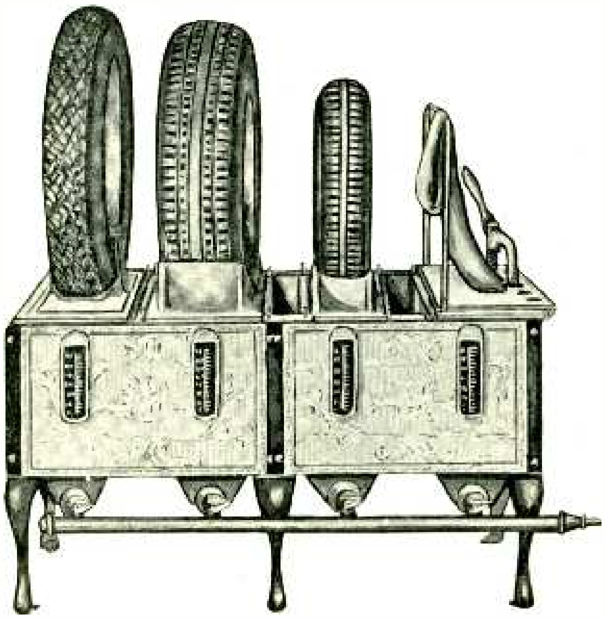

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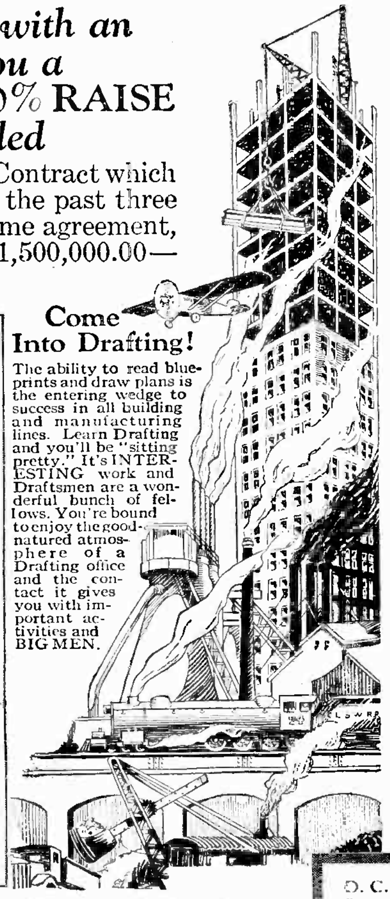

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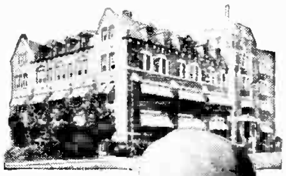

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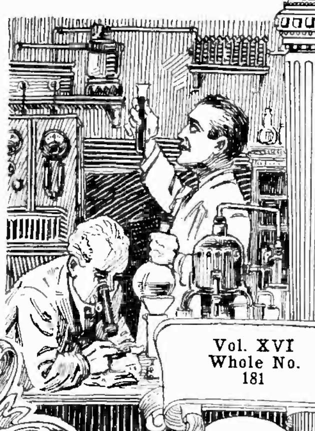
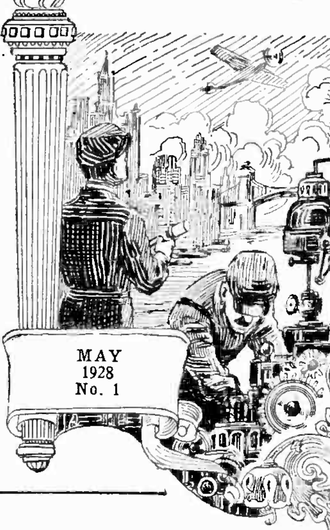


Science and Invention



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Publishers of SCIENCE AND INVENTION, RADIO NEWS, RADIO LISTENERS' GUIDE, AMAZING STORIES and FRENCH HUMOR

IN JUNE ISSUE

Giant Lizards

Most everyone has seen at sometime or other small lizards, but when it comes to giant lizards, but little is known about them by the general public. Don't miss this remarkable illustrated article.

Spiritualists Exposed

Extremely interesting, illustrated article showing how spiritualists were exposed in Germany.

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Two of the latest designs of vertically rising aircraft operating on the helicopter principle, will be described and illustrated.

Do Animals Think?

Mr. Raymond L. Ditmars, famous expert on animal life, answers the question.

Garden Sprays

Details of how to make and use them.

CONTENTS OF THIS NUMBER

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 FRENCH HUMOR, a weekly. 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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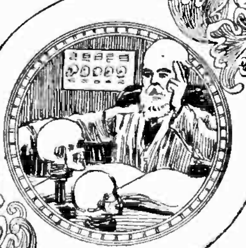
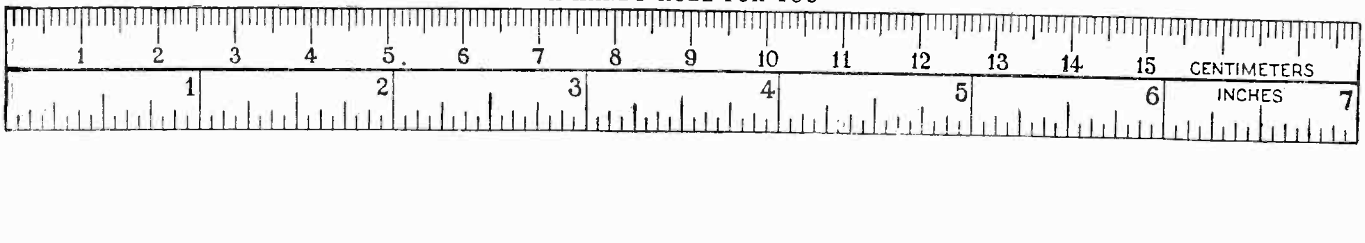


A HANDY RULE FOR YOU



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Why risk losing out? Send the coupon NOW!

Which type are you?!!

Are you going to turn the page—or will you mail the coupon NOW?

"My Course Includes Training In"
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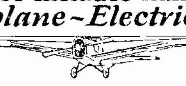

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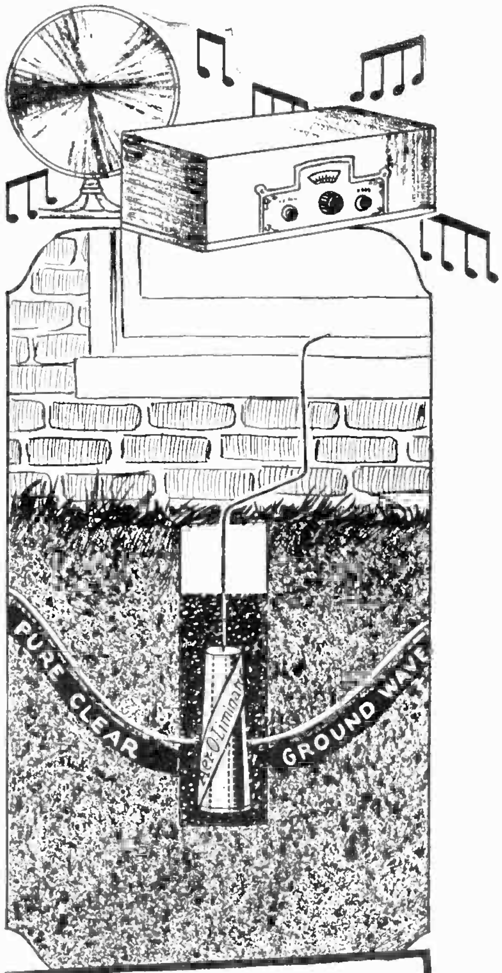

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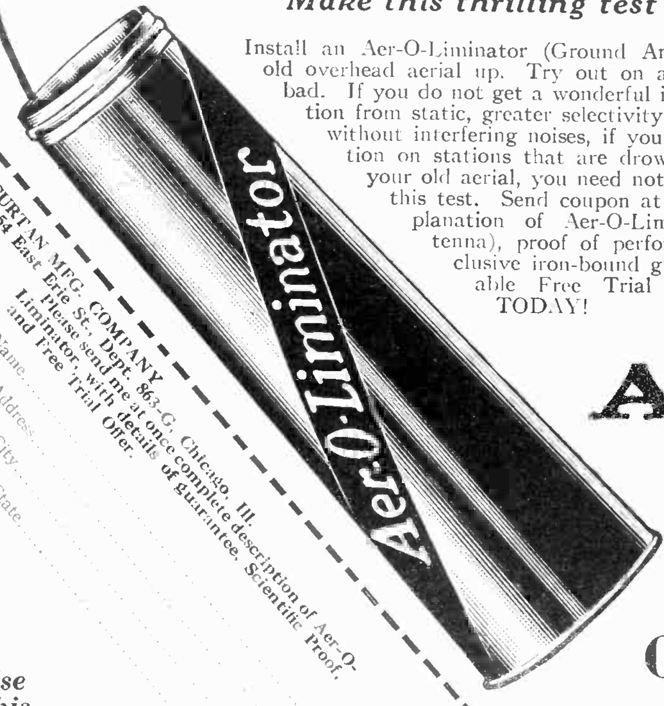

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Volume XVI
Whole No. 181

Science and Invention

May, 1928
No. 1

HUGO GERNSBACK, *Editor-in-Chief*
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Editorial and General Offices - - - - - - - - 230 Fifth Avenue, New York

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

A COMING DISCOVERY

By HUGO GERNSBACK

IT is a rare occurrence when a man, in any branch of science to-day, can announce to the world that within an appreciable time he will make a great discovery, as an explorer, for instance, might set forth to discover the North Pole or to be the first to set foot on top of the Himalayas. In either case, however, he can predict with certainty the result should he succeed. This, however, is comparatively tame, because neither the North Pole nor the top of the Himalayas is unknown; both are very well known.

If, however, a scientist should announce that he would, at a certain predetermined time, discover, let us say, a new gas or a new metal that was as yet undiscovered, and give minute instructions how the discovery could be brought about, this certainly would be classed as a remarkable prediction. Yet, that also has been done in chemistry.

But the idea of predicting the discovery of an entirely unknown world, half the size of our own earth, is a large order. Indeed, it has only been done once before and has gone down in the annals of astronomy as one of the most brilliant achievements of the human mind, of all times.

In 1846, John C. Adams, a young Englishman, and Urbain Leverrier, a young Frenchman, independently announced the position of a supposedly new planet, lying outside of the orbit of Uranus. Neither astronomer worked with a telescope, but simply used celestial mathematics. Adams sent the results of his calculation to the Astronomer Royal of England. He had predicted where in the heavens the new planet should be found, but for some reason no search was made.

Not long after, Leverrier, who had also completed his calculations sent the results to Galle, the Director of the Observatory of Berlin. A search was immediately instituted and within a half an hour, the new planet was discovered very close to the position predicted by Leverrier's calculation; the new planet, which was christened Neptune, was only about 58′ away from the calculated spot, a very small amount, astronomically speaking. This was on the night of September 23, 1846. The planet was easily found, because it happens to be a big celestial body having seventeen times the mass of our own earth. Neptune, up to the present day was the last and furthest away of all planets of our planetary system. Its mean distance from the sun is 2,791,600,000 miles. It is so far away from us, that it takes light, coming from it, and traveling at the rate of 186,000 miles a second, four hours and ten minutes to reach us. And it takes Neptune 164.78 years to revolve about the sun. One Neptunian year, therefore, compares to about 164 years on earth.

Leverrier and Adams both had noted for a long time, that the then last known planet, Uranus, showed a number of perturbations which could not be accounted for by the other known planets. Once the exact amount of perturbations were calculated, it became possible to work out by mathematics the position of the perturbing body, which happened to be the new planet—Neptune. The mathematical prediction of an unknown world within the exact area of the heavens at a certain predetermined time will remain one of the greatest triumphs of human achievement.

But history is going to repeat itself. A new world is again to be discovered. It may have been discovered by the time you read these lines. For some time astronomers have been wondering if there was not a trans-Neptunian world, that is, a planet at a greater distance than the collossal interval that separates Neptune from the sun. But inasmuch as Neptune takes so long to make one revolution about the sun, i.e., 164 years, it was not such a simple matter to locate any supposed perturbation of Neptune, supposing that there were any. Neptune itself, having been discovered in as late as 1846, astronomers have not had much of a chance to observe it adequately. Indeed, there had been previous suspicions that there might be a planet in our system beyond Neptune, and even Leverrier and Adams had thought about this, but came to no tangible results.

Of late, however, a number of astronomers, chief among them the well-known authority, Professor William H. Pickering, have been giving the matter serious attention. Pickering collected all the data available on Neptune and began to plot curves. He found out that the planet Neptune had been perturbed by an unknown body, just as Uranus during the last century had been found to be influenced by the unknown outer planet. But Pickering's job proved to be a far more difficult one than either Adams or Leverrier had contended with, because he had less material to work with than his predecessors; and the amount of time that Neptune had been under observation was comparatively short. Pickering could not be sure that the perturbations of Neptune were not actually caused by the giant planets, Saturn, or Uranus, and he began a long series of mathematical calculations; eliminating first one and then the other known planet from his calculations. In a current issue of *Popular Astronomy*, he announces the results, which briefly are as follows:

The new planet, which he terms "O," is a small one, only about half the volume of the earth. The diameter of the as yet to be discovered planet is 6,300 miles, about three-quarters that of Venus, and one-half again larger than the diameter of Mars. The mass of "O" is nearly half that of the earth, two-thirds that of Venus, and four times the mass of Mars. Being at a much greater distance than Neptune itself, it will be more difficult to locate, and it will need a good telescope to detect it. Prof. Pickering has given exact data where the new planet will be found, and it will be interesting to see how much of an error there was in his calculations when the planet is actually discovered, which it surely will be.

But the most remarkable fact about the new and unseen planet is that it has a totally different orbit from all other real planets. As is well known, all our large planets (some of the asteroids excluded) move about the sun in concentric curves or ellipses. But the new planet moves with such eccentricity, that it actually crosses the orbit of Neptune. That means that during half of the undiscovered planet's year, its orbit is within that of Neptune, and that half of its year it is outside—a remarkable phenomenon.

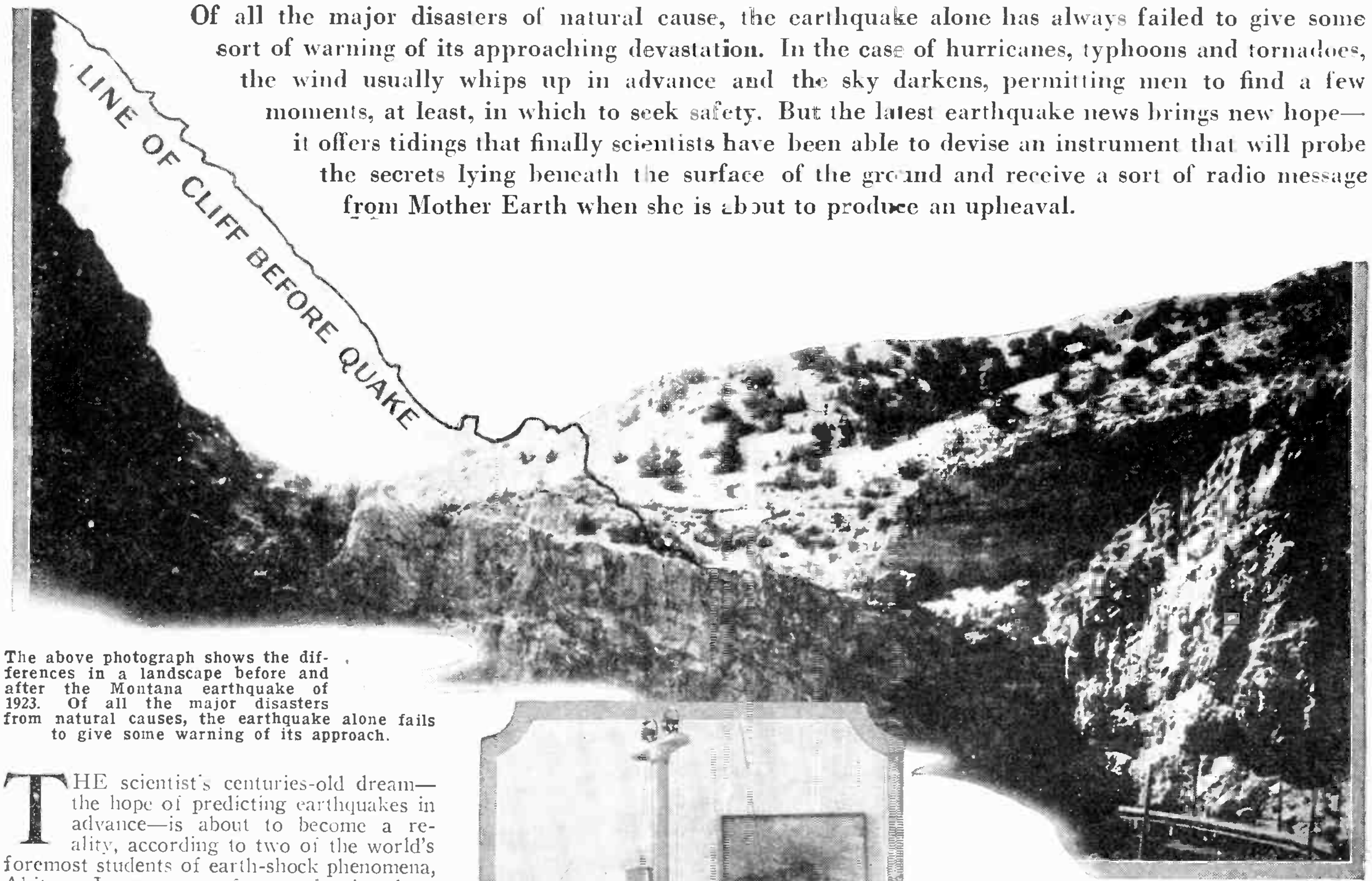
About 1841, the new planet was within the orbit of Neptune, while by 1850, it had already passed beyond it. At the present time it is in the same position, but on the other side of the sun, as it was in 1850, and within a few more years it will again be inside of Neptune's orbit. For these reasons, Pickering urges that no time should be lost in locating it, as the next perturbation that can be used will be one of Saturn, and will not take place until 1950. Here, then, is a particularly brilliant piece of work of which science can be really proud. It again demonstrates the triumph of mind over matter.

Naturally, the question comes up, if there is a new planet beyond Neptune, why may there not be others perhaps more remote than "O"? We do not know—time alone will tell. What seems certain, however, is that our solar system is closely tied together with other systems, because our own solar system is not at rest by any means, but rushes with great rapidity through the heavens. We do not even know what star or what universe is attracting our own solar system, but no doubt, discoveries such as Pickering's will make the work of future astronomers far easier and simpler, and will help us to solve some of the problems of the universe

Mr. Hugo Gernsback speaks every Tuesday at 9.30 P. M. from Stations WRNY (326 meters) and 2XAL (30.90 meters) on various scientific subjects

Earthquakes Predicted

Of all the major disasters of natural cause, the earthquake alone has always failed to give some sort of warning of its approaching devastation. In the case of hurricanes, typhoons and tornadoes, the wind usually whips up in advance and the sky darkens, permitting men to find a few moments, at least, in which to seek safety. But the latest earthquake news brings new hope—it offers tidings that finally scientists have been able to devise an instrument that will probe the secrets lying beneath the surface of the ground and receive a sort of radio message from Mother Earth when she is about to produce an upheaval.



The above photograph shows the differences in a landscape before and after the Montana earthquake of 1923. Of all the major disasters from natural causes, the earthquake alone fails to give some warning of its approach.

THE scientist's centuries-old dream—the hope of predicting earthquakes in advance—is about to become a reality, according to two of the world's foremost students of earth-shock phenomena, Akitune Imamura, professor of seismology at the Tokio Imperial University, and Professor John W. Evans of London.

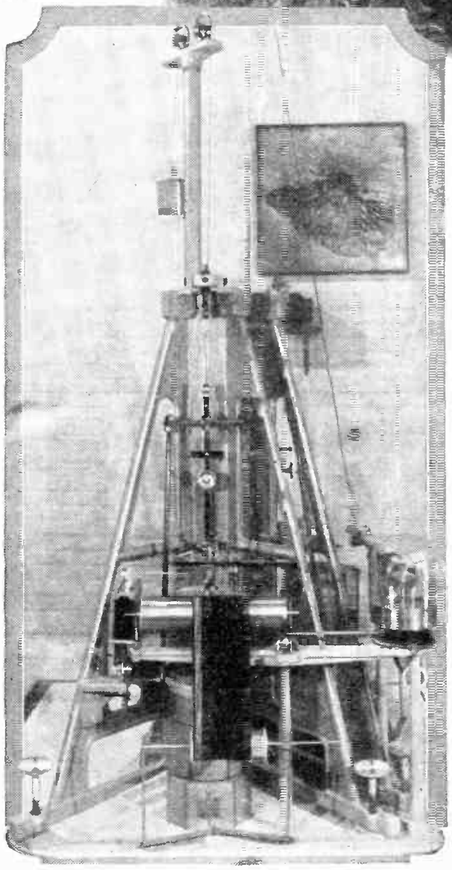
The importance of their discovery probably is unparallelled in the entire history of man's life on this planet. It should remove entirely the world-wide, blind and unreasoning fear of Nature in her worst mood.

Ever since man has inhabited the earth he has feared earthquakes as being sudden, ruthless calamities, coming absolutely without warning and whisking away the very ground from beneath his feet. Dr. Walter Hough, head curator of the Smithsonian Institution, Washington, pictures man's eternal struggle with Mother Earth's devastating maneuvers as follows:

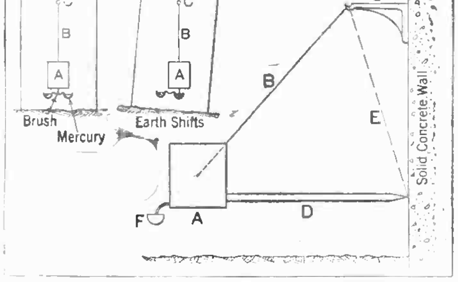
"The history of civilization and the history of migration has been an urge to get away from the dreadful fear of earthquakes. The Pyramids of Egypt were probably shaped for the purpose of withstanding earthquakes. Indeed, the entire history of architecture is another evidence of man's fear of earth shocks. So as to build with stability he has followed different styles and different plans of construction, hoping one day to discover a certain style and plan that would withstand the earthquake menace."

"The temples of the ancients withstood the shocks and so did many of their homes. But fear, that terrible specter which has always dogged the footsteps of men, drove them further north until we find them in the Pueblos of New Mexico. There they built securely. It might also be said that the original American Indians, through this continual fear of what Mother Earth could do to them when she shook her skirts, became nomads, living in tent structures that could not harm them if tumbled about their heads."

"We have but to read the beautiful story of the Crucifixion to know that an earthquake of serious force occurred while the horror of Golgatha was taking place. Or Sodom and Gomorrah — archaeology has proved these iniquitous cities were destroyed by earthquakes. Antioch was similarly destroyed by one of the most terrible earthquakes of all history hundreds of years be-



Above is a photograph of the Mainka seismograph, which operates on the principle of mechanical registration. It does not photographically record quakes.

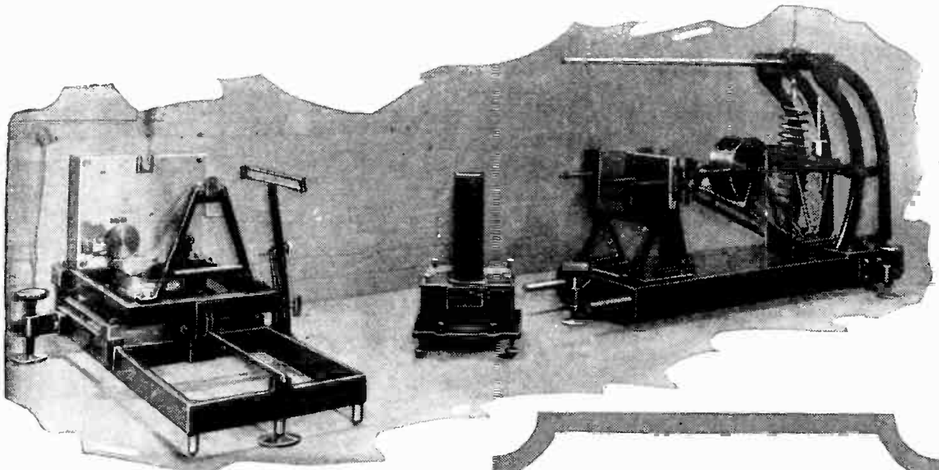


The diagram at the left shows the schematic arrangement of an earthquake predicting instrument. A, is a pendulum, B, tension member, C, pendulum support, D, pendulum boom, E, theoretical axis upon which pendulum vibrates and F, one of a pair of mercury contacts. Two clinographs would be required, one to record tilt coming from the north or south, and the other, for east or west. This tilt occurs from five to thirty minutes before a quake.

Above is a graphic chart showing method of locating earthquake by drawing arcs from three seismograph stations.

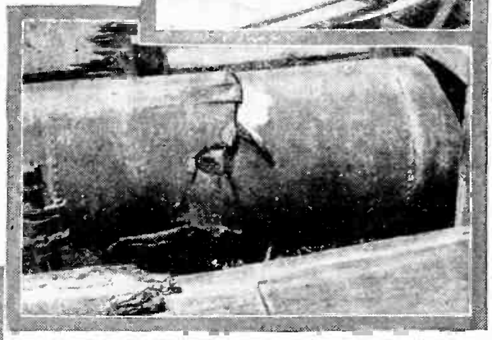
Hours in Advance

By JAMES NEVIN MILLER



The Galitzen seismograph, the most sensitive instrument used today, is shown above. The registration instrument is shown at the left and the recording device at the right. It registers earthquakes on the magnetic principle.

A photograph showing the wreckage of a lighthouse in Santa Barbara, California, appears at the right. The great quake of 1925 was responsible for this.



The famous earthquake of 1905, which struck California, ripped apart a 31inch pipe used as a water main. A photo of this pipe appears above.

The first earthquake indicating device was invented in 136 A.D. by the Chinaman, Choko.

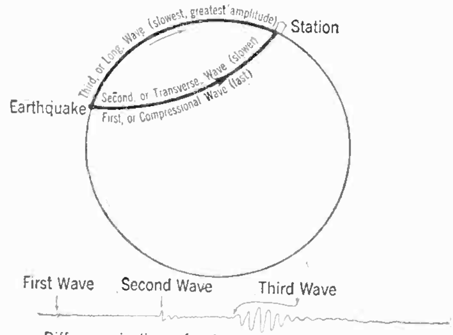
This instrument was known as the seismoscope and the shock of the quake dislodged balls from the dragons' mouths, thus showing the direction of the quake.

fore Christ. These disasters provoked the Romans, perhaps, into an onward march."

Of all the major disasters of major cause, the earthquake alone has always seemed to fail to give some sort of warning of its approaching devastation. In the case of hurricanes, typhoons and tornadoes, the wind usually whips up in advance and the sky darkens, permitting men to have a few moments, at least, to seek safety. But earthquake disturbances, born far beneath the earth's crust, can neither be seen nor heard in time for such action. Small wonder that the earthquake is regarded as the most terrible natural calamity—man has been well-nigh helpless in trying to avoid its destructive force.

However, the latest earthquake news offers new hope—it brings tidings that finally scientists have been able to devise an instrument that will probe the secrets which lie beneath the earth's surface and receive therefrom a sort of radio message from old Mother Earth when she is about to produce an upheaval.

Centuries-old in its beginnings is the earthquake drama. The drama consists of three acts. The first act began millions of years ago when, in the process of cooling off, deep cracks or fissures appeared in the earth's underlying strata, causing deep-set lines of weakness for distances virtually impossible to calculate. Due to sedimentation and erosion there is a constant change in position of the surface materials of the earth, notable in Nature's plan of mountain building, with the result that the subterranean cracks and weaknesses may be subjected to a pronounced strain.



Difference in time of arrival of first and second waves, gives distance from earthquake to station

EARTH SHIFTS BEFORE A QUAKE

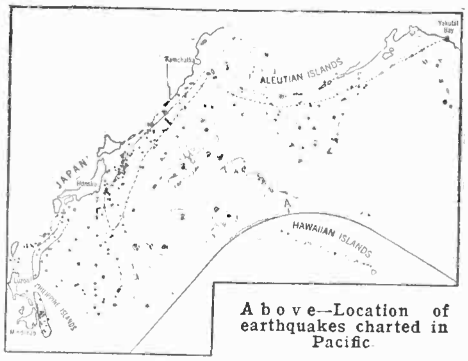
GRADUALLY they become overloaded on one side with earth materials, causing a sliding and shifting of load, the second act, which culminates in the third, the terrible tremors that man today calls an earthquake. So unexpected and sudden is this trembling of the earth's surface at times that almost in the flick of an eyelash, buildings topple and fall, water and gas mains snap, fires arise through short-circuiting of electric wires, and a paroxysm of horror ensues among the inhabitants of the stricken district. This actual earth convulsion itself is the third and final act in the earthquake drama.

It is the second act, always obscure, and always challenging, which has been investigated by scientists working in their solitary retreats, bending over their instruments which record earthquakes, while trying to discover the age-old mystery of their manner of approach.

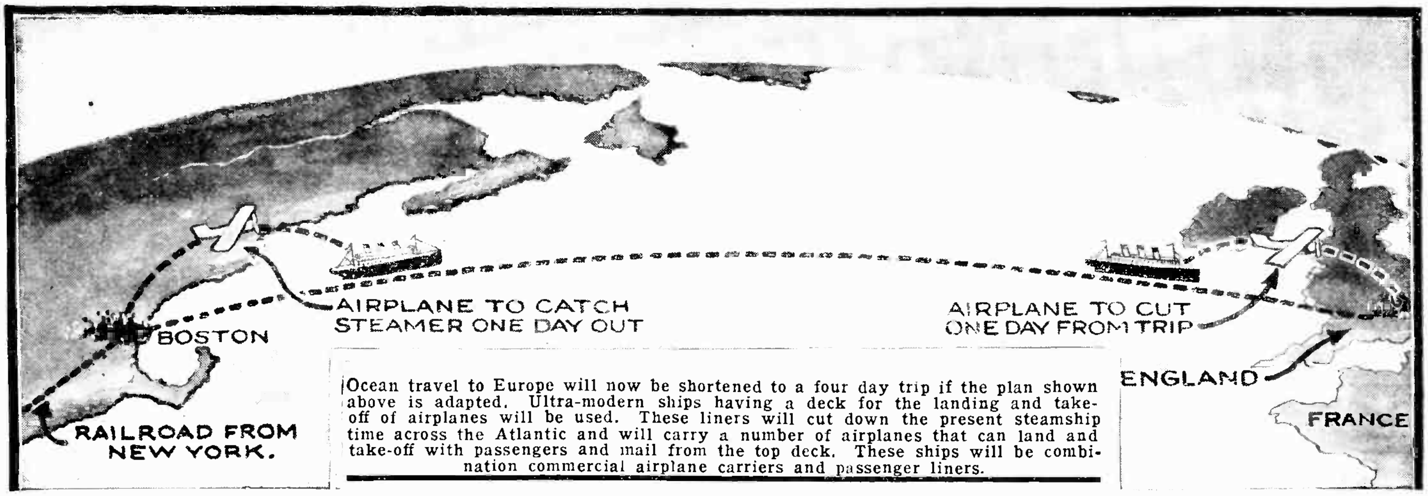
Briefly, Prof. Imamura of the Tokio Imperial University, has discovered that there is a slight tilting of the earth's surface, which occurs ordinarily a short time before an earthquake occurs. Four years ago, Professor Evans, famous British scientist, suspected the existence of such a tilt and declared that "the rupture, whatever its nature may be, that gives rise to the actual vibratory shock, is preceded by a strain or distortion of the earth's crust which gradually increases until the stress that causes it is suddenly replaced. The existence of this strain should be evidenced by a progressive sag or tilt of the earth's surface."

It was not until late in 1927, however, that Prof. Imamura gave to the world his proof that such a tilt actually did occur—from one-half hour to five hours before the actual earthquake and that the tilt could be recorded by a delicate

(Continued on page 66)



Above—Location of earthquakes charted in Pacific



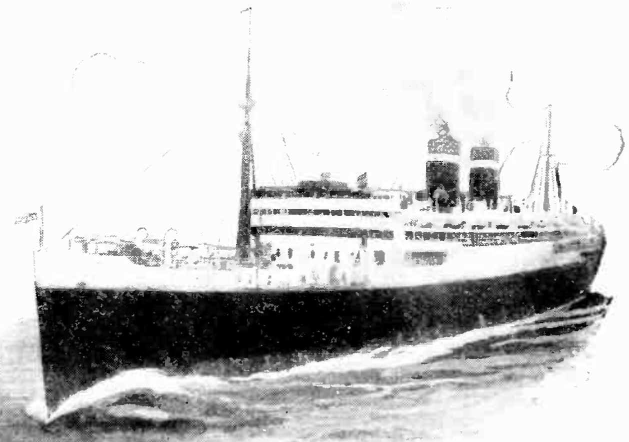
Ocean travel to Europe will now be shortened to a four day trip if the plan shown above is adapted. Ultra-modern ships having a deck for the landing and take-off of airplanes will be used. These liners will cut down the present steamship time across the Atlantic and will carry a number of airplanes that can land and take-off with passengers and mail from the top deck. These ships will be combination commercial airplane carriers and passenger liners.

SPEEDING UP OCEAN TRAVEL

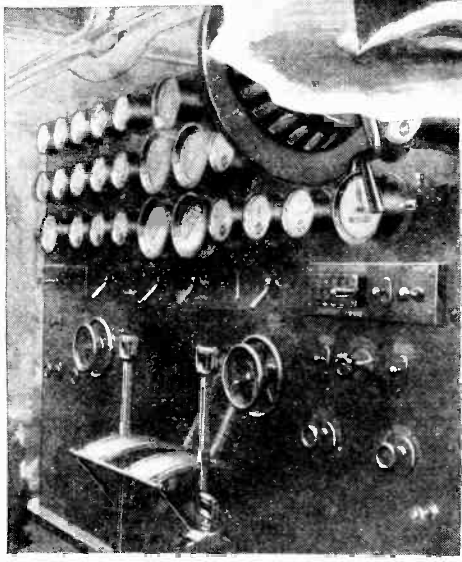
Ultra-Modern Ships Will Reduce Transoceanic Steamship Time and Increase Pleasure

ENGINEERS and ship builders have collaborated in cutting down the trans-Atlantic steamship time to a minimum. The photos and diagrams on this page show various ways in which this can be done. At the top of the page we have a proposal which has been submitted to the U. S. Shipping Board by a ship building corporation, whereby the Atlantic Ocean can be crossed in four days time. The ships to be built will be a combination airplane carrier and passenger liner having a speed of 35 knots per hour, faster than the fastest ocean liner of the present time, which attains a speed of 26 knots per hour. These boats are to be 917 feet long, with a beam of 90 feet. There will be space for 1000 tons of cargo, and accommodations for 800 passengers. Ample space for airplanes to land and take-off will be provided, so that the airplane can catch the steamer one day after it has left and leave one day before it has reached port.

All of the super-structure will be erected on one side of the deck, to allow unobstructed deck space for the planes. One desirable feature of the four-day ships is that they will answer the purpose of floating islands for trans-Atlantic fliers. At least, three of the ships would be on the high seas continuously, and at such intervals as to make short hops across the Atlantic possible. Their exact positions would be definitely fixed at specific times, and the flier could easily use their decks as a stopping place in mid-ocean.



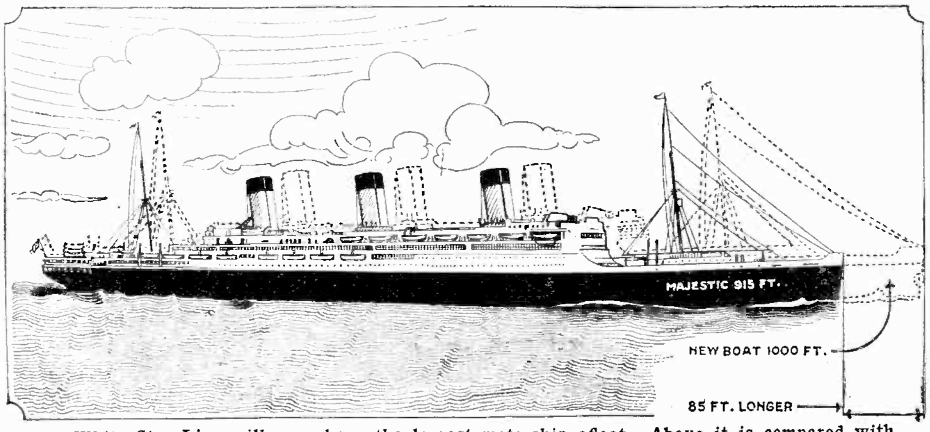
At the right is a photograph of the S.S. California, the first electrically operated ocean liner, which weighs 22,000 tons and is the largest vessel of its kind built here.



The above photo shows the main propulsion control-board on the S.S. California.

The S.S. California recently arrived in New York on its trial run from Newport News, Virginia. A maximum speed of 19 knots was established with the new merchant vessel which is electrically operated. The ship weighs 22,000 tons, and is the largest of its kind ever built in this country. Where a ship of the California's tonnage would require 120 men, the new liner requires but three men on watch in the engine room. Small twin turbines driving two generators provide the electrical energy. With this combination, it is possible to develop 17,000 horse-power. The vessel is 600 feet over all, has an 80-foot beam, and a draft of 30 feet. She will soon be placed in operation in the New York to California service, of the Panama-Pacific Line. Several unusual features are the two built-in swimming pools on the open deck, and a garage which will accommodate 140 automobiles. On the run from Newport News, nine men constituted the crew and the quarter-masters stood by a "locked" steering wheel, while the gyro-compass and gyro steering device, adjusted to the main course, held the ship on this course unaided. A view of the main propulsion board of the S. S. California is shown on this page.

The White Star Line has placed an order for a giant motor ship, which will be even larger than the Majestic, at present the biggest ship afloat, the length of the new vessel will be about 1,000 feet and she will be driven by internal combustion engines of the Diesel type. The speed of the new ship is not expected to be remarkably high. Germany, however, is planning to wrest the speed record from the Mauretania and is now building two large liners which when completed are expected to be the fastest passenger ships afloat.



The White Star Line will soon have the largest motorship afloat. Above it is compared with the Majestic, the biggest ship at the present time. The length of the new vessel will be 1,000 feet over all.

INVENTIONS WANTED!

THE primary object that all inventors have in mind when patenting ideas is to realize financial benefits from their inventions; however, it is unfortunate that there are only a small number of inventors who can claim to be successful. Very frequently articles are invented which are not required either by the general public or industry. On this page we have illustrated only a few of the vast number of much needed inventions mentioned in a booklet covering extensively the inventions most needed today and compiled by the Institute of Patentees of London.

An umbrella which can be folded up into a small space and readily carried in the pocket would find a great market today. A luminous paint which can be made cheaply and yet be seen over quite a distance at night is another much needed invention. Signs could be made with this paint, thus doing away with the expense of electricity. Non-skid rubber caps for placing over the end of ladders would prove useful. A camera device which will automatically roll the film and shift a new film into place after each exposure, thus preventing a double exposure, is much in demand. An efficient, safe and easy method of absorbing carbon dioxide from the air of a room, is a problem for the chemists to solve. Unbreakable, clear, flexible window glass, without a doubt, would be welcomed in many industries, and also by the general public. A device to prevent water pipes from freezing would gladden the heart of any suburbanite. A voice-operated typewriter will speed up office work and make for greater efficiency. For some time, a search has been going on for a non-alcoholic temperance drink which will be refreshing and have a "kick," in spite of the fact that it is devoid of alcohol. A cheap self-contained home garbage and refuse destroyer should find a place in every home. A radio-television apparatus which can be bought for a moderate sum is another needed invention, which undoubtedly will be perfected within the next ten years. A sun-power electric generator and a static eliminator would make millions for their inventors. A vacuum cleaner for chimneys would be a welcome invention. The transmission of power through the air has been the dream of more than one radio and electrical engineer and still remains to be perfected. A family airplane which would be foolproof would doubtlessly have a wide sale in this country and abroad. A method of taking colored photographs with the ordinary camera is another invention which is yet to come. A furnace for making electricity directly from coal in an efficient manner would find a place in almost any home. A liquid which will nickle-plate the metal upon which it is rubbed and yet give a durable finish such as that obtained only by electroplating, is a much needed preparation. A substitute for rubber and also a process or treatment to prevent rubber from aging, will find wide application in the commercial fields and net the inventors big money.

The Commanding Officer of the Giant Tells Here Some of the Little Known That You Have Always Been Curious to Dirigibles? Read What

Lieut.-Commander C. E. Rosendahl, U.S.N.

QUESTIONS ASKED BY H. GERNSBACK, EDITOR, FOLLOWING RADIO TALK OF LIEUT. COM. C. E. ROSENDAHL, U. S. N., FROM WRNY.

1. Q. In your opinion, can a huge dirigible of the Los Angeles' type compete successfully with airplanes in carrying passengers?

A. There is no competition between the airplane and airship if each is properly employed. To use an airship to do the work of an airplane is as extravagant and inefficient as the use of a sea-going steamer on a short coastal run or on ferry boat duty. The airplane is and will probably always be a short range carrier, while the airship is fundamentally a long range vehicle.

2. Q. What do you believe the maximum speed that airships can obtain for commercial traffic?

A. It is believed that a speed of about 100 miles per hour will be attained by dirigibles of future commercial size.

3. Q. What provisions if any have been made in passenger carrying across the oceans to safeguard passengers if airships were forced down into the ocean?

A. An airship in trouble is not necessarily forced down in the ocean—in fact, she would fly as a free balloon, in case all motors failed; but there is extremely little likelihood that all of six or eight individual power plants would fail simultaneously. Airships carry sea anchors similar to surface ship practice. There are many instances on record where German Zeppelins—badly damaged in war—returned safely to their bases. Safety lies with staying with a ship and flying to her base.

4. Q. If lightning struck one of these huge helium-inflated airships, what damage would be done?

A. Even hydrogen-inflated airships have been struck by lightning without any damage. An airship is a huge, thoroughly-bonded metallic structure, that would readily dissipate an electric charge; added safety being assured by the use of the absolutely non-inflammable helium gas as the inflation medium.

5. Q. Can this country produce sufficient helium for any amount of dirigibles?

A. The United States has practically a world monopoly of the supply of helium. Nowhere else in the world is there a sufficient quantity of helium-bearing natural gas to pay for its production. Recent reports indicate that there is practically an unlimited supply of helium in certain gas-bearing fields in the United States—certainly enough for all the airships we shall operate for scores of years to come.

6. Q. What are the advantages of helium over other lifting gases?

A. Helium is a safe lifting gas in that it will absolutely not combine with any other element and therefore cannot burn nor explode. It is next to the lightest gas known and available for airship inflation. It has 92% of the lifting power of hydrogen, and its much greater safety over hydrogen makes its use of the utmost value.

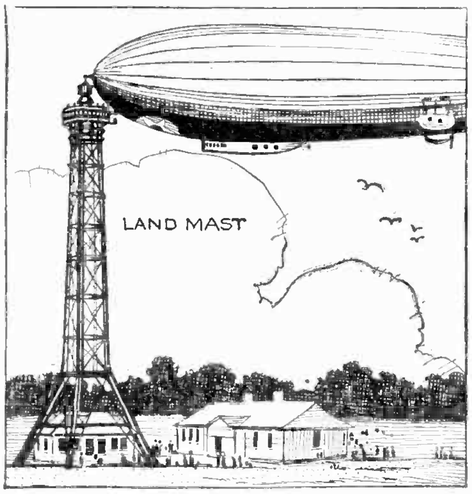
7. Q. Can an airship, while moored to its mast, outride practically any storm that may come along, including a hurricane?

A. An airship moored to a mast can ride out very severe storms—certainly any containing winds up to the speed at which the ship itself is designed to fly. In the case of hurricanes or tornadoes greater safety lies in taking the air and flying out the storm, just as a steamer puts out to sea in severe storms, heaves to at sea, or runs around severe disturbances.

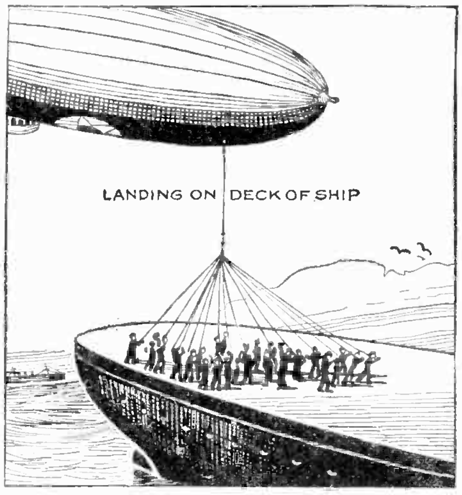
THE year 1928 will be an unusually important and spectacular one for dirigibles; it is not necessary to consult an astrologist to glean this from the stars, as there are other unmistakable signs already apparent. 1927 saw many triumphs for the airplane—its records are written in history. Outwardly, 1927 was a quiet one for dirigibles; actually, much unseen and vital experimental work progressed and some new construction continued in its early stages. It is on this dirigible or airship phase of aeronautical activity that I wish to discuss briefly.

HEAVIER-THAN-AIR CRAFT DEFINED

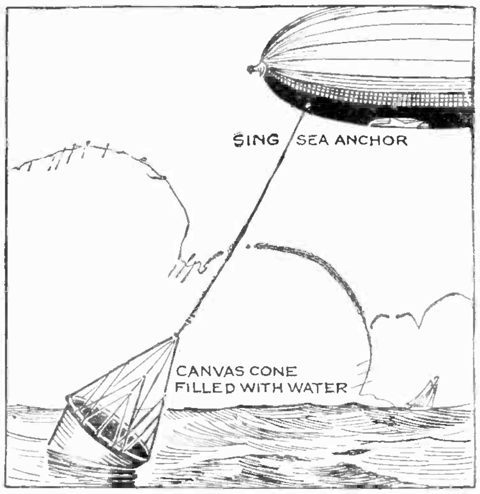
MANY people do not distinguish between "heavier-than-air" craft (i.e. airplanes) which must depend on their engines to hold them aloft as well as to drive them through the air, and "lighter-than-air" craft (or dirigible balloons) which are sustained by some buoyant medium such as helium gas and devote practically the entire effort of their engines towards propelling them. Thus the term "airship" is sometimes used indiscriminately for all forms of aircraft. We in the lighter-than-air branch of aeronautics feel that the term "airship" properly should be applied only to lighter-than-air craft, as they are fundamentally "ships" and incidentally ships that float in air. Airplanes are much more widely distributed than airships, and naturally the plane and its habits and character-



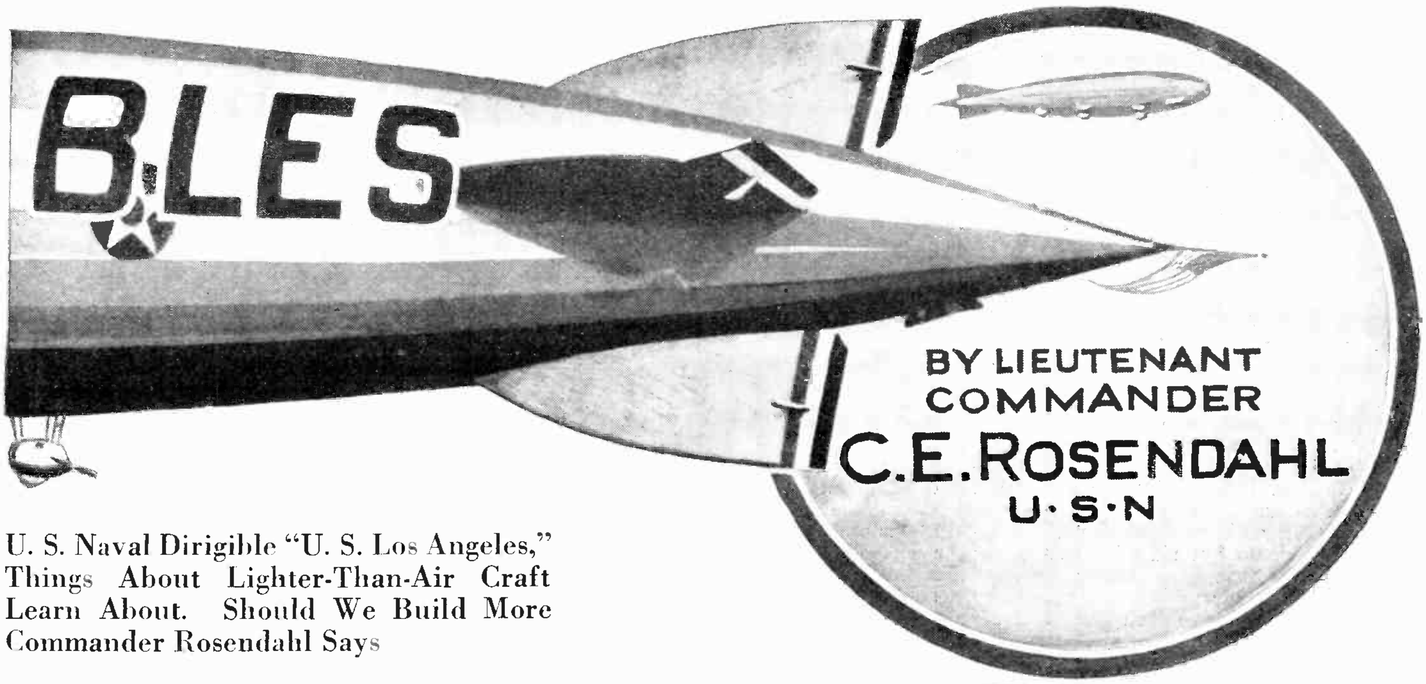
One method of mooring dirigibles is shown above. The ship is tied to a land mast.



When landing upon the deck of a ship, a number of ropes are employed as shown here.



One of the newest inventions is a sea anchor for dirigibles used as shown.



U. S. Naval Dirigible "U. S. Los Angeles," Things About Lighter-Than-Air Craft Learn About. Should We Build More Commander Rosendahl Says

istics have therefore become more commonly known than those of its scarcer cousin, the airship. However, this unfamiliarity with the airship will soon vanish, for the realization is dawning that large airships—often referred to in the past as "Zeppelins"—are essential both to commercial transport and to the national defense.

DIRIGIBLES FOR SAFETY AND COMFORT

MANKIND continues to demand greater speed in transportation—think of the vast amount of effort spent to obtain speed! Is there anyone who hasn't been thrilled at the tales of the magic carpet of the Arabian Nights and its ability to annihilate distance? High speed trains and fast steamships demand extra fare and we continue to patronize and support them. Further increases in railroad and steamship speeds are very expensive and difficult to obtain. As soon as the speediest transport of all—that by air—becomes more generally realized with safety—mankind is sure to take quite liberally to the use of aircraft—particularly if comforts and conveniences may be had simultaneously with the greater speed. Airplanes and airships are this next available means of supplying speedier travel—the airplane for short or moderate distances, the airship for long distances. Airplanes can provide a certain degree of comfort but it is the airship which can supply the maximum of comfort and safety in the air for longer voyages.

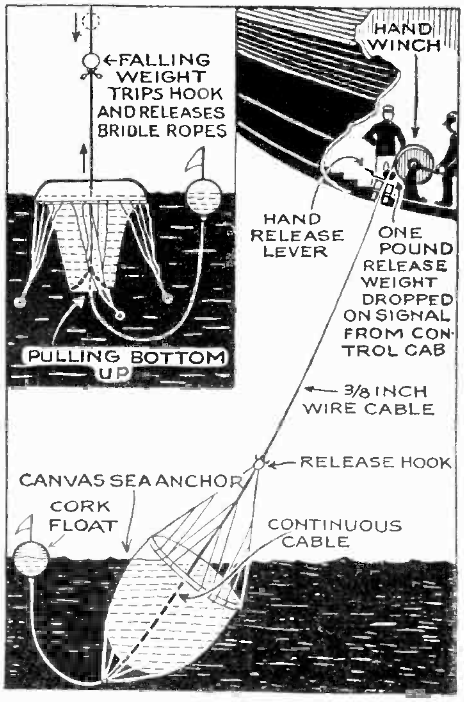
EVOLUTION OF THE AIRSHIP

PERHAPS you might be interested in the evolution of the airship. In 1783, that is, about one hundred and forty five years ago, the first balloon flight was made. Men had observed that hot air would rise; therefore by inflating a bag or container of light material with heated air, the container could be made to rise and take with it a basket or car in which to carry the passengers and other loads. Soon man was able to produce hydrogen gas in sufficient quantity to inflate a balloon and since hydrogen is so much lighter than air, it has always been a most efficient lifting gas. Of course, balloons drift with the wind, and man soon became desirous of providing them with motive power so that he might go in any direction independent of the wind. Early effort consisted of rowing with silken oars but of course this method was not practical. In 1852 the first power driven or dirigible balloon was built. It derived its motive power from a three-horsepower steam engine. The modern airship had to wait for the development of the gasoline engine and a light strong material with which to build the structure. It was in 1900 that Count Zeppelin completed and flew his first rigid airship in Germany. Our first American airship was built in 1908.

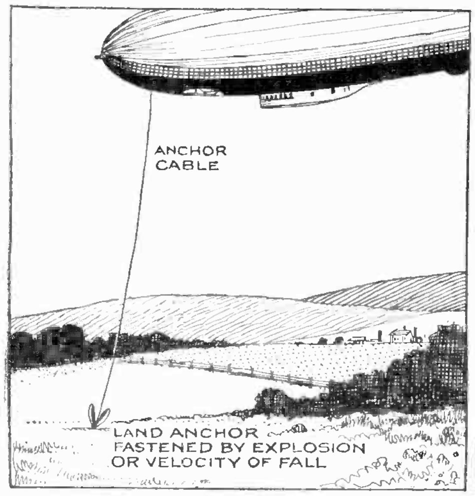
LIGHTER-THAN-AIR CRAFT CLASSIFIED

AT this point let me classify for you lighter-than-air craft or those forms of

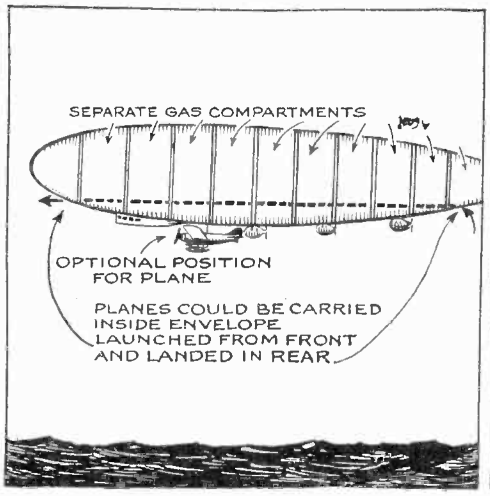
(*Continued on page* 79)



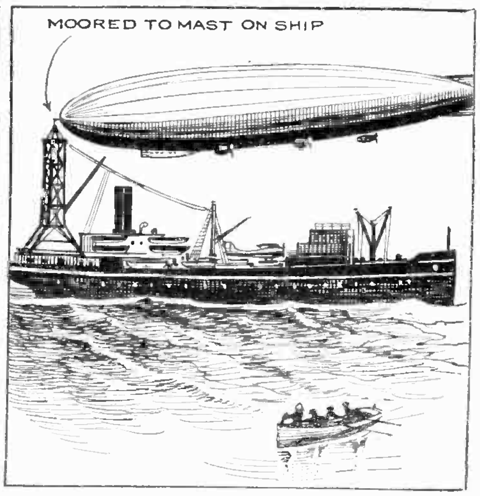
The above illustration gives all the details of the new canvas sea anchor.



An emergency landing can be effected by using a land anchor which can afterwards be cut loose.



Modern dirigibles have separate gas compartments. The U. S. Navy will fit dirigibles for carrying airplanes.



A dirigible can be moored to a special mast on a ship, as was recently done with the "S. S. Patoka."

Controlling House

Information About Pests, How They Live and

By DR. ERNEST

Mice are destroyers of food and transmit diseases. These pests are easily controlled.

QUITE a number of different insects and animals are attracted to the home of man, not only for the shelter offered, but also for the profusion of food available in kitchen and cellar. Once such creatures have made themselves at home, it is very difficult and sometimes almost impossible to get rid of them. They find everything that is necessary for life, and why should they move? They multiply rapidly and soon become such pests that the master of the house becomes disgusted and takes violent measures for their extermination.

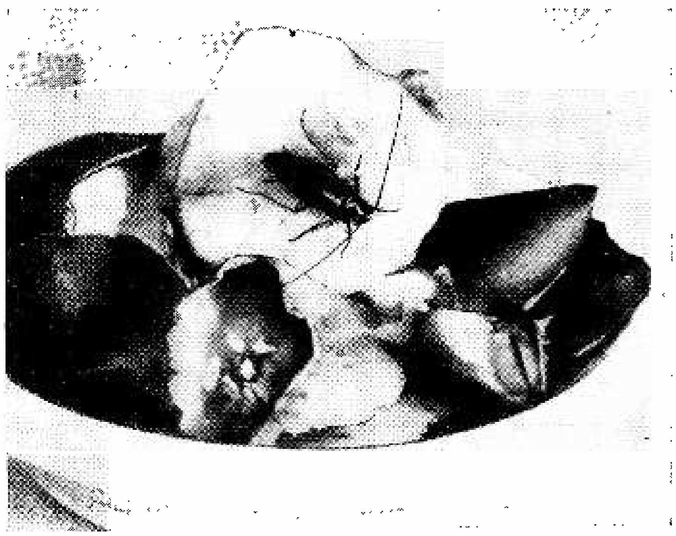
Among themselves. the pests of the house battle with more success, but their aid can seldom be used, for it would only be a case of jumping from the frying pan into the fire. It is in this way that the house rat has been practically wiped out by the wandering rat. The former (Mus rattus) has been evicted by the wandering rat (Mus decumanus), primarily through the aid of ships, by way of which they have overrun the world.

RATS

MANY methods have been proposed for the control of the rat, but almot all processes have only local efficiency. The rat is far too wise and cunning to be taken in by simple means. Then, too, he is suspicious of all new things with which he may come in contact and thus he is able to distinguish the harmful from the harmless, the dangerous from the innocuous. Traps cannot be used successfully for any length of time. If they are of iron, then the rat will not touch the bait, for he does not know iron and must first be made to realize that iron is harmless. For this purpose iron chains and other objects of iron are placed across his path and after he knows that iron is harmless and will not hurt him, iron traps may be more successfully employed.

RAT POISONS

CATS seldom attack rats. It is better to use a dog, especially a terrier. Poisonous bait is also good for only a short time, and if plenty of other food is available, it is almost useless to try to control them by this method. A favorite poison is that obtained from the bulb *Scilla maritima*, a native of southern Europe, which is often cultivated in the window garden. Its action depends upon the crystals of calcium oxalate, known as raphids, and which are thin and sharp, like small double-pointed needles. These needle crystals, when eaten by the rat, penetrate the intestines and kill the pest. The rat is accustomed to the bait by means of ordinary meat balls fried with onions. After the rats have taken a few of these, the bulbs are substituted for the onions. This is a very effective control method. In more recent times the rat bacillus has been used, but this germ is not active over any long period of time. Quick-acting poisons should not be given rats. Other rats see the effect of the poison bait and refuse to touch it.



Above is the cockroach, a pest which has travelled all over the world to the dismay of man. Borax will help control the pests if applied where they are found.

PLASTER OF PARIS EFFECTIVE

Another good rat poison which is not dangerous to handle is plaster of Paris. The plaster of Paris must be prepared by mixing it with other substances such as flour, sugar and some strong smelling cheese. This poison as well as the above mentioned may also be eaten by mice. A bowl of water is placed next to the plaster of Paris mixture and it is the water which really kills the pest, because the plaster hardens to a brick inside the pest and so kills it.

Various other chemicals can be used as the different types of barium salts such as barium carbonate or barium sulphate. They are used like the plaster of Paris (calcium sulphate). In all these cases a bowl of water should be available to the pests. The various types of fumigants such as cyanides used for control of pests should be avoided. They are far too dangerous for the layman to handle, and for best results a specialist will have to be called. In the proper hands it is an excellent method of control but it can not be used successfully under all conditions.

Above—the bed-bug which sucks the blood and transmits diseases. Kerosene, or acetic acid may be used for their control.

RATS SPREAD DISEASE

Rats should be killed not only because they are destroyers of food, but also because they are transmitters of disease. Diseases are transmitted by the rat to fleas, these attack man and transmit the germs. Plagues have been started in this manner.

Far more harmless and much more easily controlled is the house mouse. This creature is only found where it will find a hiding place. For this reason it is seldom discovered in modern dwellings. Cats and mouse traps are quite effective. In fact any type of a trap is almost sure to catch them although some traps are better than others. Rags dipped in turpentine and stuffed into mouse holes drive the pests away.

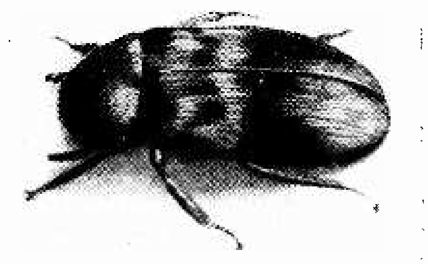
THE INSECT MENACE

OF still greater economic importance as pests of the home are the insects. There are countless myriads of them and they not only endanger our supply depots, but attack our clothing and our homes, even endangering our health.

One of the pests of the kitchen food supply is the common larder or bacon beetle, a creature about ½ an inch in length. This pest (Dermestes) is not bound to any particular food. In nature it takes to decaying matter, both organic debris and manure. Then, too, it is often found on flowers. The larva are usually found in dried material or animal matter, such as dried muscle bundles and tendons, the inner side of dried skins and pelts and furs, bacon and hams. These beetles are found everywhere and have made themselves at home in every place, and since they keep under cover and multiply rapidly, they do much damage not only to foods, but also to carpets, rugs, furs, bolsters, etc. Places infested with these larder beetles may be safely fumigated with 40 grams of carbon bisulphide for each cubic yard of air in the room. Close all holes and cracks and leave for at least 10 hours. Another safe fumigant to use is formaldehyde. Any kind of a lamp or vaporizer of formaldehyde can be used. Leave this also for at least ten hours in a closely stoppered room where all cracks of windows and doors have been stopped up. A protective method for furs, etc, is the use of insect powders dusted on the articles.

THE SILVER FISH

THE tiny rapid silver fish (Lepisma) is seldom considered as a pest unless it is found in very large numbers. It is always

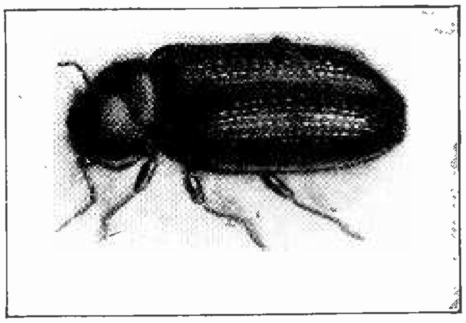


The larder or bacon beetle is a creature about one-half inch in length and may be controlled by fumigating with formaldehyde.

hold Pests

How They Can Be Driven from the Home

BADE, Ph.D.


The death watch beetle is about one-quarter inch in length and is very destructive to furniture.

found where ever foodstuffs are stored, prefers sweets, but also attacks cloth and clothes. The creature lives its life in dusk or darkness and when caught in the light, it hurries back into hiding. It is hard to catch for the body is smooth and it slips easily through the fingers and is gone. It is about a half to three quarters of an inch in length, is built closely to the ground and looks like a silver streak when caught unawares.

In the library the silver fish attacks the back of books in order to get at and eat the glue. It gnaws the paper and leaves only that part which is covered with ink. Starched cloth and silk are also eaten as are the backs of wall papers. There are few things that the silver fish will not take. The greatest damage is always done wherever materials are left undisturbed for long periods as clothes that are stored away. A general control method is the fumigation with carbon bisulphide or formaldehyde. Books may be lightly rubbed over with a cloth dampened with formalin. The formaldehyde gradually evaporates and kills. Cloth that is stored should be sprinkled with naphthalene. This also keeps moths away.

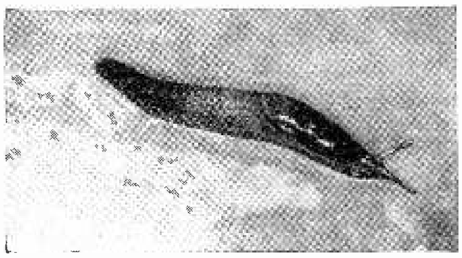
CRICKETS

ATTRACTED to the kitchen by the heat of the range in suburban and country places, is the cricket (Gryllus), which hides in cracks and cranies. The males are untiring musicians and they lure the female to them by means of this high and shrill squeak. At night the cricket hunts for food and in the home of many this consists of cakes and sweets, flour and bran, etc. Only during the time of feeding is the music stilled. They are dark brown in color, fat of body and about one inch long. They are hard to get at and the best method for their control is to place a bowl of their favorite food on the floor within their reach. Then, at night, while they are feeding, catch them at the feast and kill them by pouring boiling water over them. If desired a poison food may be prepared consisting of one part of salicylic acid, two parts of powdered borax mixed with nine parts of any of their food.

COCKROACHES

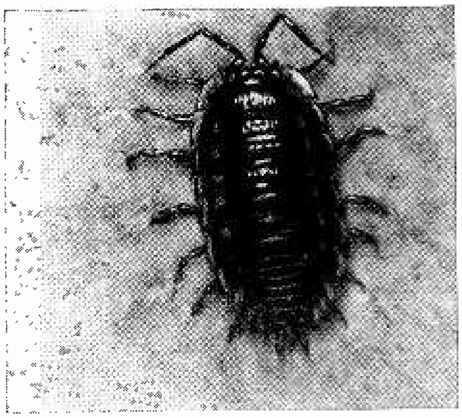
A MUCH greater pest is the cockroach (Blatta) of which two species are found in the kitchen the larger one of which has, like the rat, conquered the world, primarily through the aid of ships. The size varies from the small which is about ¾ of an inch to the large which may be twice this size. They are brownish red in color, very flat and wide in proportion. The eggs of the roaches are formed into balls and are carried by the female for some time. Then they are deposited into hiding places. The food consists of all edible things, sweets being preferred, but even leather goods are destroyed by them. They may be chased away by sprinkling borax and insect powders around the floors and shelves where they travel. Since these creatures are slim, they enter all cracks, and in order to keep them out permanently, these should be filled with a good crack filler. They may also be killed by the poison food mentioned for the cricket. In addition they may be controlled by a mixture consisting of five parts of plaster of Paris and one of flour, the parts being taken by weight. A mixture of one part of honey and half a part of yeast is also a good poison.


Household pests can only be destroyed by a persistent fight against them. Remember that the eggs may be hatching, even after all the adults have been killed. Persistence in the use of control measures is necessary.


Slugs are commonly found in cellars and may be effectively destroyed by using powdered lime.

PERSISTENT FIGHT AGAINST PESTS NECESSARY

PERSISTENCE in the use of control measures for any pest is absolutely necessary. The eggs of the pest may be hatching a few days after all adults have been killed and if a second and even a third time control is not used, the pest may be back with renewed vigor.


The pill bugs are not particularly injurious but are a nuisance, especially in damp cellars. Since they are slow moving, they are easily exterminated.

Insect powders as such may be quite different from each other. Pyrethrum is usually used. This is the powdered part of a plant, the flower and leaf being usually taken. In addition, powdered sulphur, pepper, tobacco, white lead, borax and others are also used in combination with pyrethrum.

An excellent insect powder is made by mixing equal parts of pyrethrum with borax. If desired a half a part of flower of sulphur may be added. This last is very good for any insect and especially for cockroaches.

PILL BUGS AND SLUGS

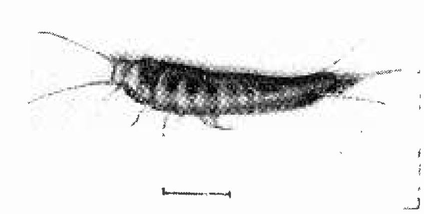
PILL bugs and slugs are commonly found in cellars. The latter demand moisture in order to live. On dry ground they secrete slime and give off much moisture which soon causes their death. For the control of slugs, lime is the best chemical that can be used for each slug that comes in contact with the dry powdered lime must die.

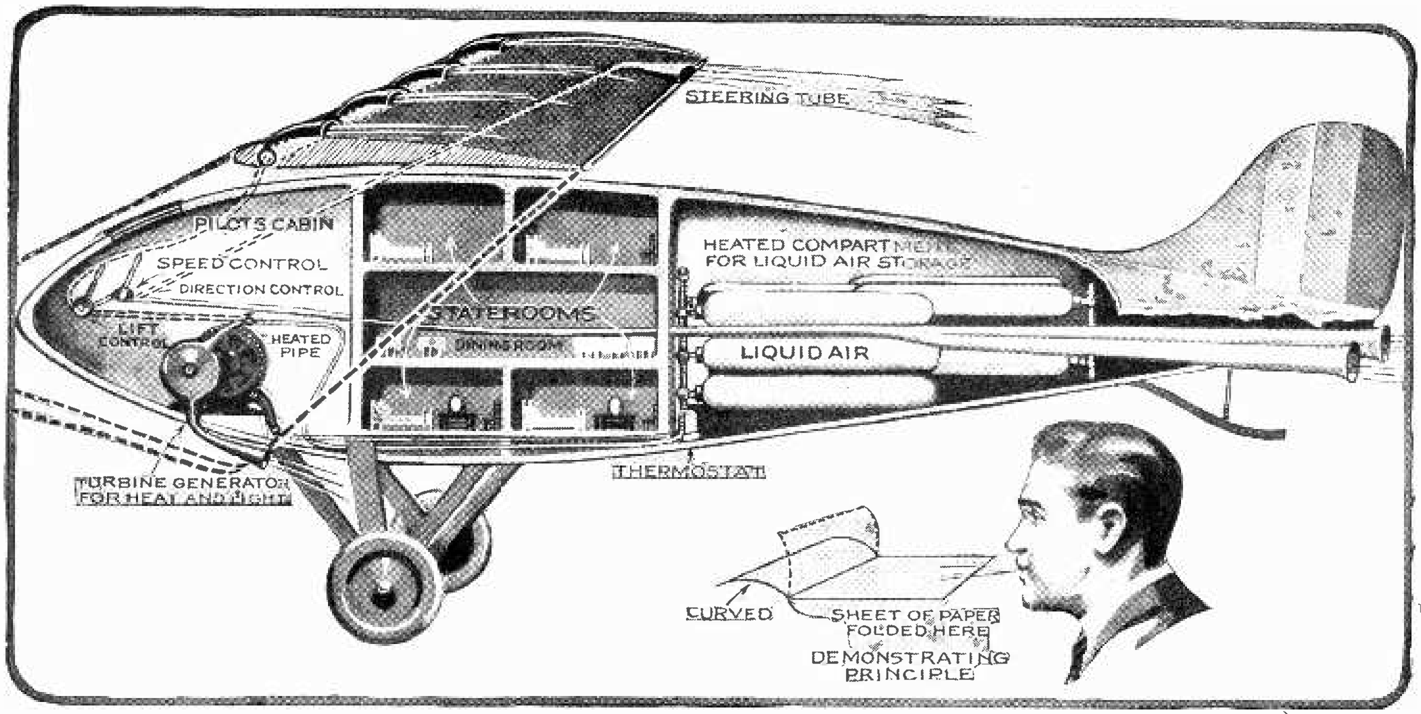
The pill bugs are found under stones, bark and other dead and decaying material of field and woods. One form also enters the cellar where its food consists of decaying potatoes, fruit, etc. They really do not do any damage, but they are unwelcome guests. They may be trapped during the night with hollowed carrots, slices of pumpkins, etc., where they will be found next morning, and since they do not run away, they may easily be killed by stepping on them.

THE BEDBUG

AN entirely different type of pest is the bedbug, a comparatively small insect, wide in body and built flat, in length it may vary from ¼ of an inch to slightly larger. The bed bug is not a comparatively recent addition to the sleeplessness of man, being known to the ancient Romans. Since these blood suckers are very flat, they are always found in cracks and cranies, under molding and even under wall paper. They are also found in crevices of beds and furniture. There are many ways in which this pest may be controlled. Kerosene and gasolene may be used to brush the cracks or, which is better, to soak the cracks with the aid of a spray. Acetic acid is still more effective but it can not be used where the acid may

(Continued on page 68)


The silver fish is destructive to books and cloth. Formaldehyde fumigation kills this pest.



Conception of the proposed type of engineless plane which will obtain its lift by streams of air forcibly ejected through special nozzles mounted along the edge of the wing. Air tubes propel and steer the plane because of the reaction effect. Insert shows the operating principle.

Engine-less Plane Driven By Liquid Air

Propellers and Engines to Be Supplanted by Novel Method Employing Liquid Air for Propulsion and Vertical Lift

By AUGUSTUS POST

WHEN Glenn Curtiss was looking for a landing-place half-way between Albany and New York at the time of the first long-distance flight in this country, May 28, 1910, he found just the place he wanted, a broad expanse of lawn in front of an imposing public building near Poughkeepsie. When we asked permission to make a landing there, the Superintendant, Dr. Taylor, replied genially: "Why certainly, come right in! Here's where they all land!" It was the State Lunatic Asylum.

Even as late as this year, this was the popular notion of the place where flying-machine inventors belonged. Nowadays the public is going crazy over aviation, and the only level-headed ones are the Lindberghs who do the great things and the inventors who dream them. These dreamers, the "crazy inventors," are now looking as far ahead into the impossible, as the Wrights were when they were building a heavier-than-air machine to navigate the air above the clouds. The present-day dreams are of the navigation not only of air but of space, by the application of methods new to flight, including the reaction principle and the utilization of liquid air, one of the most condensed forms of mechanical energy known. The possibility of a fuel-less motor even seems to be coming up over the horizon.

LIQUID AIR FOR PLANE PROPULSION

CURIOUSLY enough, the very first engine that we know to have been constructed, Hero's engine, used the reaction principle. Most of us have in our childhood seen this applied, if we owned one of the toy tin boats intended for sailing in bathtubs and fitted with an alcohol lamp and boiler, a jet of steam furnishing the force that pushes it along. A jet of air has been used of late years by two French engineers, Papin and Rouilly, to revolve the blade of their revolutionary type of helicopter, by forcing an air blast from the rear edge of its propeller blade. This naturally suggests the possibility of driving a machine through the air by the expansion of a gas through specially designed nozzles that would give the maximum thrust. One of the most concentrated forms of mechanical power may be obtained from the expansion of liquid air. This is expensive, and its efficiency is not yet satisfactorily proved if we consider propulsion alone, but if in addition to the propulsive effect of this rapid exhaust and expansion of the liquid air, these specially constructed nozzles are directed over the upper surface of an aerofoil—or airplane wing—this tends to create an upward lift. This upward lift is easily demonstrated by a familiar experiment with a piece of paper five inches long and two inches wide, creased across at about a third of its length, the short end curved as in the drawing.

Augustus Post, the author of this article, is a pioneer aviator and aeronautic expert. Mr. Post has been active in aviation circles from the days of Wright's Ft. Meyer flights. As early as 1910 he flew in various meets. As an aid to Alan R. Hawley, the winner of the Gordon-Bennett Balloon Race in 1910, he was lost in Labrador wilderness for ten days. He also drew up the rules for the Raymond Orteig prize won by Charles Lindbergh.

Blow above the upper surface of the flat section and the curved section will move up and against the stream of air, demonstrating how the air flowing over the upper surface of an airplane lifts the wing. Liquid air in process of expansion by heat through the properly constructed nozzles over the surface of the airplane wing would in like manner tend to lift it as well as to drive it forward.

HOW LIQUID AIR PROPELLED MOTOR CAR

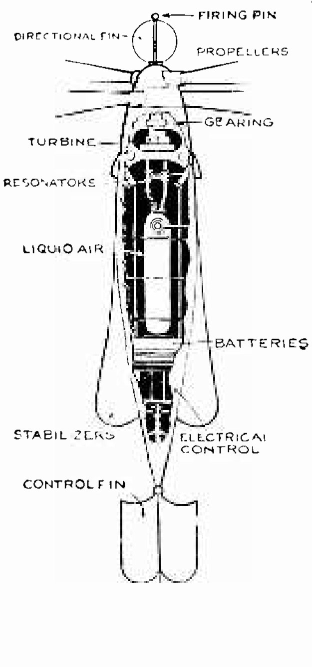
I HAVE ridden in a steam automobile in which liquid air was used to take the place of steam; it could be used anywhere that compressed air is used for propulsion. It was used with phenomenal success by Dr. Sidney Morton Baruch in driving a liquid air turbine directly connected to the propeller of his aerial torpedo.

One of the advantages of liquid air for aerial flight, and one that at once impresses anyone interested in the long-distance flights of the future, is that it is not necessary to take into the air any machinery for the purpose of generating power, for this generating has all been done on the ground in the process of liquefying, and in a small amount of liquid air we have stored up an immense driving force. This makes it specially well adapted to "unmanned" planes and aerial torpedoes, and in general in instances when imperative necessity makes cost of no importance.

The air travel of the future, whatever fuel may be used, will probably be carried on not only at the altitudes at present commercially available—which have already added 16 miles to the diameter of the earth, by giving mankind command of 8 miles upward on either side—but at heights far greater than are at present deemed practicable. This is bound to be the case with long flights. The resistance of the air at great altitudes being so much less, much higher speeds would be possible. The "superterranean express" with its enclosed cabin holding apparatus for oxygen-feeding of passengers and the maintenance of normal air-pressure, keeping up a speed of 500 miles an hour, may be here in a comparatively short time, if it but follows along the line of present conservative development. Maj. Gen. J. H. McBrien, President of the Aerial League of Canada, and a former officer of the Royal Air Force, goes even further, predicting a speed of a thousand miles an hour at a period not far distant. Our War Department is experimenting with an airplane to operate at a height of fifty thousand feet, fitted with liquid oxygen flasks and lined with plywood and quilted felt corduroy, to keep out the terrific cold. The airplanes of yesterday were rowboats hugging the shore of the ocean of air; we are bringing into being the Leviathans of the "high" seas of the sky, and it is on these high seas that the future of aviation lies.

ROCKET AIRSHIPS

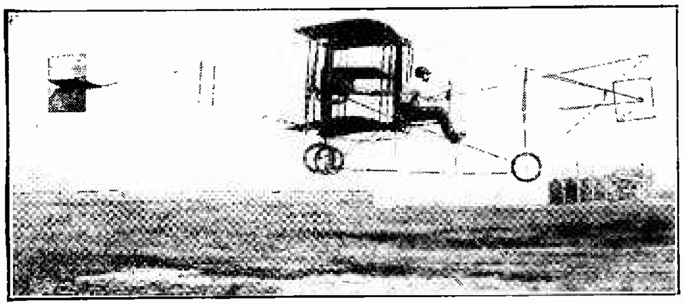
MAX VALIER, a German astronomer and aeronaut, has been attracting much attention not only at home but abroad, by his statements that we need not be restricted, through our use of the present-day type of flying-machine, to heights of eight or nine miles now possible for flying, but may operate at a hundred miles up, or even more. His ideas are in line with the researches in various countries of Profs. Ziolkowsky, Goddard, Oberth, and von Hoefft, who with other experimenters have brought the idea of "projection into space," appreciably nearer to possibility. As evidence of the resulting change of mind on the part of the public, the editor of as conservative a periodical as the English magazine *Discovery* recently featured a description by Herr N. Valier of his "space-plane," saying editorially, "We have printed this author's views, not because his proposition should be judged as practical politics of the moment, but rather as opening up possibilities in a field which has as yet been the subject of a little serious research."



Here is the aerial torpedo designed by S. M. Baruch, employing liquid air for propulsion.

A rocket-ship such as Herr Valier plans, would start at an angle of at least 80 degrees, reaching as soon as possible the thin-air stratum. After 17 seconds the ship is calculated to reach a speed of 400 meters per second at 3,000 meters high; after 35 seconds, at 20,000 meters high, a speed of 800 meters; after 45 seconds at 50,000 meters high and seventy kilometers horizontal distance from the starting-point, the horizontal speed would be 2,000 meters per second. At this rate it would take an hour and a half to go from Berlin to New York.*

Herr Valier answers the objection that his proposed machine could not move through empty space because this has no resistance for power development, by explaining that just as in traveling through the atmosphere the rocket does not rely on the support of air, but moves by its own internal energy through it, so his "space ship" would move forward by means of the expulsion through nozzles as exhaust, of the gas molecules developed by the explosion of the propellant fuel, whereby a continuous recoil would exist to drive the ship onward.



This photo shows Mr. Post piloting one of the first airplanes. Compare this with modern constructions.

The imagination of writers and artists has always played with the idea of interstellar communication. But it is something really new for the imagination of inventors and engineers to take it into sober consideration, and to make calculations based upon exact data. Herr Valier says:—

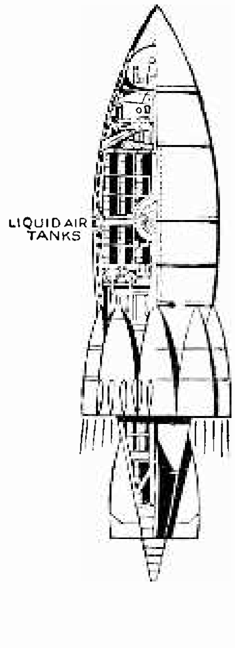
"Whether we are able to build rockets of such colossal power that they will be able to force a passage to a point beyond the field of gravity of the earth and other planets, is another question. Today we know the exact formula from which to calculate theoretically the necessary recoil and we know the "ideal terminal velocity" including the overcoming of the air-resistance, of 12,700 meters per second. The real recoil of the rocket is furnished in the product of the forced-out gas-mass per second and its exhaust speed. If the ship itself permits an ideal terminal velocity which is equal to the speed of the exhaust gas, then 63.2% of the total weight of the starting machine must consist of fuel: if double or treble the exhaust speed is to be attained, then must 86.5% or 95.2% respectively of the total weight be fuel, and there remains only from 13.5% to 5% for the actual weight of machine, including cargo.

"Therein lies the greatest difficulty of the whole problem with the present flying-machines: the liquid fuel carried is at most 35%, the tare weight is about 40%, crew 5 to 10%, so 15 to 20% remains for cargo. If one takes a comparatively cheap fuel such as powder, the results are far too small for high exhaust speed (highest 2500 meters per second) and hence insupportable conditions as between fuel, cargo, and tare weight of machine. On the other hand, a very high exhaust speed (4000 to 5000 meters per second) can be obtained from explosions of hydrogen with oxygen and of similar fluid propellants of high kinetic power. These, however, are too expensive, and too heavy, while much regarding their combustion remains to be investigated. *In fuel lies the greatest practical difficulty, even when the problem is successfully explained theoretically in other directions.*"

It is his belief that only a machine in which the method of working is quite independent of the surrounding air can open the path to the celestial spaces, and then only when it can develop sufficient power and carry fuel in great enough quantity. He thinks that the only method likely to be successful is the rocket system. It is his intention to advance along this path of development by way of the present airplane to the eventual "space-ship," working on the construction of a normal pursuit plane into whose wings will be fitted auxiliary rocket apparatus, thus making it possible to study, *during flight*, the workings of the rocket as a motive power.

It is of course to be understood that if the "space-ship" does really succeed in navigating at these immense heights above the earth's surface, there will be no putting one's head out of the window. At 25 miles up, daylight is faint; the sun is a ball of fire, but the light is not diffused, as there are no dust motes in the air—I have myself experienced an approach to this condition in a balloon flight to an altitude of 24,200 feet, and in an airplane at an altitude of 22,000 feet. Climbing to 50 miles above the earth, the ship would find no more air than would be found under the receiver of the best air-pump; and darkness is practically complete. At a hundred miles, according to Willis Moore in "The New Air World," the temperature is probably 459 degrees Fahrenheit below zero. Conditions for making human life possible must of course be maintained inside the cabin. Man must take his world along with him if he goes beyond the air, just as, under exactly opposite conditions, he manages to take it with him when he goes in a submarine below the sea.

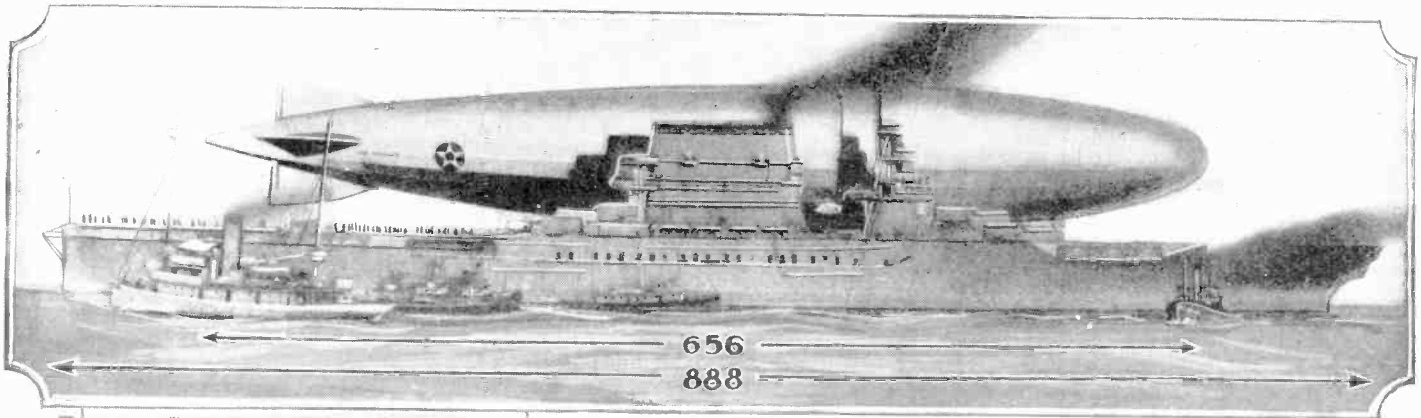
Captain Thomas Scott Baldwin, our famous pioneer of dirigible navigation and construction, who, before he was the world's champion parachute jumper, began his career as an acrobat with Ringling's Circus, told me that the artists who drew the bill-posters displaying men turning somersaults over the backs of elephants always added a few elephants to those over which the men were at the time able to jump, and threw in a few extra somersaults for good measure. But so great is the propulsive power of an ideal that once the picture was drawn, the acrobats set themselves to equal it, and so the fiction became fact. Something like this continually comes to pass in the world of science, and its most picturesque illustration is nowadays in the field of aviation engineering.



Here is a view of a different style of rocket from that opposite. This is intended for interplanetary communication. The time will come when we will be able to send men to our sister planets in space.

* One kilometer is .621 miles.

¶ One meter is 3.28 feet.

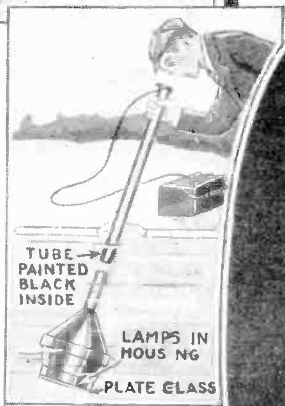


LOS ANGELES LANDS ON SARATOGA'S DECK.—The above photograph shows the giant dirigible "Los Angeles" successfully landed on the deck of the airplane carrier "Saratoga," in the first test of its kind. The photo on the following page shows the ship being hauled down to its place on deck. Figures show relative sizes in feet.

Scientific

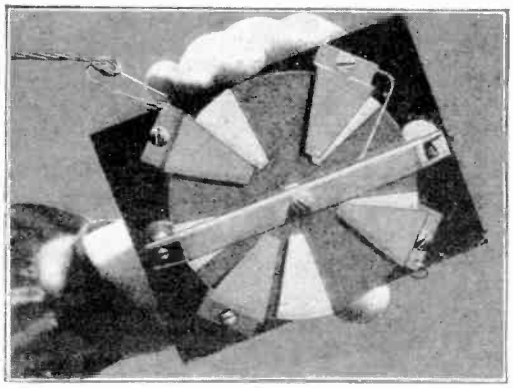
A Photographic Picturization of Modern Scientific Advances

It is almost impossible to keep up with the rapid strides taken in the field of science. This is truly a scientific age. On these pages we can portray but a few of the advances made in many different fields.

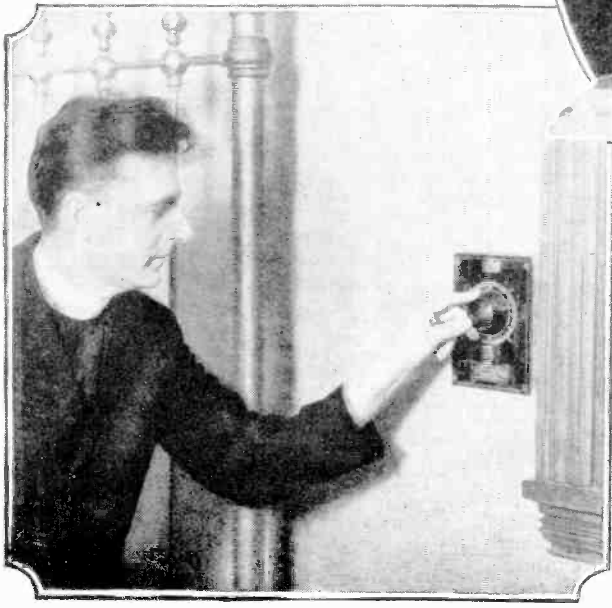


SUBMARINE LIGHT FOR SEARCHING LAKE BOTTOM—In the search for a missing college student, Gilbert C. Weis, of Indianapolis, brought into use the submersible searchlight indicated in the photo above. This is simply a long tube, darkened on the inside with a bell-shaped housing at the bottom, in which four lamps are placed. The device is operated by two storage batteries. The diagram at the right shows the way in which it is used. It is an improvement over the old style of water telescope, which consisted of a long tube with a piece of plate glass at the bottom. This device can be better used at night than in the daytime.

NEW BATH TUB AID—Depending upon how many tanks there are, a device invented by F. J. Cantrel of San Francisco, Calif., will deliver soap suds, fresh water, toilet water, salt water, or what you will. Photo shows three streams in use at same time.

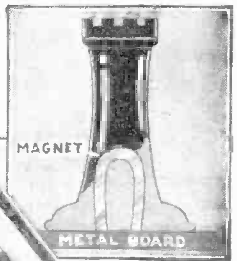


MOTOR OPERATED BY STATIC—Of course, we know that static may ruin a perfectly good radio program in the summertime, but here is a device that will not work unless there is plenty of static present. It is a static motor, and operates from power obtained from the air. The motor is connected in series with the antenna and the ground. This device was built by C. Francis Jenkins, of Washington, D. C. Copyright Harris and Ewing.

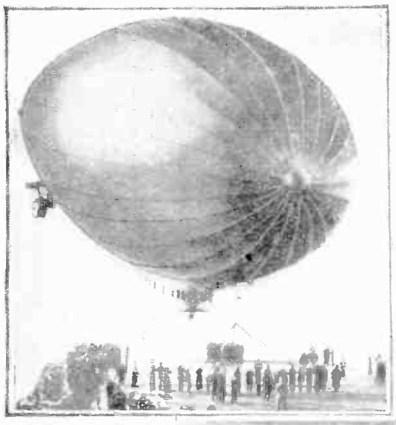


NEW WAKING ALARM—This device was invented by Father Daniel Driscoll of Villanova College, Pa. It is noiseless, but when once set, will operate for fifteen minutes and then stop.

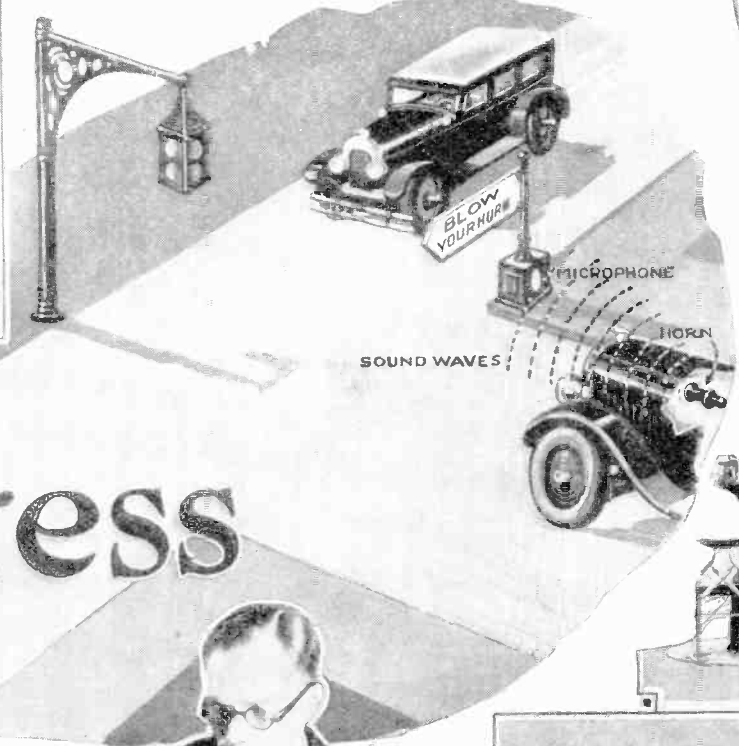
MAGNETIC CHESS BOARD—The playing pieces of this chess board are magnetized so as to hold the set to the metal board, regardless of the position of the board.

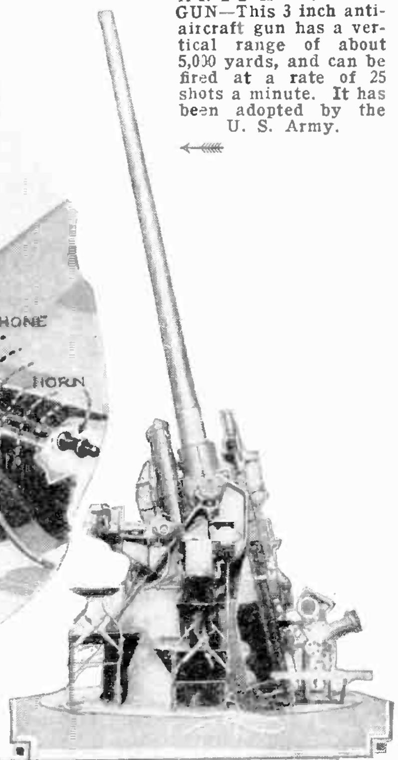


The diagram above indicates how the chess pieces of the magnetic chess board are made. The magnet comes in direct contact with the metal board.

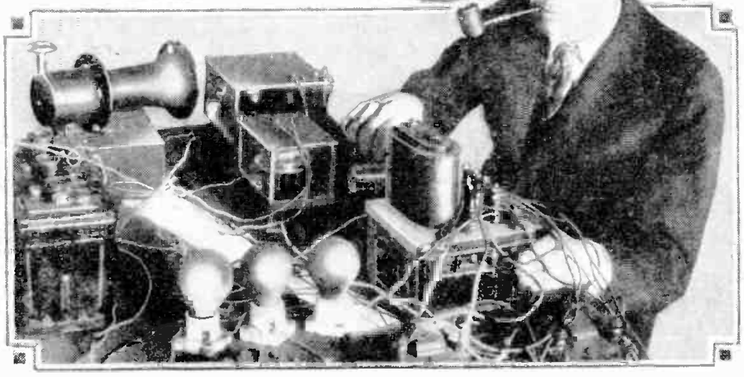


Progress



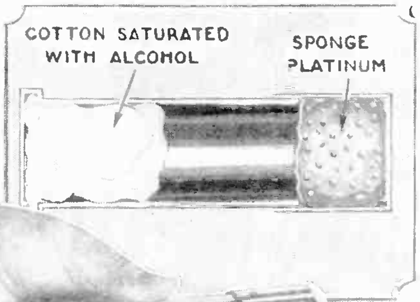


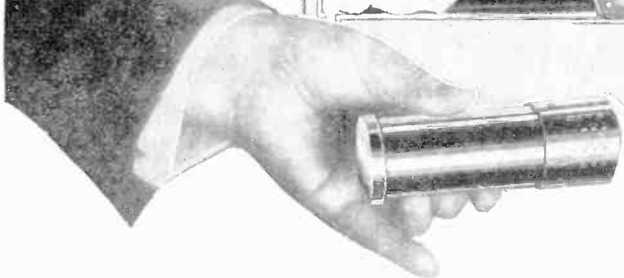
ANTI-AIRCRAFT GUN—This 3 inch anti-aircraft gun has a vertical range of about 5,000 yards, and can be fired at a rate of 25 shots a minute. It has been adopted by the U. S. Army.



AUTO HORN OPERATES TRAFFIC SIGNALS—The above photograph shows Charles Adler consulting safety engineer with his device which may speed up traffic considerably. An autoist desirous of crossing a main thoroughfare from a side street, draws up to the curb and sounds his horn. These sounds are picked up by a transmitter and then sent through other apparatus, turning on the red light on the main highway and giving the motorist ten seconds to proceed, after which the light switches back again. Picture diagram shows operation.

It is claimed that with the device indicated and demonstrated by Dr. I. S. Falk and Ruth Bilger, that the killing power of diphtheria bacteria can be electrically determined.





POCKET OVEN—The photograph above and the diagram insert show the invention of Dr. Kalischer. This is a small pocket oven. The fumes from an alcohol saturated wick are absorbed by sponge platinum which incandesces to such an extent that it warms the container. It can operate for twelve hours.

INSECTS GASSED BENEATH CANVAS HOODS—In the Los Angeles region, insects and lava as well as the eggs of insects, are killed by covering the tree with a canvas hood, then pumping a cyanide solution under the tree with a special pump. After this, the cover is removed. Photo Ewing Galloway.

Springtime Garden Suggestions.

A Number of Timely Aids for the Back Yard Enthusiast

Above—Watering a withered plant with the aspirin solution.

ON this page we have illustrated a number of practical springtime garden hints, which we believe will be of interest to many. The devices or processes which have to be employed are of a simple nature and their use should result in better gardening.

A photograph showing the garden spray in use appears above. Note that the spray nozzle has been fastened to a piece of pipe as an added convenience.

RESTORING DROOPING PLANTS

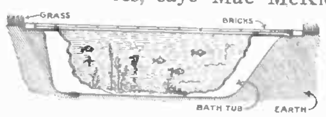
MANY plants thrive well enough out of doors, but when potted and brought into the house have a tendency to droop and if nothing is done, eventually die. Badly withered plants can be revived and brought to normal by using a weak solution of aspirin, or acetylsalicylic acid as it is known chemically. It is readily soluble in 100 parts of water. Two tablets should be dissolved in each pint of water used. If the solution is slightly warm, the reviving action will be hastened considerably. The whole plant should be drenched with the liquid as shown in the photograph. The aspirin mixture can also be used with surprising results in restoring plants which have become frost nipped, but here, the solution used should be cold, states S. Leonard Bastin.

MAKING A TREE SPRAYER

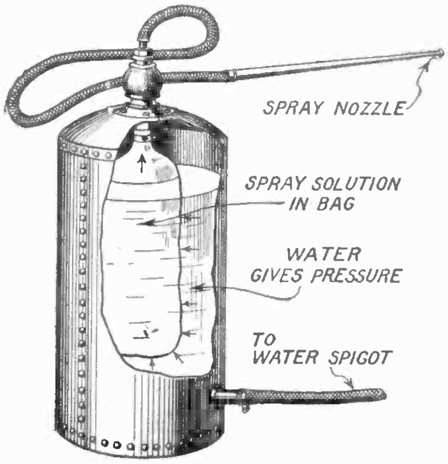
A TREE SPRAYER which anyone can easily make at home is shown upon this page. It will save the exertion of the usual hand-pumping operation and the expense of a large motor-driven machine. The spray is operated by water pressure. A metal drum

The above photo shows the plant ten minutes after the aspirin solution was applied.

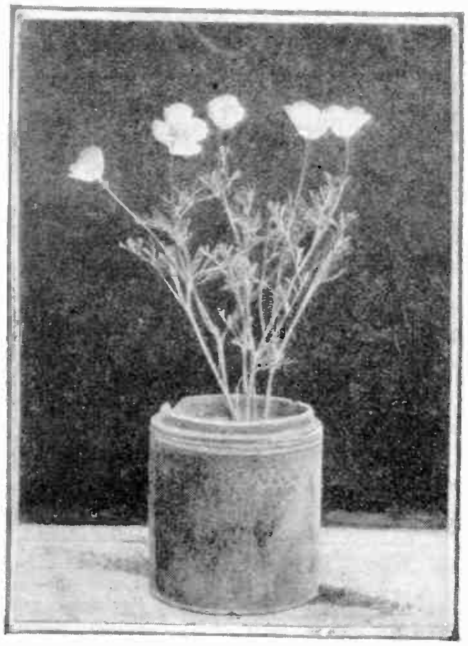
holding about 8 gallons is fitted with a water-proof bag which contains the spray solution. A connection is made with a hose from the water hydrant to the cask or drum, thus using the water pressure to force the spray from the bag. A length of hose fitted with a spray nozzle is fastened to the top end of the bag. The particular sprayer described here, was made to supply a small orchard of 15 trees, says Mae McKie.



The method of making a goldfish basin from a discarded bathtub is clearly shown above.



Details of the home-made garden spray are shown in the above illustration.



A photograph of the plant taken 25 minutes after aspirin was applied, shows that it was completely revived.

A GARDEN GOLDFISH BASIN

DAMAGED or discarded bathtubs make excellent basins for goldfish and the like when sunk into the ground of a garden, as shown in the illustration. Any holes in the tub should be plugged thoroughly before filling with water. Cover rim with bricks.—P. C. Van Petegem.

Above we have a photograph of the novel water bouquet described in the text.

A WATER BOUQUET

A VERY pretty way of arranging flowers is in the form of a water bouquet. For this purpose a glass shade of some kind is required and a dish on which this can be placed. Some soft adhesive medium like clay or putty, will now be needed. Put a lump of this into the center of the dish and then insert the stalks of the flowers which are to be used in forming the bouquet. Almost any kind of flowers will do for the

(Continued on page 71)

Advances in Travel

Cameraman Snaps Interesting Views of Various Means of Locomotion

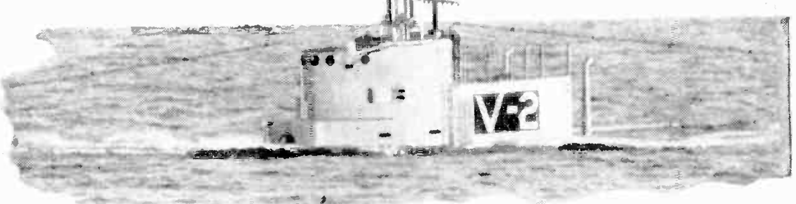
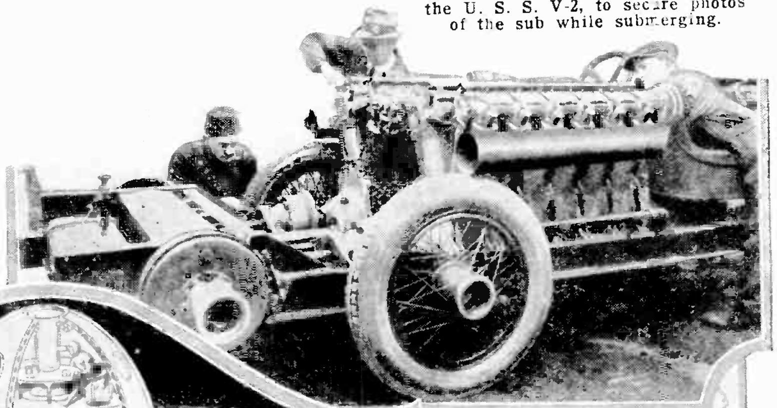
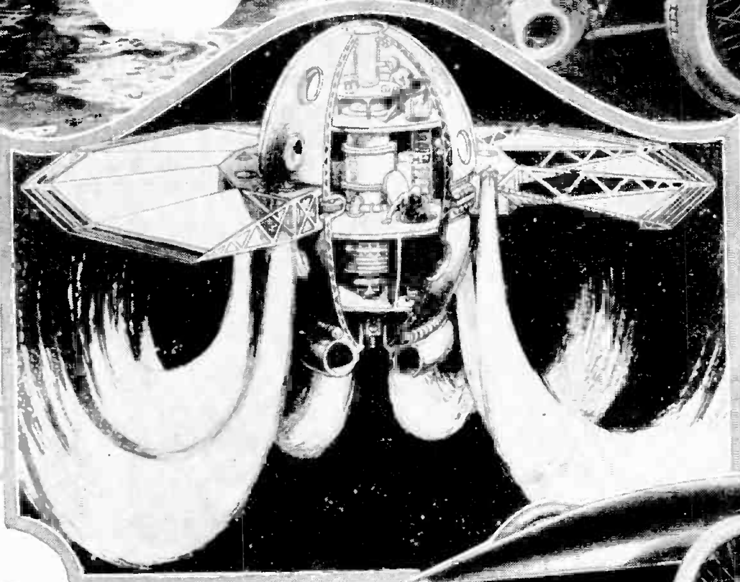


Photo shows news-reel cameraman lashed to one of the periscopes of the U. S. S. V-2, to secure photos of the sub while submerging.



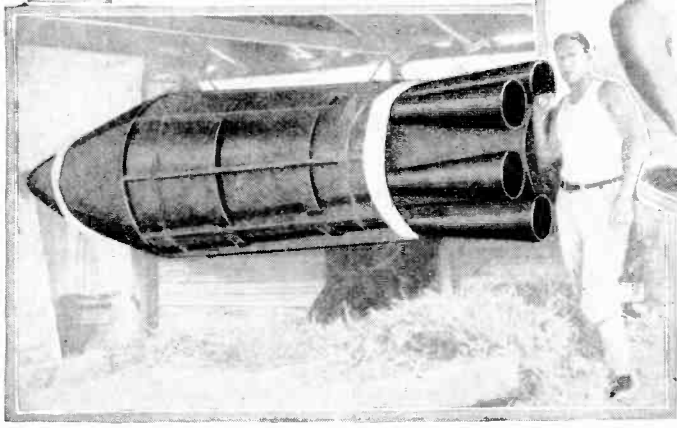


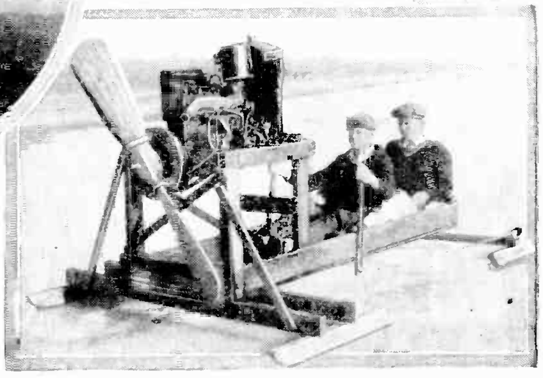
This boat is supposed to roll along on the water. It was built by E. R. Thomas, of Buffalo. Two galvanized iron drums can turn freely on their support. Power is supplied by an outboard motor, located in the center.

Zoom!—225 miles per hour (unofficial) made by Triplex, three-motored auto shown above. The 3,000 H.P. is geared directly to rear axle.

Here is the Bluebird, Captain Campbell's speed devil, which was entered in the International speed trials. Note airplane tail design to prevent swerving at high speeds. Also observe streamlines. This machine made 206.956 miles per hour.

Contrast the automobile shown above, called the Tea-Kettle, Frank H. Mariott's Stanley steamer, which was the fastest thing on wheels in 1906. It made a mile in 28 1/5th seconds on the Daytona Beach. Observe the auto advances made in twenty years.





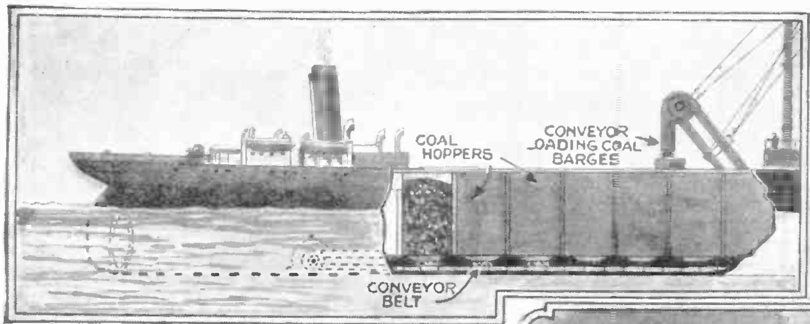
The photograph above shows the torpedo designed by Prof. Robert Condit, in which he expects to take off toward the planet Venus. Explosions drive the mechanism through the air like a rocket. Insert shows the professor in the machine.

Another proposed interplanetary mechanism is that peculiar contraption with the long white tails in the center of this page. It is to obtain electrical energy from the sun's rays, the platform wing arrangement producing the lifting power. It was designed by Ulinski and is said to be under construction.

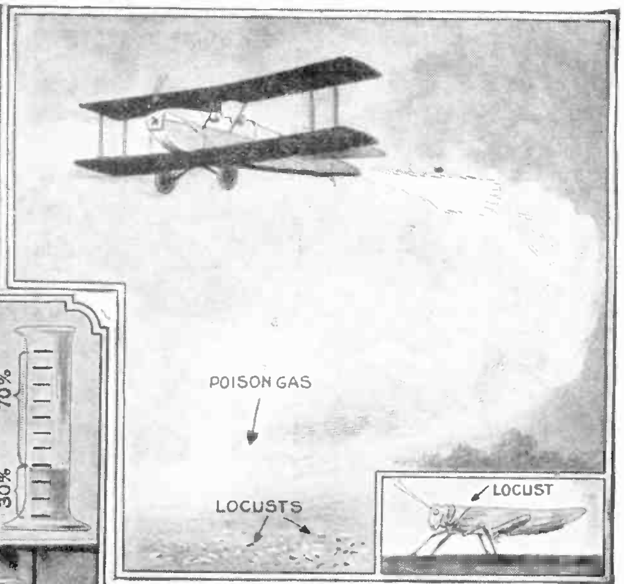
Here is an ice boat made by two youngsters, Ronald Ringsrud and Leonard Murphy, of Elk Point, S. D. Some two-by-fours and a propeller made of spruce, together with an auto engine, produced a speed of 35 miles an hour.

The Month's Scientific News Illustrated

By GEORGE WALL

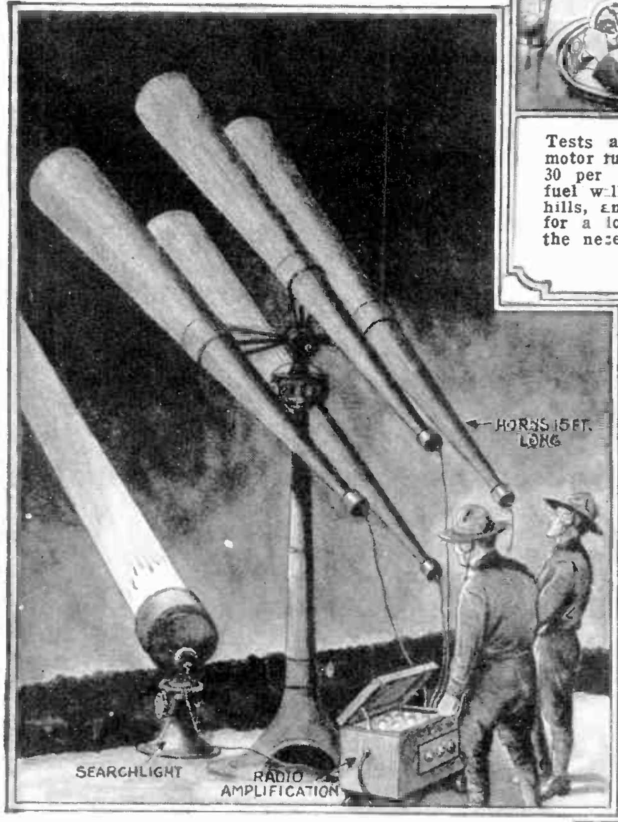


A new self-discharging collier has recently been put in service by a Montreal concern. Features of the boat's design are conveyor belts situated below 40 hoppers holding the cargo, which carry the coal over a boom extending 75 feet out from the vessel's side when discharging. When the boom is not in use, it can be lowered between the hatches and lashed in place. The ship is called the "Coalfax," and has a dead-weight capacity of 3,050 tons. She made a 20-day voyage from England, where she was built, to Montreal, Canada.

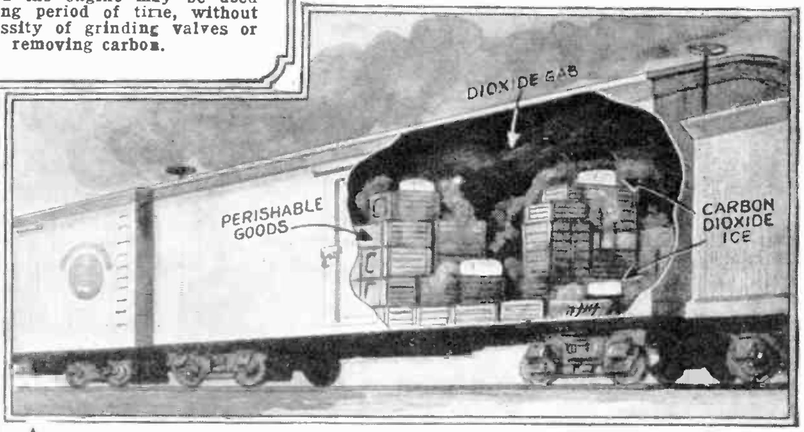


The Egyptian government is taking active measures to combat an invasion of locusts. The young locusts are now in the crawling stage, and efforts are being made to kill them before they reach the flying stage. The British air force is lending assistance in the campaign, and will use poisonous gas emitted from an airplane to destroy these pests.

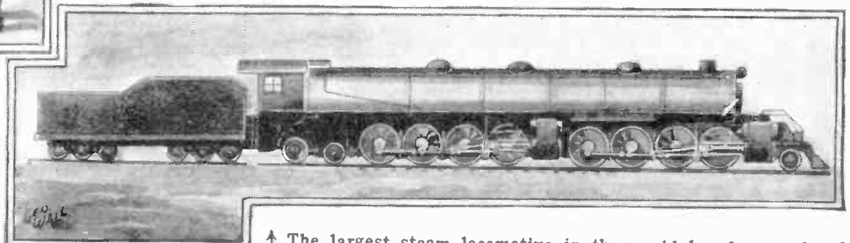
Tests are being made on a new motor fuel which contains from 20 to 30 per cent of alcohol. This new fuel will give great acceleration on hills, and the engine may be used for a long period of time, without the necessity of grinding valves or removing carbon.



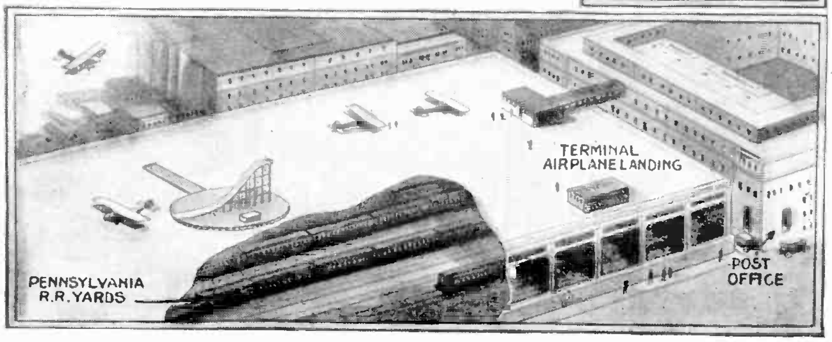
The U. S. Army has perfected a sound locator which picks up a plane 15 miles away. A 15-foot horn picks up the sound made by an airplane, which is further amplified by a bank of radio tubes. At night a searchlight is synchronized with the sound-locator. The horns work in pairs and these are attached to two observers. One for the horizontal, the other for the vertical movement.



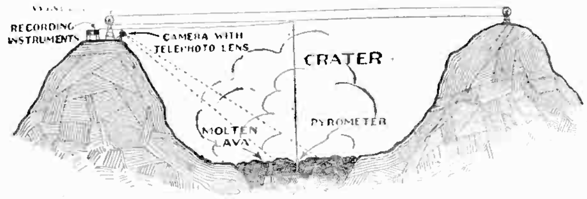
Ice cream and perishable foods are now sent from New York to Cuba and arrive in perfect condition. Solid carbon dioxide "ice" or "snow," so-called "dry ice," is used for the refrigerant. The reduction of this substance by evaporation is only about 10 per cent in 24 hours. The carbon dioxide gas given off, being heavier than air, forms a frigid insulating blanket and keeps warm air away. This new refrigerant is about fifteen times as efficient as water ice.



The largest steam locomotive in the world has been ordered by the Northern Pacific Railroad, for use between Mandan, North Dakota, and Glendive, Montana. The Northern Pacific engine will be 121 feet in length, over half as long as a city block. It will be carried by 22 wheels, 16 of them will be "drivers." The engine tender will hold 26 tons of coal and 20,000 gallons of water. The area of the grate will be approximately 183 square feet. The fire-box measures 266 inches x 114 inches. The tender is to be 33 feet long and about 16 feet high, at its front end.



Eight of America's largest railroads are considering plans for constructing airport landing decks above city terminals. The planes would be used in connection with rail transportation. Complete plans have been formulated for railroad terminal landings, at about twenty of the largest cities. Mr. F. Naulty, an aeronautical engineer, has been engaged to work out details of the construction. He is also the originator of the airport landing deck idea as outlined recently by Postmaster General New. It is considered that this method of airplane landing offers the best practical solution of the airport problem in congested communities.

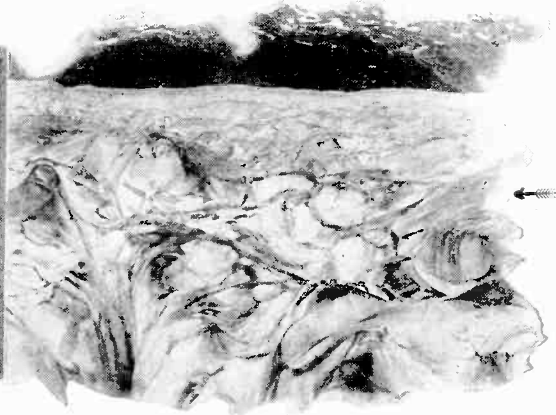


Above—Method of making pictures and recording temperature.

Wonders of Nature

Above photo shows an island in a lake of lava flowing from Kilauea, the Hawaiian volcano now in eruption.

Above is an exceptional night view of the lava fountain.



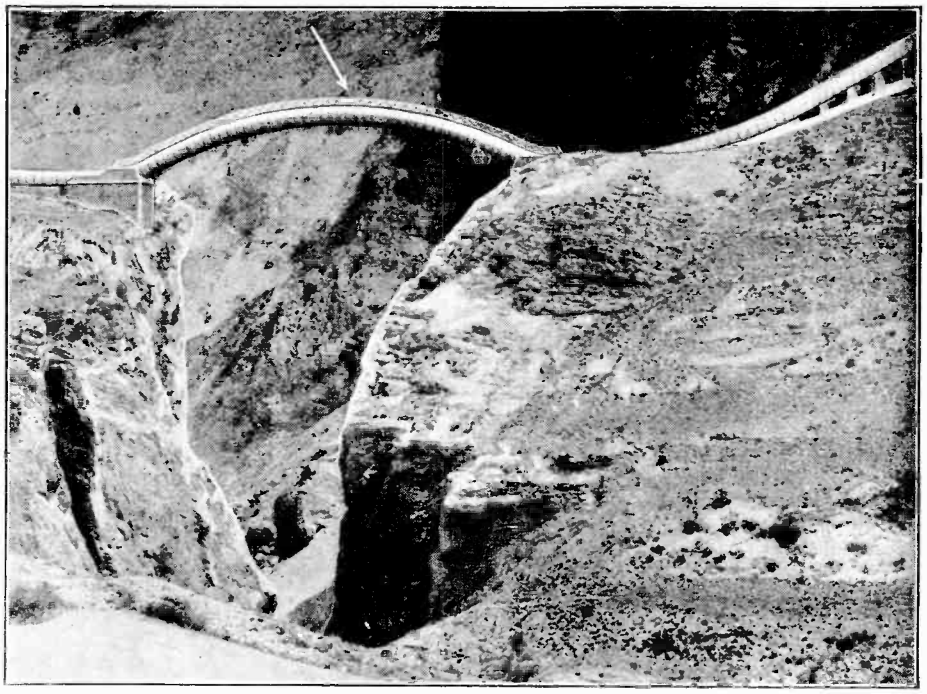
The above photo shows the Taku glacier in Alaska, first traversed by Rev. B. R. Hubbard and party.

THE world's largest volcano, known as Kilauea is situated in Hawaii and is now in eruption. By means of a telephoto lens it was possible to take the remarkable photographs shown here which give a view of the lake of lava and a night view of the spatter-phase of the lava fountain of the volcano. By means of this lens, Mr. Frank A. Perret, a famous volcanologist was able to take these pictures. The drawing at the top of the page shows the method of taking pictures, and how the temperature of the lava can be measured with a pyrometer suspended upon a cable stretched across the crater.

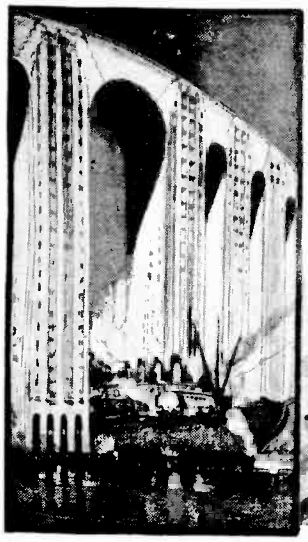
The photograph at the top of the page to the right, shows a view of the ice covered wilds of the unmapped glacier Taku, in Alaska. Rev. B. R. Hubbard, Prof. of Geology of the University of Santa Clara, California, accompanied by two companions recently crossed this unmapped waste of ice. For over 85 miles they pushed across ice and rock, every step of their journey fraught with dangers. The arrow on the glacier photograph points to Jack Koby, a young prospector, one of the exploring party, as he is seeking a way across the ice.

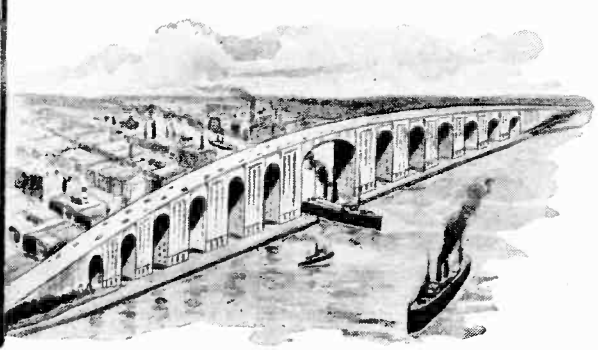
Below is an architect's drawing of a proposed skyscraper bridge, with a ship passing through the widest span. The huge structure may link Chicago's north and south lake shore drives. Charles Morgan, Chicago artist and architect, has submitted drawings for a mammoth bridge 150 feet wide using skyscrapers 25 stories high as piers. The structure, if built, will be several miles long and present the appearance of a row of skyscrapers connected by arches.

A Remarkable Aqueduct



The above photograph shows a great serpentine water conduit used in conjunction with a hydro-electric power plant in the French High Alps. The ruined walls of Vaudois may be seen at the bottom. The water supplies the hydraulic works of the city of Vaudois. Bridging a large gap in the mountains, the overhead water aqueduct is an achievement of modern engineering.





Mammoth Skyscraper Bridge

THE huge bridge shown at the left would alleviate traffic conditions in Chicago. Business men would find it convenient to have their offices in one of the skyscraper piers and keep his car in a garage built on the bridge. The center span of the bridge would be wide enough to stretch across the Chicago river and high enough for the tallest boats to pass under. It is suggested that the entire structure be coated with terra cotta, so that when viewed from the city or Lake Michigan, it would appear as a rainbow. Motorists passing through the city, would not find it necessary to thread through the heart of Chicago and the heaviest traffic, as they do at the present time.

Science Frauds Exposed

By K. M.

Above, Postal Inspector D. F. Angier is shown inspecting a number of fraudulent articles. The inspector is directly responsible for running down a large number of these frauds. It is Mr. Angier's job to collect evidence concerning the various articles and submit it to Horace J. Donnelly, the solicitor of the Post Office Department.

BARNUM knew the gullibility of the race, when he said, "There's a fool born every minute," and Barnum proved himself right to the extent of amassing one of the world's largest fortunes. As long as there is a civilization, though it be tenaciously materialistic, there will be credulous individuals who are ready to acknowledge miracles, even in the form of colored water and metal rings "guaranteed" to cure every ailment from adenoids to cancer. As a vaudeville comedian recently said, "In 1776 it was Bunker Hill; in 1928 its 'bunkem still.'"

Harking back to the old medicine road shows, we have the foundation of the "profession" on which the medicine faker has built his profitable business. But with the increased population and growth of cities, the tent show faded into the limbo relegated to the horse and carriage, and the mails became the medium of barter between the medical charlatan and his ever-trusting public. Once more fate has stepped in and hindered his progress, this time in the form of the United States Post Office Department and SCIENCE AND INVENTION Magazine, the latter organization conducting a private investigation in line with that under way in the Post Office Department.

WHAT CONSTITUTES A FAKER

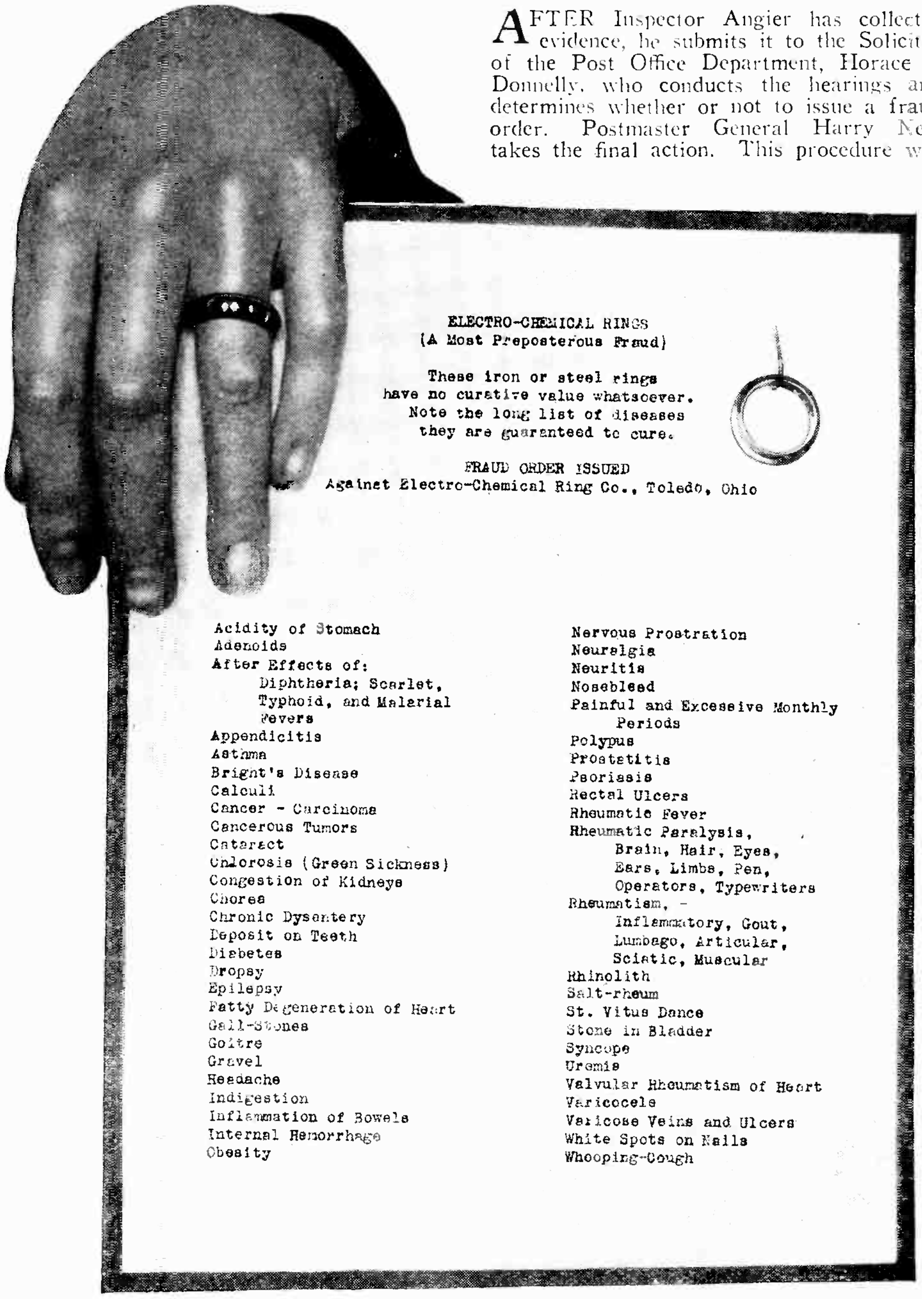
LAST year Uncle Sam refused the privileges of the mails to at least 50 of these medical fakers, whose business receipts amounted to over $5,000,000. When Postal Inspector D. F. Angier, of Chief Inspector Grant B. Miller's Office, undertakes to run these fakers to earth, he considers two problems: Are their remedies deliberate misrepresentations, do the makers know their remedies to be worthless; or are they ignorant, and think they have made a startling discovery? After he has decided the class in which to include the offender, he collects the necessary evidence, and the Bureau of Chemistry then steps in to analyze the wonder-working liquids that cure tuberculosis and cancer with ease—a feat which the medical science has failed to accomplish with drugs.

PENALTY FOR FRAUDULENT USE OF MAILS

WHILE the Post Office Department cannot be nursemaid to childish individuals who expect to find the fountain of youth in a box of pills, they protect the public to the extent of their power, specifically stating that: "The reliability of any person, firm or corporation is not passed on by the Department, and the Department is not a collection agency and does not undertake to effect the return of any money which may have been lost in unsatisfactory business transactions; but, the Post Office Department does seek to prevent the use of mails in all schemes to defraud, and the Postmaster General may, upon evidence satisfactory to him that any person or company is conducting a scheme for obtaining money through the mails by means of false or fraudulent pretenses, representations, and promises, direct that all mail for this person or company be stamped 'Fraudulent' and returned to the sender. The penalty for using the mails in schemes to defraud is, upon conviction, a fine up to $1,000 or imprisonment up to 5 years (one or both), and every letter mailed in pursuance of this scheme is considered a separate offence."

A FAKE PYORRHEA CURE

AFTER Inspector Angier has collected evidence, he submits it to the Solicitor of the Post Office Department, Horace J. Donnelly, who conducts the hearings and determines whether or not to issue a fraud order. Postmaster General Harry New takes the final action. This procedure was



ELECTRO-CHEMICAL RINGS
(A Most Preposterous Fraud)

These iron or steel rings have no curative value whatsoever. Note the long list of diseases they are guaranteed to cure.

FRAUD ORDER ISSUED
Against Electro-Chemical Ring Co., Toledo, Ohio

Acidity of Stomach
Adenoids
After Effects of:
Diphtheria; Scarlet, Typhoid, and Malarial Fevers
Appendicitis
Asthma
Bright's Disease
Calculi
Cancer - Carcinoma
Cancerous Tumors
Cataract
Chlorosis (Green Sickness)
Congestion of Kidneys
Chorea
Chronic Dysentery
Deposit on Teeth
Diabetes
Dropsy
Epilepsy
Fatty Degeneration of Heart
Gall-Stones
Goitre
Gravel
Headache
Indigestion
Inflammation of Bowels
Internal Hemorrhage
Obesity
Nervous Prostration
Neuralgia
Neuritis
Nosebleed
Painful and Excessive Monthly Periods
Polypus
Prostatitis
Psoriasis
Rectal Ulcers
Rheumatic Fever
Rheumatic Paralysis, Brain, Hair, Eyes, Ears, Limbs, Pen, Operators, Typewriters
Rheumatism, - Inflammatory, Gout, Lumbago, Articular, Sciatic, Muscular
Rhinolith
Salt-rheum
St. Vitus Dance
Stone in Bladder
Syncope
Uremia
Valvular Rheumatism of Heart
Varicocele
Varicose Veins and Ulcers
White Spots on Nails
Whooping-Cough

Above is a magic ring which has no curative properties whatsoever but was advertised to cure 62 ills of mankind from adenoids to cancer. The rings were made of iron or steel and worn upon the finger. They cost about ten cents to manufacture and were sold for $2.50.

by Uncle Sam

PAINTER

observed in the recent issuance of a fraud order against the makers of Amasol, a concentrated solution for use in the cure of pyorrhea. Consisting of common sheep dip, used to kill parasites, the sale of Amasol spread like wildfire, and in the year which this product was on the market, the maker realized $48,000 profit.

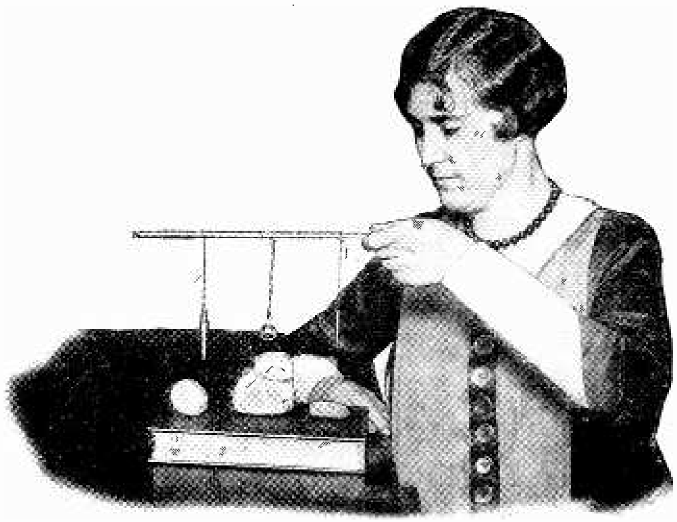
When Inspector Angier wrote for a bottle of Amasol, he said, "I have a bad case of pyorrhea, so bad, in fact, that I can remove my teeth from the gums and put them back. If your remedy will make my teeth adhere, send me a bottle C. O. D." In sending the remedy the company, in effect, agreed to "grow" teeth, thereby making themselves answerable to the Post Office Department's fraud order.

MANY TESTIMONIALS BONA FIDE BUT WORTHLESS

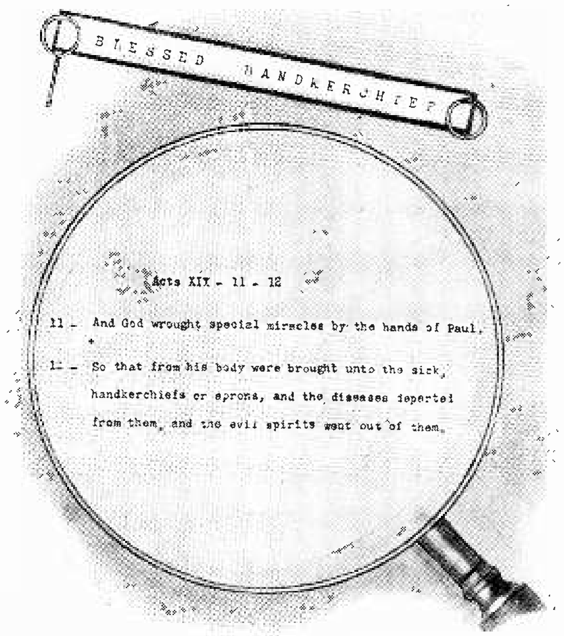
MANY cases of testimonial givers are bona fide, the sufferer hastening to report a cure as soon as he feels the effect of the laxative or tonic contained in practically all of these remedies. Undoubtedly he is the innocent ally of the medical faker. For instance, "Electro-Chemical Rings" were "guaranteed" to cure diseases caused by acid in the blood. By the aid of a testimonial signed by a "cured" minister of the gospel, this fraud was perpetrated to a financial success. The testimonial read: "From the use of your ring I was cured of rheumatism, neuralgia, indigestion, kidney and bladder troubles and heart trouble. I would not do without wearing it for $1,000, for life is all!"

HOW "ELECTRO-CHEMICAL" RINGS WERE TO BE USED

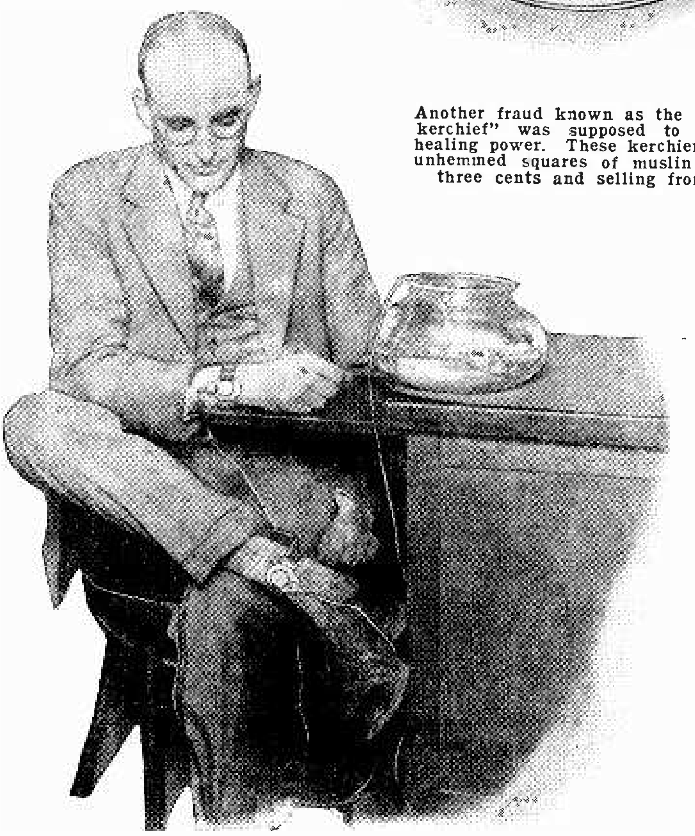
To ease the minds of those suspiciously inclined who might wonder at the tarnish caused by these rings which were made of iron or steel—having no curative value whatever—the directions stated: "The ring must be cleaned bright on the inside, at least once a day, when in use. If the deposit on the finger is strong, clean twice a day. Clean inside with a knife, scissors, emery-cloth, fine sandpaper, pulverized pumice-stone or coarse whetstone. Use a small piece of pumice stone, soap and water to clean finger, if deposit will not wash off." Utterly without conscience, the makers of "Electro-Chemical Rings" further advised: "In some cases the acid is so intense and the action of the ring so strong, as to cause a sore under the ring; this is an indication of the greater necessity for wearing the ring; wear it on some other finger or between the first and second joints of any finger on either hand until the finger usually worn on gets well." Manufacturing costs were about 10 cents, while the ring sold for $2.50.



Above are three different types of "sex indicators" which are supposed to indicate the sex, whether dog, peanut or egg.



Another fraud known as the "blessed handkerchief" was supposed to contain divine healing power. These kerchiefs were merely unhemmed squares of muslin costing about three cents and selling from $5 to $15.



At the left is a photograph of one of the clerks in the U. S. Post Office Department demonstrating the so called "Oxypathor" a "cure-all" which is made of nickle plated gas pipe, containing sand or other inert material, and flexible cords for fastening to the body of man or beast. The pipe is submerged in water, while the patient strapped two contacts to his body, one on the wrist and one on the ankle. The same concern also made an "Animal Oxypathor." The "Oxypathor" costs about $1.23 to make and retailed for $35 while the "Animal Oxypathor" sold for $50.00.

"OXYPATHOR" A WONDER INSTRUMENT

PERHAPS the greatest fraud of recent years was the "Oxypathor," specializing in the cure of cerebro-spinal meningitis, though also extensively advertised for the cure of milk fever, Texas fever, hog cholera, rheumatism, blood poison. Almost every country community in America had its "Oxypathor," and in addition, hundreds of thousands of these instruments were sold in India, Spain, Egypt, and Africa. The principle of this device was that water had magnetic properties of a curative value and when superficially absorbed by the body, water worked wonders. The "Oxypathor" (a piece of nickel-plated gas pipe filled with sand) need be submerged in water, while the patient strapped two "contacts" (strips of tape, with metal disks) to his body—one to the wrist, the other to the ankle.

Not content with working miracles on humans, this enterprising concern manufactured the "Animal Oxypathor," yet, strangely enough, no provision was made for keeping the animal to be treated in a fixed position, while the "Oxypathor" was working, and contacts were around the fore-legs and body of the animal. The "Oxypathor" cost about $1.23, and retailed for $35; while the "Animal Oxypathor" sold for $50.

FOURTEEN REMEDIES ALL MADE SAME WAY

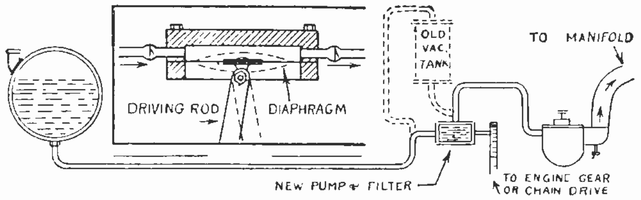
FOURTEEN different remedies, known generally as "Vegetable Compounds," netted $300,000 for their brewer. Curing anything from cancer to snakebite, the compounds were ordered according to the ailment—the number from 1 to 14 each representing a dire malady. However, the Bu-

(Continued on page 69)

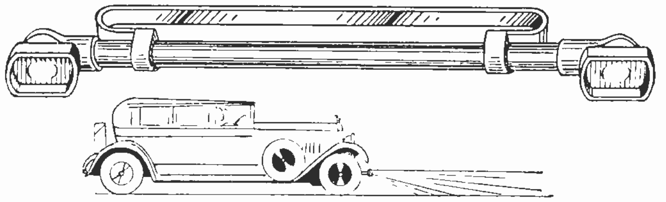
New Inventions Shown

Recent Refinements Provide Greater

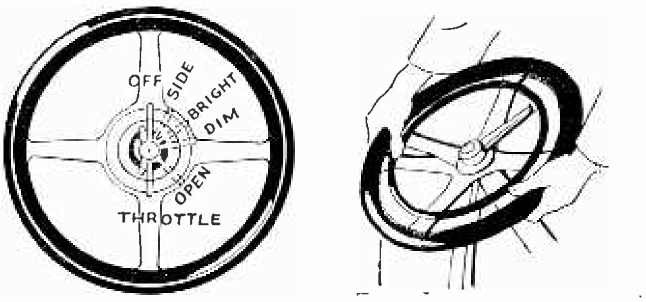
By H. W.



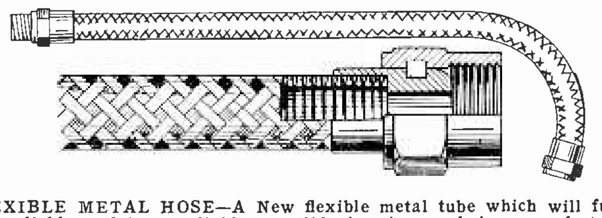
FUEL PUMP—A new system of feeding the gasoline to the engine, which has hitherto only been used on racing cars, is now being installed on many modern automobiles. The system is shown above and does away with the vacuum tank by making use of a small pump. This pump is cleverly constructed and has a flexible diaphragm for pumping. This maintains a constant flow of gas and is much more reliable than the old method of vacuum tank feeding.



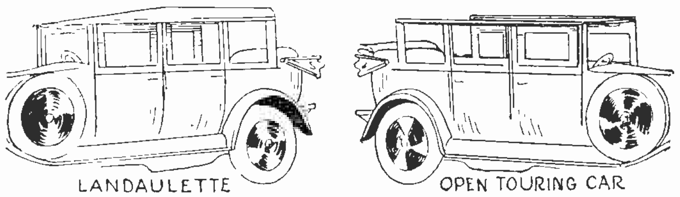
ILLUMINATED BUMPER—A new safety bumper for night driving has recently appeared. The road ahead is clearly illuminated by safety road lights placed on either side of the bumper, as shown above. These lights do not have to be dimmed as the beam shines directly ahead of the tires for more than 500 ft., but does not bother approaching drivers. Furthermore, it is never more than 20 inches off the road. The bumper ends, lenses and reflectors are practically indestructible.



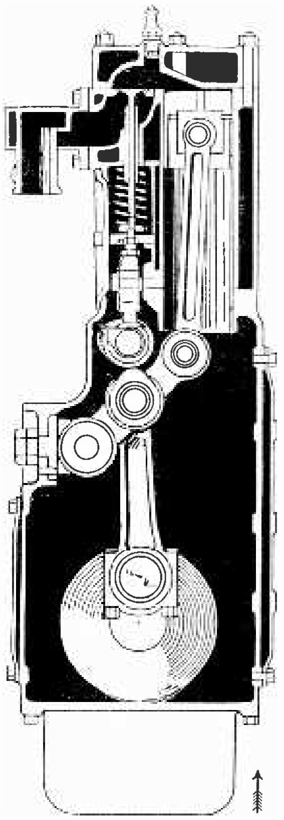
CONTROLS ON WHEEL—Two other novel features seen at the Show were a new steering wheel with a solid steel core having all controls, such as throttle and lights, mounted upon it directly. The other device was a signal ring which is attached to the wheel as shown, and a light pressure anywhere upon its upper rim closes the circuit operating the horn. The rim lies centrally on the wheel and may be installed in any car.

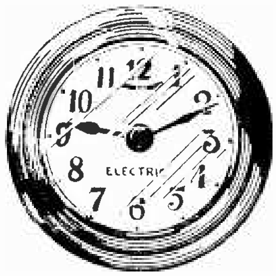


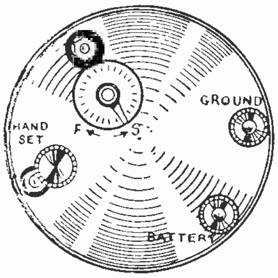
FLEXIBLE METAL HOSE—A New flexible metal tube which will function reliably and is as reliable as solid pipe, is now being manufactured and finds particular use in automobiles. The tubing is all metal and no packing is necessary in making a connection. As it is all metal it does not deteriorate as rubber will. A section of the tubing showing the metal braid construction and swivel coupling appears above.



CONVERTIBLE BODY—A progressive firm is now making a convertible car body which can be quickly changed by the driver from an open touring car to a landaulette, or vice versa. The transformation can be effected with ease. It is simply necessary to release two thumbscrews and to turn a handle. When the roof has been removed, the windows can be lowered, and the automobile is then transformed into a touring car.

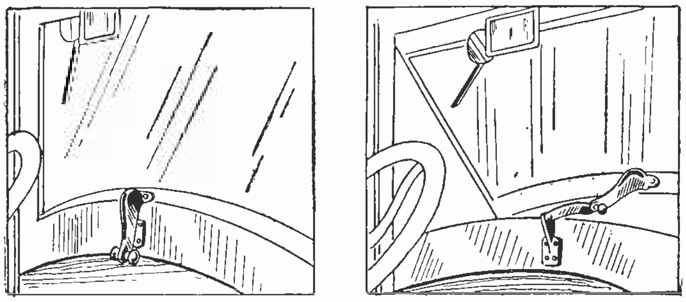




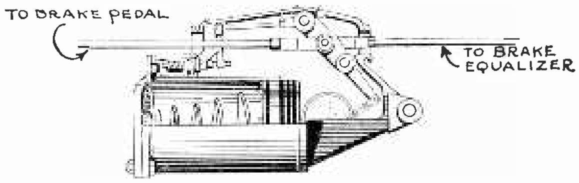


ELECTRIC CLOCK—The value of an automobile clock depends upon its reliability. The electric clock shown above gives the motorist the correct time always. The clock automatically winds itself and is connected to the car storage battery. A jeweled movement and rugged construction insure correct time. It requires no attention from the car owner, for it is wound automatically.

IMPROVED ENGINE—The very latest development in automotive power is shown above. This motor uses a lever which is interposed between the piston and the crank shaft. Superior acceleration, higher compression and a more complete burning of fuel, are a few of the advantages of this new engine.



ONE-HAND WINDSHIELD ADJUSTER—No longer does the motorist have to wildly clutch the steering wheel in one hand, while he frantically endeavors to open the windshield. Quite a number of accidents have been caused in just this manner, when the driver either lost control of the car, or failed to notice an approaching car. The small "one-hand" lever shown above permits the windshield to be opened easily. There are several notches which make it possible for the windshield to be locked at various angles.

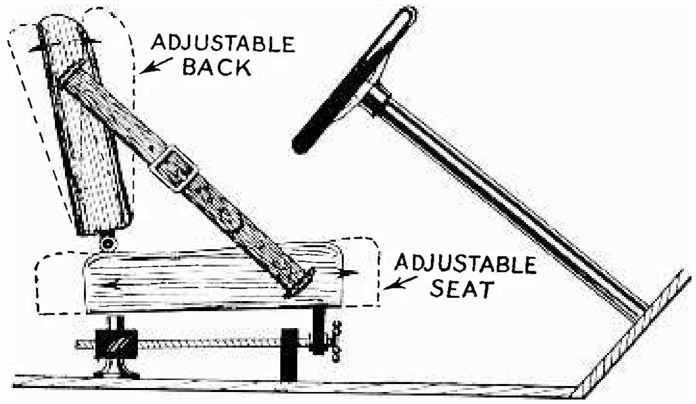


VACUUM BRAKES—A new margin of safety is now assured the automobile driver by the development of an automotive vacuum brake. The slightest touch of the toe on the brake pedal exerts a powerful pull on the brakes. It can be attached to any car and uses the vacuum created by the engine as its source of power. Pressure upon the brake pedal opens a valve in the brake unit, and the operating piston is moved, pulling on the brake rods with a force three times as great as that obtained without this unit.

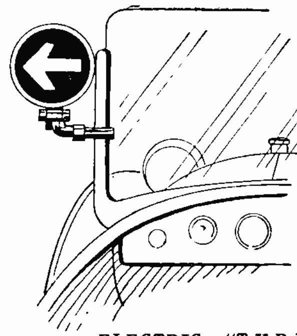
at New York Auto Show

Motor Car Satisfaction and Efficiency

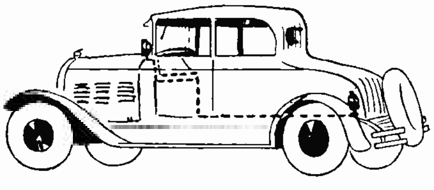
SECOR

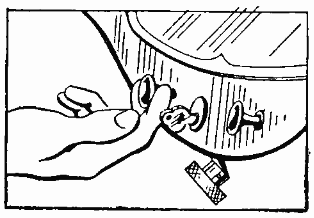


ADJUSTABLE SEAT—At the left is an adjustable seat which will be welcomed by the "long-legged" motorist. In size and shape it is much the same as the ordinary folding seat, but can be easily adjusted. A strap on each side may be tightened or loosened, raising or lowering the back. The distance from the seat to the wheel may also be adjusted by turning a small handle placed at the bottom of the seat, either to the right or to the left, even while occupied.

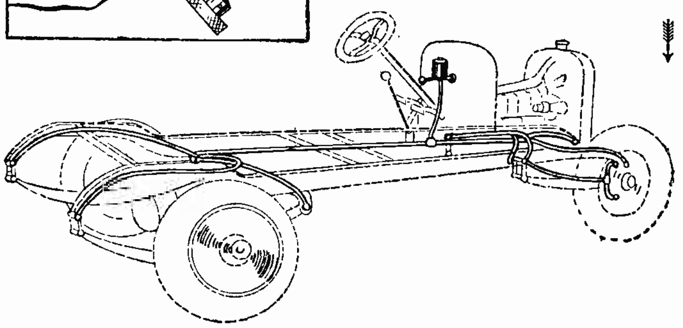


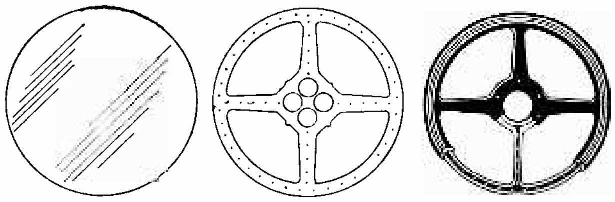
ELECTRIC "TURN" SIGNAL—Above is a view of a new traffic signal which clearly indicates to drivers behind and in front of the automobile when a right or left hand turn or a stop is about to be made. The signal is plainly visible 350 feet away, by night or by day. A rear indicator is also obtainable and is shown installed at the left.





STARTER BUTTON ON DASH—At the left is an illustration showing a view of the dashboard of some of the modern motor cars which instead of having the starter pedal on the floor of the car have the starter control on the dash. Below is a skeleton view of an automobile chassis showing the new "one-shot" system of lubrication.

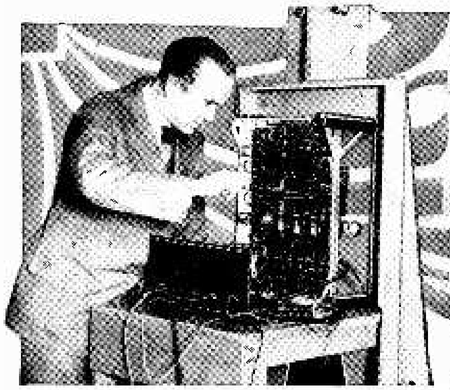


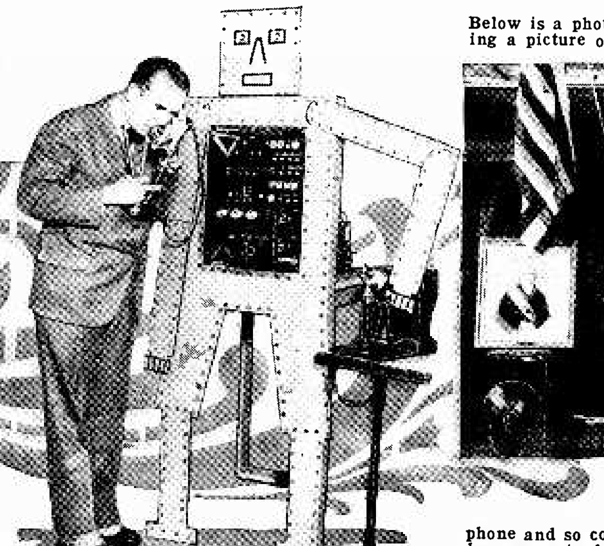


UNBREAKABLE STEERING WHEEL—The safety steering wheel has created quite a sensation in automobile circles. A sheet steel blank is punched out and perforated as shown below. The finished wheel is then covered with hard rubber. This new wheel can be bent, but does not break.

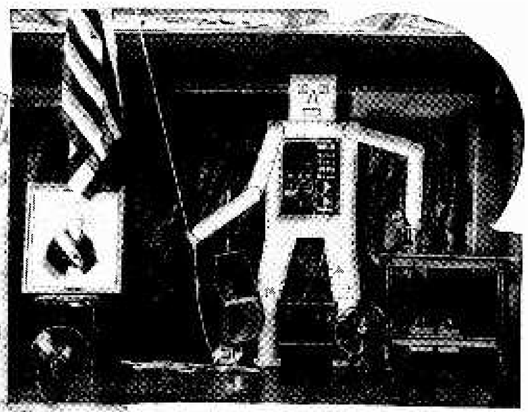
Electrical Servant Gives No Back-Sass

The photograph below shows Mr. R. J. Wensley making some critical adjustments on the coils of his mechanical servant, which performs various services in response to impulses received from its human master. Pitch pipes or electrically driven tuning forks are used for giving the various commands.





Below is a photograph of the mechanical servant unveiling a picture of George Washington, in New York City.



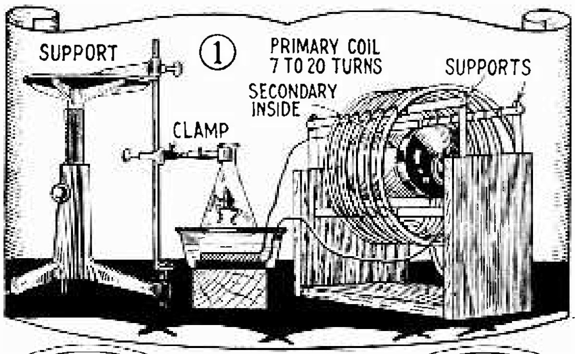
The center photograph shows the inventor with his electrical servant. Mr. Wensley is whistling into the telephone and so commands his mechanical man. The device has come to be known as the Televox, and was further described in the January issue of this magazine.

THE Televox, an electrical servant, which consists of a number of relays and tuned filters, will respond to various signals. This newest electrical handy man will do almost any kind of a job desired. The ordinary telephone can be used to control it from a distance. Sounds that come over the telephone are picked up from the receiver by a sensitive microphone and amplified. The signals may be produced by three pitch pipes, or three electrically driven tuning forks having a low, medium and high pitch. The device was originally devised for starting and stopping electric motors and generators in a sub-station, but will easily find many applications in our everyday life. The electric servant can be made to close the window, turn on the electric fan, turn off the lights, open the door, and a host of other things and all when directed over the telephone.

Marvels of the Ultra Sound Waves

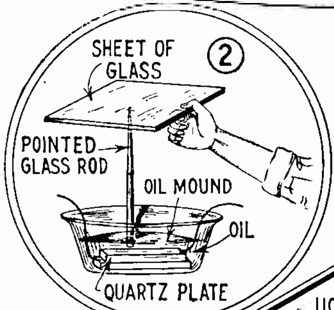
By RAYMOND B. WAILES

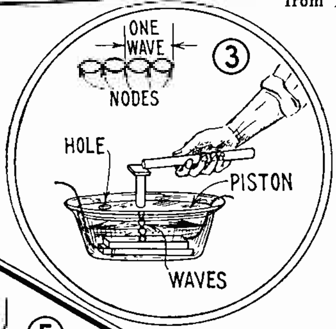
In the July issue of this magazine, we described some experiments which had been done with super sound waves, those high frequency vibrations which are inaudible to the human ear. In Fig. 1 we show a view of the apparatus used to produce these high frequency vibrations of 100,000 to 700,000 per second. As may be seen in Fig. 5, a quartz plate clamped between two sheets of metal is made to vibrate or oscillate at these high frequencies. The quartz plate is covered with a layer of oil which mounds up in the center when the plate oscillates. The oil which thus mounds up will support a weight of five ounces.



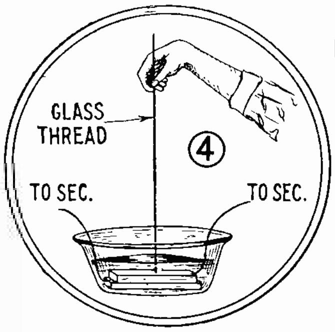
If a flat disc is pressed down on the oil mound, it descends with jerks and bumps, due to the fact that it encounters the loops and nodes of the wavelengths as shown in Fig. 3. The apparatus employed in the present work was developed in the Research Laboratory of the General Elec. Co., at Schenectaday. It consists of a 2 killowatt oscillator, a bank of oil condensers, a large variable air condenser and several pairs of coaxial coils for raising the voltage. Fig. 5 shows in conventional manner, the wiring of the various parts. The use of several coils and of different size quartz plates made it possible to obtain waves with frequencies ranging from 100,000 to 700,000 per second.

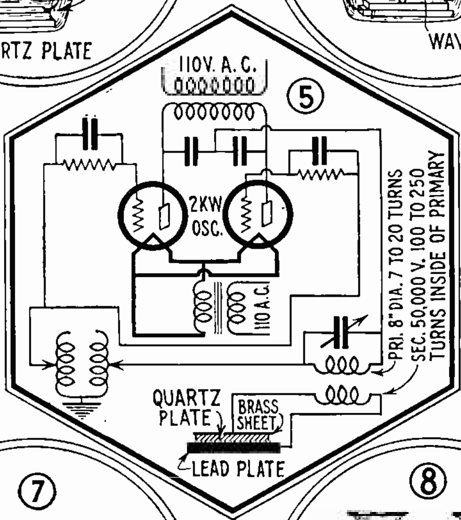
In Fig. 2 at the right, a pointed glass rod can be made to vibrate and drill a hole in a sheet of glass pressed against the point. The rod drills its way rapidly through the plate and the microscope shows fine globules of molten glass and finely powdered material. If the plate of glass is pressed lightly against the top of the rod, the surface is etched.





If a test tube is dusted on its inner surface with lycopodium powder, or is coated with molten sealing wax, and then pushed into the oil bath, a beautiful system of concentric circular rings will be formed, as shown in Fig. 6. Permanent rings suitable for wavelength measurements were made with a solid glass rod with sealing wax, brought into contact with the oil.





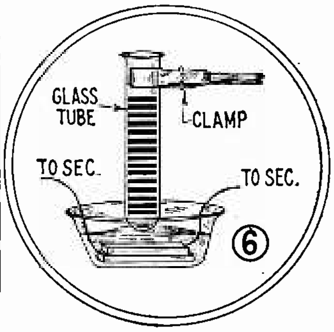
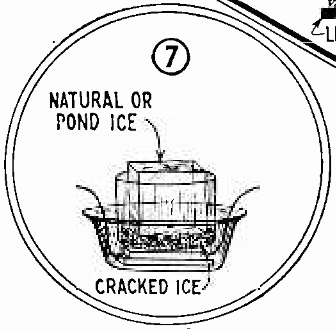
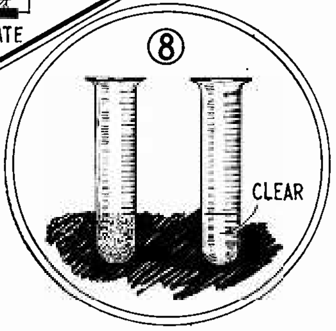
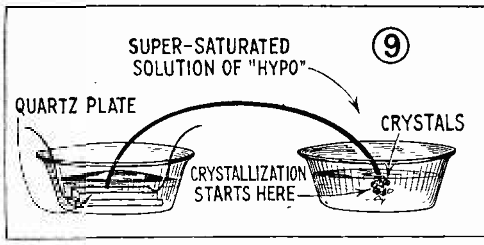


Fig. 4 shows another interesting experiment when a glass thread .008 inches in diameter and 39 in. long, held in the fingers produced a burning sensation, although the thread itself does not become heated. The heat, of course, is developed by friction between the vibrating thread and the skin of the fingers. This same heating effect is noticed when a rod, tube or beaker is held in the fingers and dipped into the vibrating oil bath.



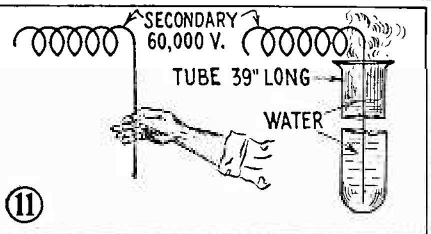


A good proof that natural ice is a single huge crystal is shown by the fact that it does not change when subjected to super sound waves. Artificial ice, however, becomes "snowy" and can be broken with the fingers. This experiment is shown to the left in Fig. 7. Fig. 8 shows how red corpuscles in a physiological salt solution are rapidly destroyed. The turbid liquid becomes as clear as a weak solution of red analine dye.

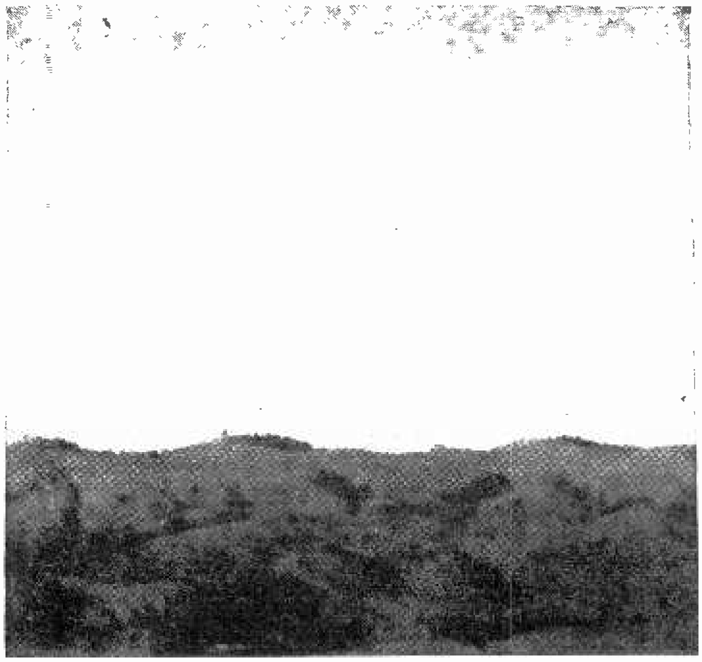


A glass thread placed with one end in a supersaturated solution, causes immediate crystalization.

Above is a top view of the oil mound.



One end of the secondary coil which supplies 60,000 volts, can be grasped in the hand.



The above photograph was taken with an ultra-violet light filter and the city of San Jose was invisible, as it was shrouded in a fog.

The photograph above was taken a few seconds afterward on the same day with an infra-red filter and the city can be plainly seen.

Lifting the Veil of Venus

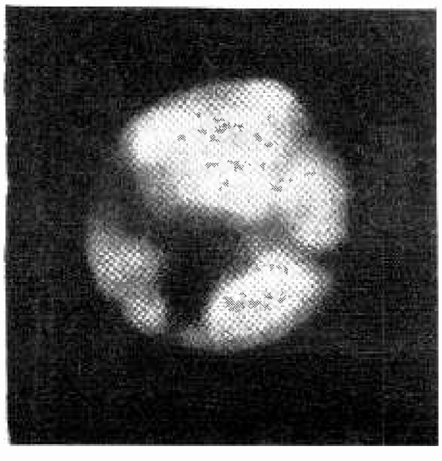
Infra-red Filter Enables Astronomers to See Surface of Planet

By DONALD P. BEARD

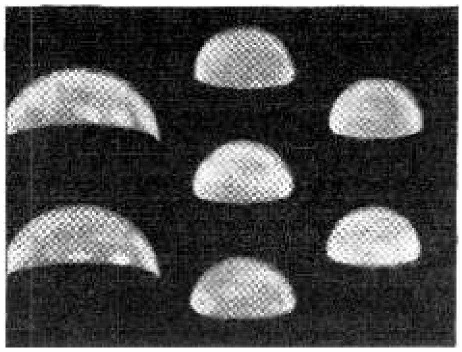
THE impenetrability of the dense cloud-envelope that surrounds the planet Venus has for centuries prevented a closer telescopic acquaintance with her surface features. These vague dark cloud areas that obscure the planet's actual surface have recently been photographed for the first time.

An announcement to this effect comes from Prof Frank E. Ross of Yerkes Observatory, who has been photographing Venus throughout the past summer with filters that transmit selected "light" from the infra-red region of the spectrum.

On June 23, 1927, a telegraphic report from Mount Wilson, California, to Prof. Edwin B. Frost, director of Yerkes Observatory, stated that an extensive cloud area near the south pole of Venus was thus photographed, while other dark cloud areas were showing rapid changes. By study of these photographs Prof. Ross hopes to determine the rotation period of Venus, the inclination of her axis, and perhaps the nature of her surface features.



The above photo of Mars was taken with an infra-red filter. Compare this with the photo at the right.



Above are the waning phases of the planet Venus, showing the dark clouded area. Photography, by means of infra-red filters, has recently penetrated this dense cloud envelope.

VENUS POSSIBLY INHABITED

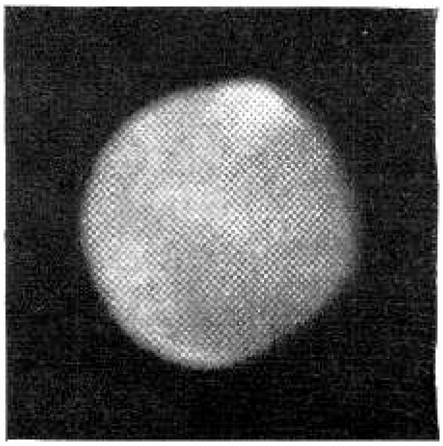
Prof. Edwin B. Frost of Yerkes Observatory has recently expressed belief that high forms of sentient life are "much more likely to exist on Venus than on Mars. Venus is nearer the sun (two-thirds of our distance away) and were it not for the heavy clouds the heat there would be unbearable."

Briefly, Prof. Frost's method was to photograph Venus at intervals throughout her recent apparition (or "elongation," as it is technically termed) with an infra-red filter interposed between the great 60-inch mirror of the Mt. Wilson reflector and a rapid photographic plate. This infra-red filter transmits those long waves of light near the red end of the spectrum at about wavelength λ7,200, which play a negligible rôle in ordinary processes of human vision.

Already the infra-red ray has unlocked an amazing domain of research for industrial physicists in practical aspects of technology, as in certain textile processes; in signaling and locating enemy positions in nocturnal war operations; in light therapy applied to cancer and diseased tissues, etc. In the hands of Prof. J. L. Baird of London, recently, these radiations have revealed invisible objects in a dark room, opening up a new field through television, etc., and they now promise to clear up the mystery of cloud-veiled Venus.

HOW INFRA-RED FILTER WORKS

The technical details involved in this application of the invisible red radiations of the spectrum to planetary photography are too involved to enter into her. In brief, photographs made with an infra-red filter have their images formed by the agency of light which plays almost no part in ordinary visual perception. If the reader will hold a piece of deep red or "ruby" glass before his eyes and carefully examine a sunlit landscape with trees and white buildings, he will behold a scene similar to those depicted in Prof. Robert W. Wood's remarkable photographs of quarries, gardens, an old cathedral in Florence, and other subjects taken in Italy some 15 years ago. In Prof. Wood's infra-red photographs a weird effect similar to moonlight is observed, while the green foliage of trees apparently does not absorb infra-red light, causing them to appear as though covered with frost or white paint. (*Continued on page* 64)



An ultra-violet filter was used in taking the photo shown above, which is about 6 per cent larger than the infra-red ray image.

The Metal EMPEROR

by A. Merritt

Author of "THE MOON POOL", "THE FACE IN THE ABYSS" etc.

(Eighth Installment)

Synopsis

Dr. Louis Thornton is traveling through Tibet with his Chinese servant-cook, Chiu Ming, and two ponies that carried the impedimenta. They come upon a white man who introduces himself as Richard Keene Drake. Drake's father had been very friendly with Thornton. The three decide to carry on and come upon Martin Ventnor, a geologist, and Ruth, his daughter. The latter are guarding themselves against hundreds of soldiers who belong to an age at least twenty centuries back. While escaping they are attacked and would have been exterminated, were it not for the timely intervention of Norhala, a tall, beautiful, metallic-haired woman, whose control over lightning and over heavy metallic blocks was phenomenal. These blocks, at her command, would make a bridge for her to walk on or form themselves into battling monsters to protect her or obey her every whim. Chiu Ming is killed in the battle, the survivors leaving with Norhala. Ruth and Norhala get on one of the blocks. The others stand upon a second composed of four smaller ones joined together by their own peculiar super-normal power. The platforms speed through space at a terrific rate, arriving eventually in the court of the Metal Emperor. Angered by the influence of Norhala over Ruth, Ventnor raises his rifle and fires at the red ruby-like object he believes to be the brain of the metal monster. He is struck down by a lance of green flame and rendered unconscious. The metal monster gives Norhala the entire company to serve as her toys. She takes them to her home, where she informs Yuruk, her ape-like eunuch attendant, they are not to be harmed. Ventnor talks, then lapses into unconsciousness again. Ruth, after telling about the strange power that holds her enslaved, goes to sleep. Drake and Thornton discourse on the metal intelligences, and come to the conclusion that they are guided by some sort of group consciousness, and that they move by super-rapid molecular "steps!" Yuruk, because of jealousy, informs Drake of the way back to the city, which Ventnor, in a semi-conscious state, told them was their only hope. Yuruk claims that though the inhabitants of the city were hostile, it is much safer to escape. Leaving Ruth with Ventnor, Thornton and Drake decided to skip away from Norhala. They informed Ruth that Yuruk has learned the meaning of the pistol. After rather spectacular adventures, they come upon the Metal City, where geometrical and intangible forms are seemingly endowed with super-intelligence. The city saw and was alive. Norhala appears unexpectedly and is just as quickly blotted out from sight. They observe the metal hoards and make the acquaintance of the Metal Emperor, to be subsequently brushed out of his presence, after which they glide away rapidly.

CHAPTER XXII

THE BIRTH CHAMBER OF THE HORDE

"PROFESSOR," Drake broke the silence, "this isn't the way to get out. We're going in, going away all the time from the—gates."

"What can we do?" my anxiety was no less than his, but my realization of our helplessness was complete.

"If we only knew how to talk to these Things," he said. "If we could only have let the Disc know we wanted to get out—damn it. I believe it would have helped us!"

Grotesque as the idea sounded, I felt that he spoke the truth. The Disc meant no harm to us. In fact, in speeding us away, I was not at all sure that it had not deliberately wished us well. I could not forget the strangling tentacles of the Keeper of the Cones.

"Pushed us away as though we were children—or the cat." Drake echoed my thoughts. "Shooed us off as though it were saying 'Run along now and play—or you may get hurt!'"

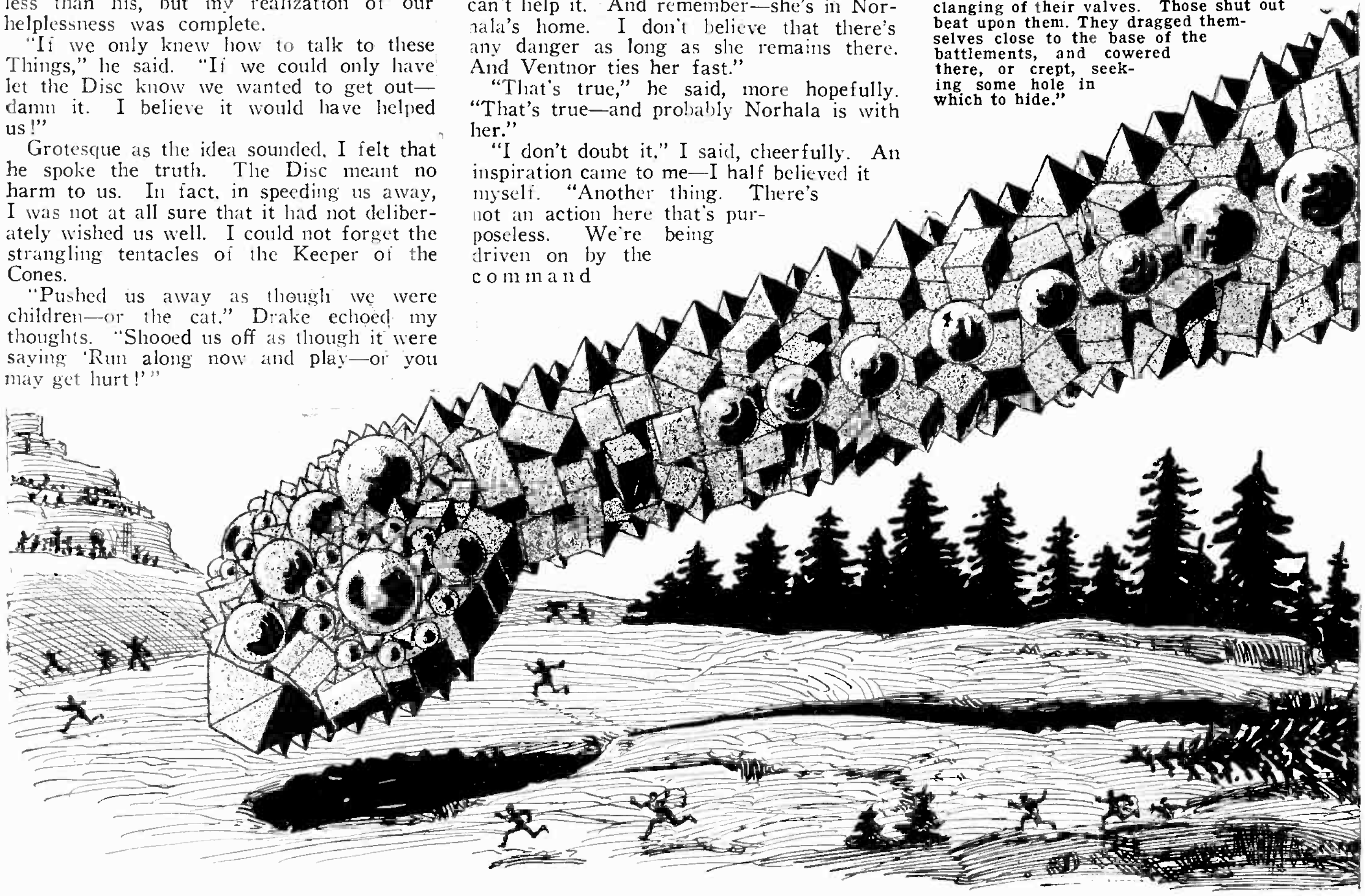
Still up we sped along the shaft. A thousand feet, two thousand feet I knew we must be now above the level of the valley.

"We've got to get back to Ruth! What will she be thinking?—It's night! And what may be happening—what may have happened to her?"

"Drake, boy—we're up against it. We can't help it. And remember—she's in Norhala's home. I don't believe that there's any danger as long as she remains there. And Ventnor ties her fast."

"That's true," he said, more hopefully. "That's true—and probably Norhala is with her."

"I don't doubt it," I said, cheerfully. An inspiration came to me—I half believed it myself. "Another thing. There's not an action here that's purposeless. We're being driven on by the command of that Thing you have called the Metal Emperor. It means us no harm. Maybe—maybe this is the way out."



"Again the monster shook beneath us. Faster we moved. Louder grew the clangor of the drums, the gongs, the pipes. . . . Now we were close upon the heels of the last fleeing stragglers. We slackened in our stride. We waited until they were close to the gates. I heard the brazen clanging of their valves. Those shut out beat upon them. They dragged themselves close to the base of the battlements, and cowered there, or crept, seeking some hole in which to hide."

"Maybe so." He shook his head doubtfully. "But I'm not sure. Maybe that long push was just to get us away from there. It strikes me that the impulse has begun to weaken. We're not going anywhere near as fast as we were."

I had not realized it, but our speed was slackening. I looked back—hundreds of feet behind us fell the slide.

"There are other passages opening up along this shaft," Drake urged. "I'm not for trusting the Emperor too far—it has other things on its metallic mind, you know. The next opening we get to, let's try to slip into it—if we can!"

I had noticed the openings along the ascending shaft, corridors running apparently transversely to its angled way. I nodded.

Slower and slower became our pace. I glimpsed one of the apertures, a hundred feet above us. Could we reach it? Slower and slower we arose, and nearer it came, nearer—our feet began to slip backward along the steep way. Now the gap was but a yard off. But we were motionless—were tottering.

Drake's arms wrapped around me. With a tremendous effort he hurled me into the corridor. I dropped at its edge, writhed swiftly around, saw him slipping, slipping down, and thrust my hands out to him.

He caught them. There came a wrench that racked my arm in its sockets. But he held. I writhed back into the passage, dragging up his almost dead weight.

For a minute or two we lay, flat upon our backs, resting. I sat up. The passage was broad, silent, apparently as endless as that from which we had just escaped. Along it, above us, under us, the crystalline eyes were dim. It showed no signs of movement. Drake arose.

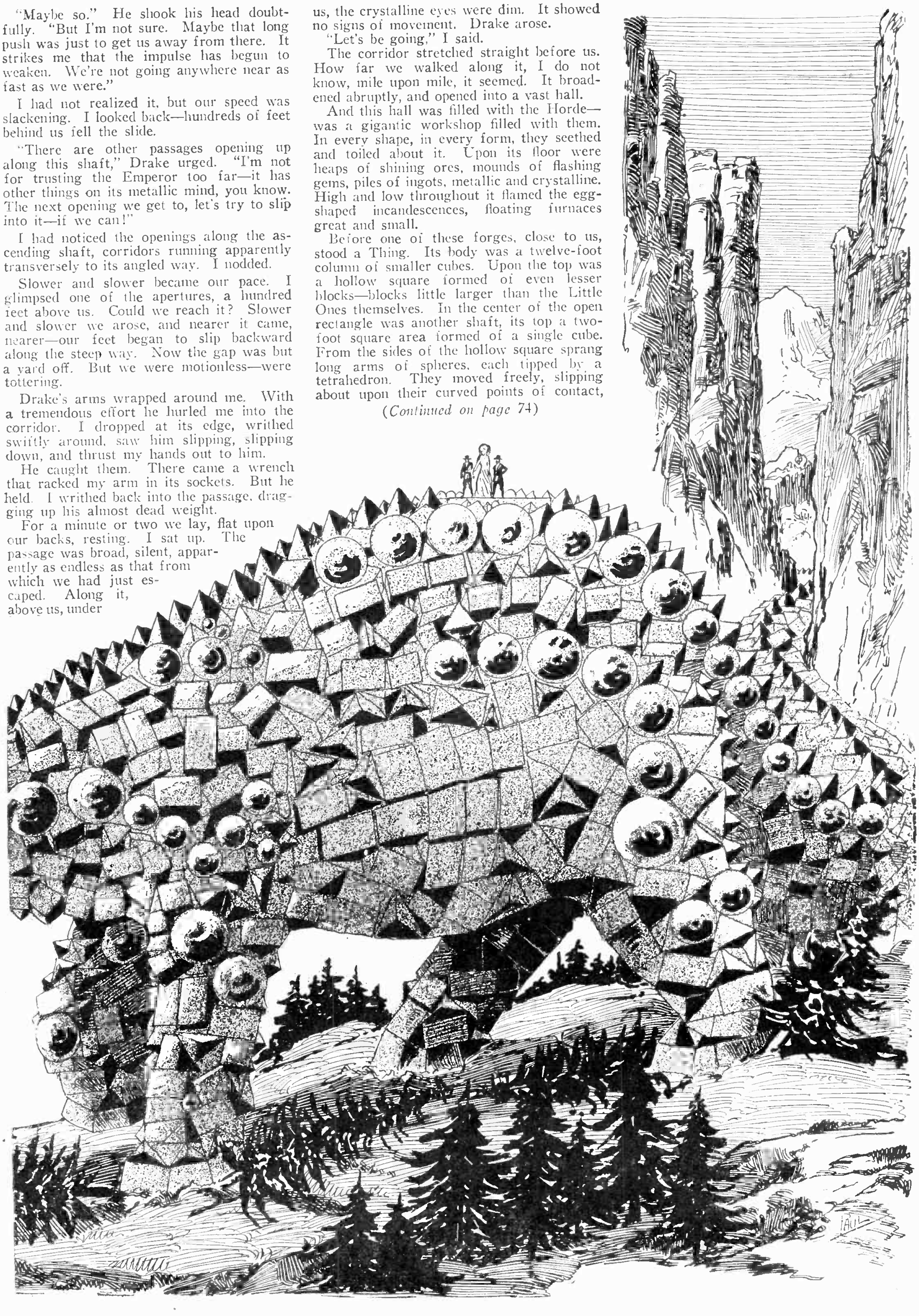
"Let's be going," I said.

The corridor stretched straight before us. How far we walked along it, I do not know, mile upon mile, it seemed. It broadened abruptly, and opened into a vast hall.

And this hall was filled with the Horde—was a gigantic workshop filled with them. In every shape, in every form, they seethed and toiled about it. Upon its floor were heaps of shining ores, mounds of flashing gems, piles of ingots, metallic and crystalline. High and low throughout it flamed the egg-shaped incandescences, floating furnaces great and small.

Before one of these forges, close to us, stood a Thing. Its body was a twelve-foot column of smaller cubes. Upon the top was a hollow square formed of even lesser blocks—blocks little larger than the Little Ones themselves. In the center of the open rectangle was another shaft, its top a two-foot square area formed of a single cube. From the sides of the hollow square sprang long arms of spheres, each tipped by a tetrahedron. They moved freely, slipping about upon their curved points of contact,

(*Continued on page* 74)

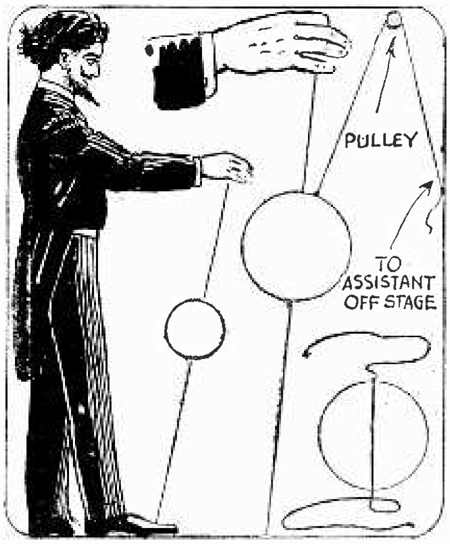


MAGIC By "DUNNINGER"

NO. 62 OF A SERIES

IMPROVED OBEDIENT BALL

FOR a number of years the so-called obedient ball trick has been a favorite deception, particularly among amateur magicians. Its operation being generally



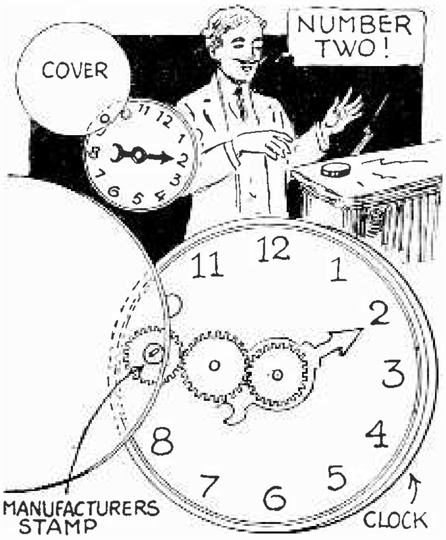
A celluloid ball moves up and down on a string, held between the performer's foot and his hand. Its mystical operation is caused by another string attached to the ball by a wax pellet, and controlled by an assistant.

known, it has been discarded from the programs of magical newcomers. In the present method, the possibility of passing the paraphernalia for examination is greatly increased, hence the trick much improved. In effect, a large celluloid ball with a hole drilled through it is shown and then a string is passed through the hole. One end of the string is caught beneath the foot, the other end held in the hand. At the magician's command, the ball will be seen to fall, stop, or rise again.

Explanation: There is nothing about the ball or the string which will not pass an examination. The secret lies in the fact that a very thin thread, passing over a pulley overhead and to an assistant in the wings, is affixed to the ball by a pellet of wax. The wax pellet may be detached whenever and as often as desired.

THE X-RAY EYE

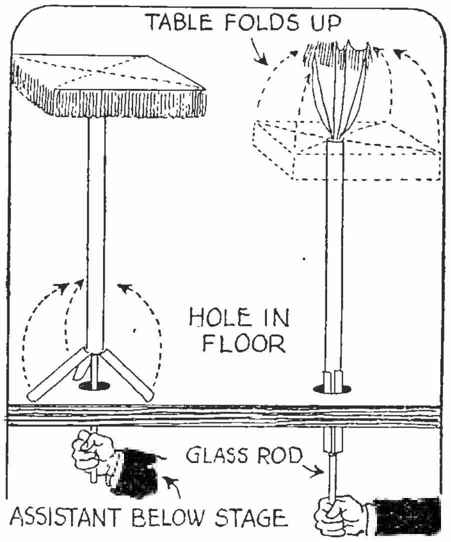
THE magician passes a small pill box, about 4 inches in diameter and 1 inch high to any one of his spectators. Upon turning the lid, the spectator will observe a pointer similar to a clock hand, and the dial of a clock. The spectator turns the hand to any of the twelve numbers he desires, closes the cover, and returns the box to the magician. The latter, without even opening the cover, tells the hour to which the hand has been set. The conjurer may even be blindfolded if the spectators so desire. The illustration below shows why this trick is so relatively simple. An axle runs clear through the box from the hand to a gear in the back. This gear in turn communicates the motion to two others, the last of which is connected directly to what seems to be a manufacturer's trade-mark. The position of this manufacturer's trade-mark with reference to the box, or with relation to another mark on the box indicates the time. With the pill box upside-down, the magician has but to look at the direction in which the manufacturer's stamp is pointing to correctly tell the time. When blindfolded, the box must be held in such a position that the magician can look beneath the blindfold, or else he will have to resort to the sense of touch.



The arrangement of the gears for performing the X-ray eye effect is indicated above.

THE VANISHING TABLE

HERE is an excellent finale to a stage presentation of a magical performance. After the presentation of a series of tricks, the wizard's assistant clears the side-table



A folding table made as indicated, can be vanished at the end of the performance.

which the magician has been using during the performance. The conjurer displays a large cloth, holds it in front of the table for but a fraction of a second, jerks the cloth away and tosses it out toward the audience, who see at the same time that the entire table has been mystically vanished in thin air.

Explanation: The table itself is mechanical. The top consists of four ribs, which close up umbrella fashion. These are covered with silk and fringe. The table legs are three metal shells, supporting the metal stand. These shells, when folded to the sides of the table, lie perfectly flat. The stand is held in place by the assistance of a glass rod, reaching up from beneath the stage through a small floor hole no more than 2 inches in diameter. Just as the cloth is held in front of the table, the assistant pulls down on the glass rod, collapsing the table, and pulling it through the hole.

THE COIN IN THE EGG

THIS is quite an effective parlor trick, very easily mastered. A coin is borrowed from anyone in the audience and is marked for identification. An aluminum egg cup, together with an unprepared egg, is then examined. This egg had previously been chosen by someone in the audience. The egg is put in the cup and the whole presented to some member to hold. The coin is then mysteriously vanished, and on breaking the eggshell is drawn from the center of the egg with the assistance of an examined pair of tweezers. By way of explanation, it might be mentioned that the original coin is secretly placed in a groove in the egg cup made to receive it. A duplicate is vanished, by any of the various methods previously suggested in this publication. As the egg is placed into the cup, the thin shell is broke by the edge of the coin.

Conducted by GEORGE A. LUERS

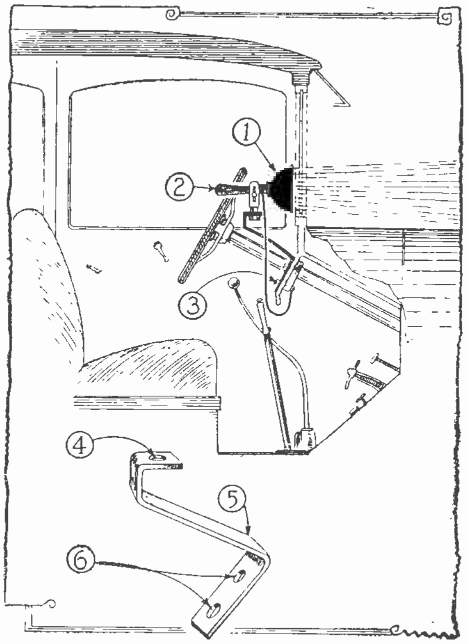
MOUNTING SPOT-LIGHT INSIDE THE CAR

A spot-light mounted inside the closed car, just to the right of the steering wheel, is handy for all seasons, as it does not require the window to be open for use. A second feature of an inside spot light, is the facility for repairing, greasing and adjusting the transmission and clutch.

One owner made up a simple neat bracket as shown in the sketch.

This bracket was made from a strip of quarter inch iron about an inch wide. This was bent by heating in a furnace and forming while hot, that the extension would hold the spot-light close to but clear of the windshield glass. Two quarter inch bolts were used to secure the bracket to the dash. The spot-light used was about four and one-half inches across the face. The control of the light is within easy reach of the driver's right hand.

Obviously, a neat coat of black enamel completes the job.



In the above drawing No. 1 is the spotlight, No. 2 shows the convenience of the arrangement, 3 shows the bracket and 4, 5 and 6 show where the holes should be drilled in the bracket iron. The spotlight is mounted to the right of the driver, close to the windshield.

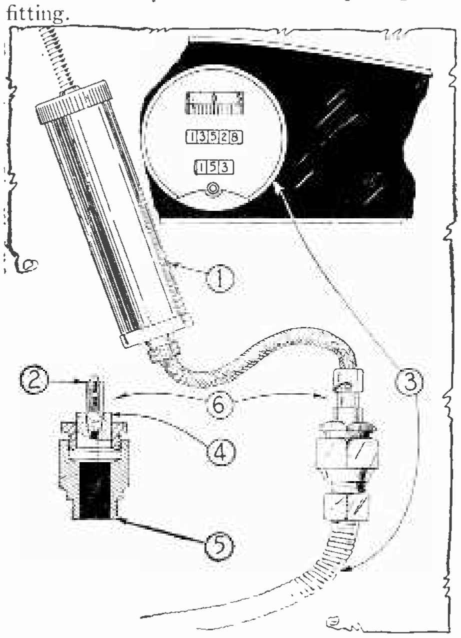
ALEMITE FITTING FOR SPEEDOMETER CABLE

One of the fast moving parts of the car, for which there is no provision for lubrication is the speedometer cable. Obviously failure is to be expected of this member if greasing is neglected.

A simple means to facilitate greasing the cable as devised by one owner is shown in the attached sketch. This means will appeal to other owners, chiefly because it can be made up from scrap parts which are available about the garage.

A ⅞-inch spark plug shell is fitted with a brass bushing and this is tapped out for a one-eighth inch pipe plug. An alemite grease fitting is screwed into this bushing. To grease the cable, it is detached by the coupling nut at the rear, the special alemite fitting is screwed into the nut and the grease gun is applied.

It will be apparent the same fitting will not screw on all types of speedometers, and some require machining and re-threading of the shell. Try this before completing the fitting.



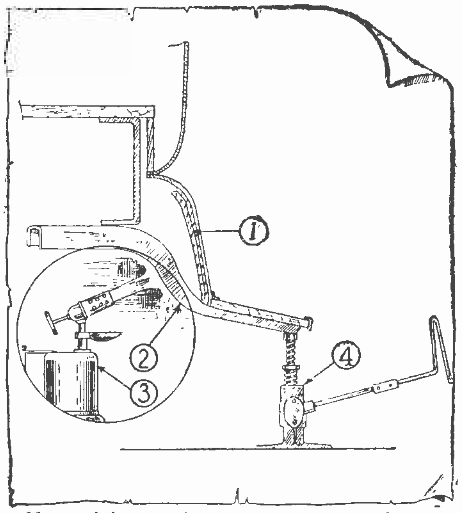
Above—1 is a grease gun; 2, a grease nipple; 3, speedometer cable; 4, brass bushing; 5, spark plug shell; and 6, a grease fitting.

STRAIGHTENING RUNNING BOARD OR FENDER BRACES

A slight collision will invariably bend either a running board bracket or a fender brace. The owner may try to straighten these out by cold bending; however, this is usually too much of a task.

Torch heat will cause the bracket to yield to a slight pressure, either through use of a bending bar or a jack, as shown in the sketch.

If possible, a piece of asbestos paper should be folded to confine the heating to the bent bracket. The torch should be applied until the bracket is a bright red, at which time it is easily returned to position. Quenching with water will tend to harden it or restore its former comparative inflexibility.



Above—1 is an asbestos sheet; 2, bend in the bracket, 3, blow torch; and 4, the jack.

DO YOU KNOW—the spares most needed for a tour in remote regions are, one ignition coil, a spare axle and two valves. Data from several touring clubs, show these parts to be the most frequent sources of trouble.

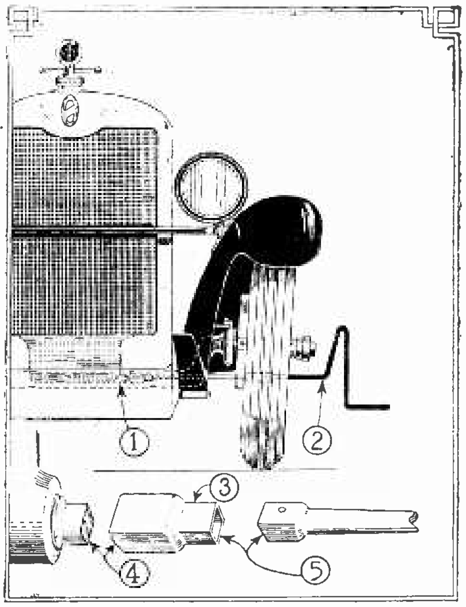
The main advantage of this means for rebending a bracket, is that it avoids the possibility of starting a break or crack in the metal.

USING JACK HANDLE FOR DRAINING OIL SUMP

The owners of those cars having side outlet drains for the oil sump of the engine, will find the suggestion shown in the attached sketch useful and far more satisfactory than having to crawl under, when the oil is to be drained.

The usual folding type of jack handle is used as a tool, when fitted with a special socket, which will fit the pipe plug in the oil sump.

Sockets of the required size are available in the larger accessory stores, however it is possible to make up one from a piece of pipe by heating this and hammering it to shape.



In the above drawing 1 is the side drain outlet in oil sump; 2, folding type jack handle; 3, special socket connections. Numbers 4 and 5 show how the special socket connections are made to fit.

The owner will find this facility one of the most expeditious and clean method of handling an otherwise dirty task. This additionally prompts more frequent oil changing, which is a benefit not to be overlooked.

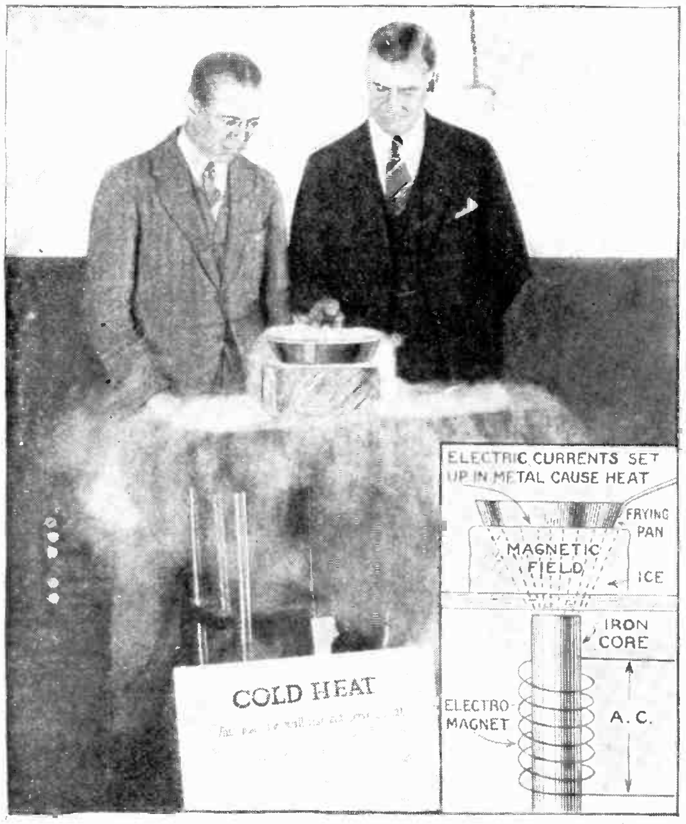
FITTING COUPE OR ROADSTER FOR EXTRA BAGGAGE

Space for baggage, especially on camping trips, is at a premium on the roadster or coupe. Tents, mattresses and blankets are bulky, but these must be kept out of the rain.

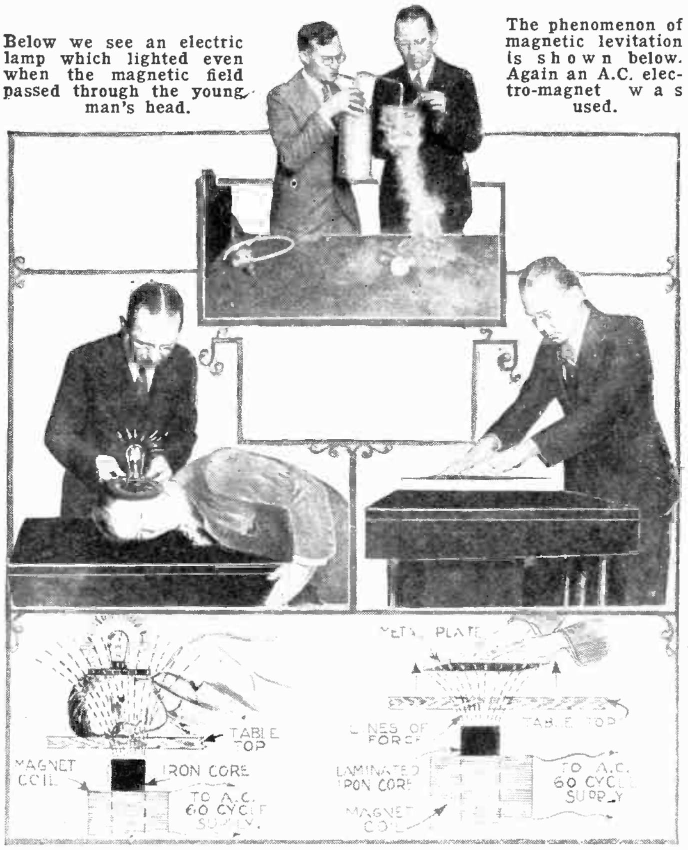
An ingenious idea of one owner to provide stowage space on a coupe, is shown in detail in the attached drawing. The features of this carrier, will be evident without much explanation. *(Continued on page 62)*

Electricity Helps the Showman

Startling Tricks Carried Out with A.C. Magnets and Oudin Coil



At the left is a photograph showing one of the wonders of the Radio World's Fair. Bernays Johnson is shown frying some sausages on a cake of ice. The insert shows how this feat was accomplished by means of an electro-magnet.



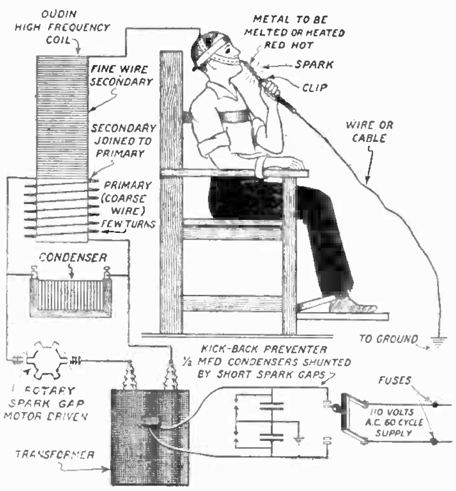
Below we see an electric lamp which lighted even when the magnetic field passed through the young man's head.

The phenomenon of magnetic levitation is shown below. Again an A.C. electro-magnet was used.

RECENTLY, there appeared at the Radio World's Fair at Madison Square Garden in New York City, a famous radio engineer known as Bernays Johnson. His demonstrations were spectacular and a never-ending source of wonder and entertainment to the huge crowds which flocked to the Garden. As a feature stunt, the exhibitor even allowed a powerful current to pass through his body without apparent harm. As he explained it, he had developed the faculty of being immune to electrical currents, and could stand these 350 amperes of current at a pressure of 2,200 volts, while an ordinary person would immediately be electrocuted. The "miracle man" provided further thrills by holding a small piece of metal in his teeth during the exhibitions, which seemingly melted in his mouth. The photo at the bottom of the page shows the electric chair with its contacts and straps. The diagram next to this photo shows just how it was possible to melt the metal without injuring the performer, or even requiring him to take the slightest amount of current through his body. Since the Fair, Mr. Johnson has gone on the stage with this and other acts, and it is really wonderful to notice the effect that 350 amperes of current at a pressure of 2,200 volts has upon his system. As is well-known high frequency currents can be handled with impunity and so the lecturer in the present case was in no danger. After the electric chair act is over, Mr. Johnson staggers around on the stage apparently in a state of the utmost physical exhaustion. It behooves the lecturer on high frequency currents to be somewhat of an actor. Bernays Johnson also fried eggs and sausages upon a block of ice, lit lamps held in the hand which were connected to no electrical supply, and even went so far as to defy gravity. A large A.C. electro-magnet with an iron core was used to fry the eggs. The magnetic field set up electric currents in the frying pan and thus generated the heat which Mr. Johnson claimed was coming through the air in the form of cold heat, as the placard shown in the photo testifies. The same trick, of course, was used when lighting the electric bulbs. An A.C. magnet with a laminated iron core served to produce the effect of *nullified gravity,* which Mr. Johnson heralded as a world startling accomplishment. According to the master-mind, Bernays Johnson, these amazing feats were made possible by the use of *cold heat* or *radio waves* which were coming through the ether and performing these miracles. It may be well to mention that when melting the rod of metal, the connection was made to the end of a metal head band; at no time was the rod held in the mouth of the performer, although it could be with sufficiently high frequency to preclude the danger of shocks.

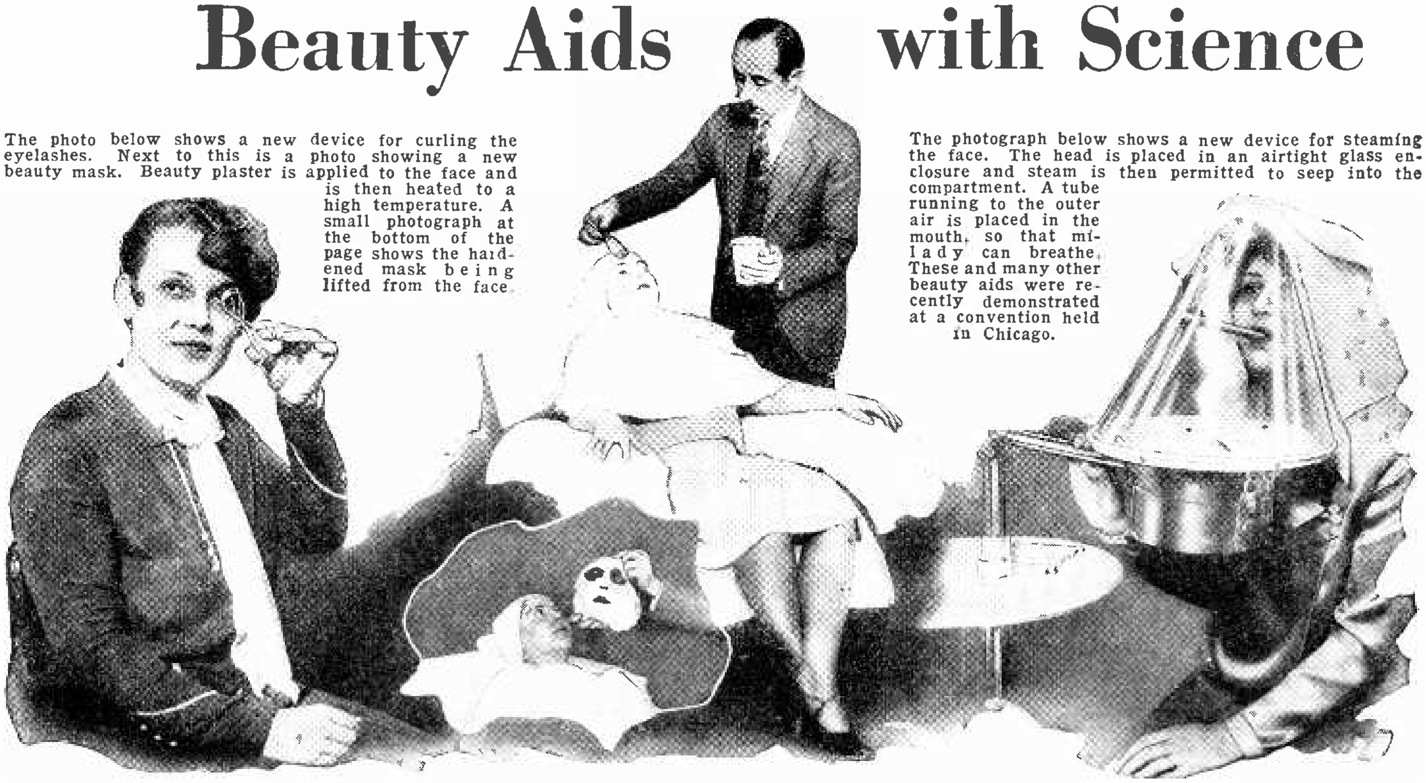
The drawing at the bottom of the page shows just how the metal rod was melted by using an Oudin high - frequency coil, to the secondary of which the metal rod was touched. The other end of the metal rod was connected to a metal headband to which was connected the ground. The photo at the bottom of the page shows Mr. Johnson seated in the electric chair with the rod held in hand.

Bernays Johnson is shown above in the electric chair, holding in his hand the metal rod to be melted.



Above we see how it was possible to melt the heavy piece of metal seemingly held in the mouth.

Beauty Aids with Science



The photo below shows a new device for curling the eyelashes. Next to this is a photo showing a new beauty mask. Beauty plaster is applied to the face and is then heated to a high temperature. A small photograph at the bottom of the page shows the hardened mask being lifted from the face.

The photograph below shows a new device for steaming the face. The head is placed in an airtight glass enclosure and steam is then permitted to seep into the compartment. A tube running to the outer air is placed in the mouth, so that milady can breathe. These and many other beauty aids were recently demonstrated at a convention held in Chicago.

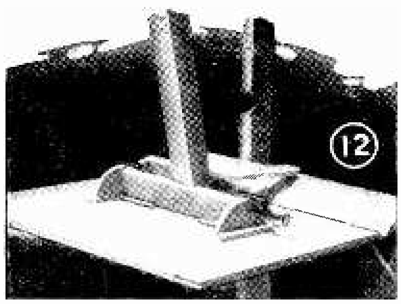
BEAUTY parlor operators in the United States at a Chicago convention exhibited their latest inventions to aid women in the search for youth and beauty. The latest innovation is to have the face baked. A coating of beauty clay is put on the face and raised to a temperature of 160 degrees Fahrenheit. After the treatment is over, the beauty mask can be easily lifted from the face, as may be seen in the above photographs. Eyelash curlers are also becoming popular with the fair sex and our photo shows one of these in use. A new massaging apparatus has also recently been perfected. This consists of an airtight glass enclosure into which steam is allowed to enter. While the steam bath is being administered, the patron breathes through a tube placed in the mouth, having an outlet in the outside air. Rubberized fabric attached to the glass compartment allows the facial steaming apparatus to fit tightly.

Can You Answer These Scientific Questions?

SCIENCE and INVENTION Magazine readers, especially our thousands of friends in schools and colleges everywhere, have frequently testified in their letters to the editors that they obtain invaluable help from the columns of this magazine, in clearing up technical questions which arise daily. It is a recognized fact that everyone today, including those of both sexes, are expected to have a fairly good general knowledge of the latest scientific developments and discoveries. It is quite impossible to obtain this knowledge of the latest conquests in science from text-books, as they are usually revised but once a year, and in many cases not as often as that. You will find the questions below a good challenge to your knowledge of modern science, and we advise you to form your own answer, before you turn to the page referred to in each case.

1. How is it possible for astronomers to calculate and predict the position of a new planet in the heavens? (See page 9.)
2. Explain how the location of an earthquake is figured out by scientists; and what do you know about earthquake predictors? (See page 10.)
3. Can you name ten greatly needed inventions which would bring fame and money to the man perfecting them? (See page 13.)
4. Does a dirigible roll excessively under average flying conditions? Is there a severe vibration felt throughout the airship, due to the engines? Do you consider a dirigible as safe as an airplane? (See page 14.)
5. What household pest can be successfully combatted with borax? How is formaldehyde gas used in fighting insects? (See page 16.)
6. How do you imagine the powerful forces locked up in liquid air can be used to propel an airplane? (See page 18.)
7. How would you apply aspirin to the resuscitation of plants? How would you make a simple yet powerful garden spray apparatus? (See page 22.)
8. How would you measure the temperature of the molten lava in the crater of a volcano? (See page 25.)
9. Thousands of people have bought and tried out "sex-indicators." Are they scientifically workable? (See page 26.)
10. What new means of drawing the gasoline from the tank of a motor car is now being widely used, in preference to the well-known vacuum tank device? (See page 28.)
11. How is it possible to actually photograph a distant scene obscured by fog? (See page 31.)
12. Could you fry eggs on a cake of ice, without any fire? (See page 36.)


The finished drawing table in use.



Above—Photo No. 5 shows how the columns are built, No. 7 shows the method used in locating the position of the hinges. In the photograph No. 9 we see how the legs are shaped. Fig. 12 shows the details of the tilting mechanism used in the construction of the drawing table.

Drawing Table and Utility

By EDWIN

THOUGH a draughtsman or artist may desire a center-supported drawing table, he is likely to hesitate before paying the $30.00 that an average table costs. For an expenditure of $10.00 for materials, however, he can build a table with all the desirable features of the store pieces, such as tilt-adjustment and regulation of height, with a constantly level tray, and in addition a very neat little cabinet to stand beside the desk, which will house the usual drawing and coloring equipment.

The top and tray of the table are made from 5-ply stock, with the hinged edges beveled to 45 degrees, as in Figures 1, 2, and 3. Rip a 28 in. length of ½ in. hardwood dowel down the center, and glue the halves to the tray edges, forming sides.

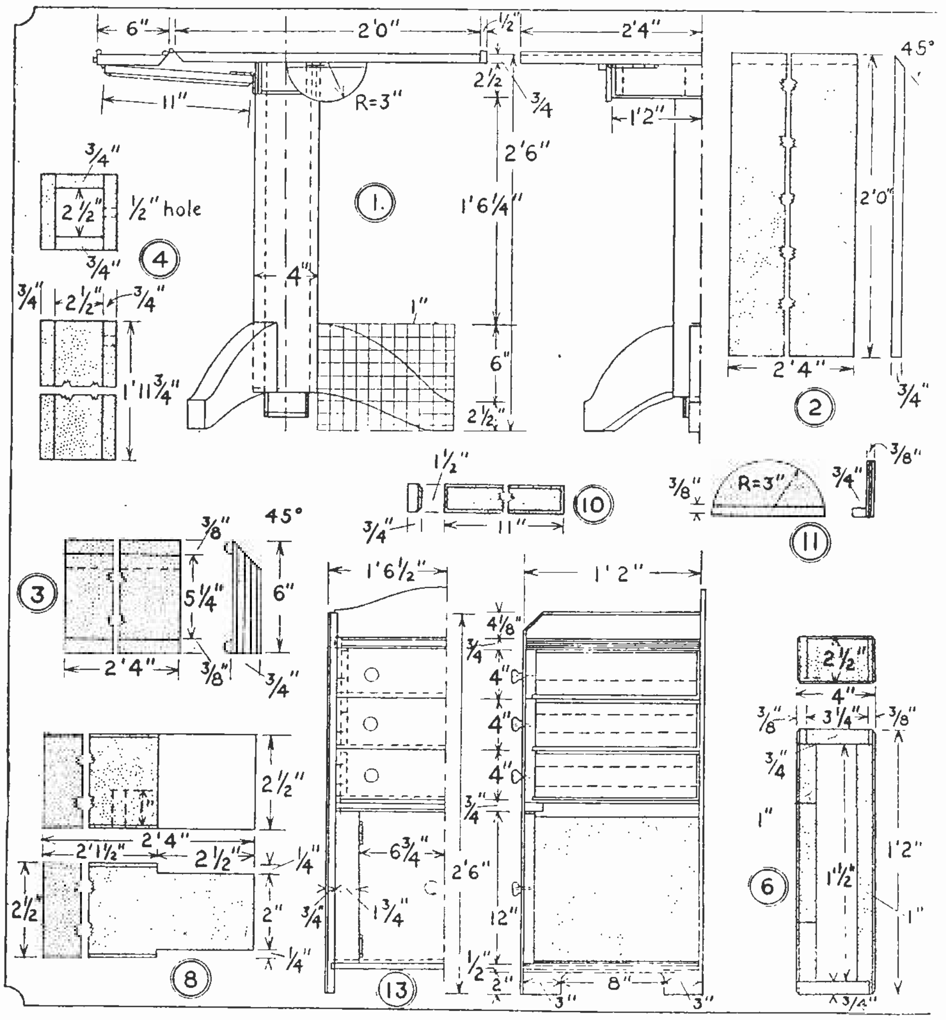
Next, build the column, shown in Fig. 4, gluing and nailing it together with the 2½ in. × 2½ in. post inside to keep it square. See Fig. 5 The post yoke, to which the top is hinged, is illustrated in Fig. 6. and is built of 1⅛ in. × 3 in. stock. Size the end grain of all joining parts, and glue and nail together. When dry, mortise the 3 in. hinges ¼ in. deep into the upper edge of one side. Lay the yoke on the underside of the top to locate the hinge positions there with the point of a knife, as in Fig. 7.

Now pull the post from the column and finish to dimensions given in Fig. 8. Apply glue to the end rabbets, put glue inside the yoke at the center, force it over the post, and nail solid.

For the legs, make a cardboard pattern by dividing a piece into 1 in. squares, through which the outlines may be drawn as in Fig. 1. Trace on 2 in. × 6 in. stock, cut saw kerfs every 2 in., and trim to the line with a chisel, as in Fig. 9. Smooth with spokeshave and rasp. The joint ends of two legs are cut at a 60 degree angle, obtained by setting a bevel square across the 6 in. and 10⅞ in. points on a steel square, and marking the angle on the top edge of each leg. The length must be located at the center of the edge.

Hinge the tray to the top with 2 in. × 2 in. hinges placed 1½ in. from the ends, with pins above the surface, and the tops of the tray edges flush with the table top.

Attach the top to the post yoke with the hinge pins. Make a parallel bar (Fig. 10), screwing on one end a strap hinge as in Fig. 1 to bend around the end. Screw this hinge to the center of the yoke side opposite to the top hinges with the center of the pin 1⅛ in. below the yoke top. Stand the post with the yoke flat against the top, so as to measure accurately the distance from the center of the top hinge pins to the center of the strap hinge, and lay out on the underside of the tray the point at which the other strap hinge will come an equal distance from the tray hinge pins. Cut off the parallel



In the above illustration, Figs. 1, 2 and 3 give the constructional details of the top and tray of the table. Fig. 4 shows details of column. The post yoke is shown in Fig. 6. Fig. 8 gives the finished dimensions of the column. Fig. 10 shows the details of the parallel bar. Fig. 11 shows the semi-circular segments and Fig. 13 shows the dimensions of the sides.

Cabinet are Easy to Build

M. LOVE

bar to suit, and apply the hinge. If this is not carefully done, the tray will not remain level at all angles of the top.

Two semicircular segments of 3-ply stock (Fig. 11) glued and nailed to ½ in. × ¾ in. cleats are nailed to the under side of the top, centering on a line with the hinge pins, just clearing the yoke ends. Put on two small clamps as in Fig. 12, driving nails into the yoke top to prevent them from falling off. With these the top can be clamped instantly at any angle.

Nail to the front edge of the top a strip of ½ in. hardwood flooring ripped and dressed to a width of 1¼ in., keeping it flush underneath, forming a lip. Glue and brad around the other edges a strip 3/16 in. × ⅝ in., to hide the lamination.

A piece of dowel 1½ in. long, drilled lengthwise to take the bolt of a glass knob, serves as a pin to lock the table at any height.

For the cabinet, get out two sides, as dimensioned in Fig. 14, using 5-ply stock. See also Figures 13 and 15. For drawer slides, rip ½ in. hardwood flooring.

Both upper and lower shelves are 5-ply stock. The lower is rabbeted ¾ in. wide to the depth of the second ply, along the front edge, according to Fig. 16. Assemble these with the sides by gluing and nailing as illustrated in Fig. 17. Since the sides may be sprung, square the case by measuring from corner to corner diagonally, and tack a diagonal strip across the front. The back, shown in Fig. 18, is then put in.

Make the drawer rail dimensioned in Fig. 19, measuring its length by the shelf. It, like the hanging stiles shown in Fig. 20, is nailed and glued.

Fig. 21 clearly illustrates the construction of the drawers. Assemble one without the bottom, getting measurements for sides and bottom from the cabinet itself, as in Fig. 22. Try the bottom for a sliding fit, and nail to the frame. Insert the drawer and mark the front length as in Fig. 23, giving a clearance of 1/16 in.

With the drawers in place, lay the cabinet on its back and scrape the fronts to an even surface (Fig. 24).

Fit and hang the door as indicated. Being so narrow the front edges must be beveled considerably. Place the hinges 1½ in. from top and bottom, put an elbow catch on the left door, and after painting, a frog catch in the edge of the right door, as well as glass knobs on doors and drawers.

Glue and brad the 3/16 in. × ⅝ in. molding along the edges of the sides, shelves, and drawer rail, shown in Fig. 25. Sponge the cabinet and table with a damp cloth to raise the grain, and sand smooth. Both are then ready for finishing.

MATERIAL LIST

1pc. 5-ply ¾ in. × 28 in. × 7 ft. pine veneer, good one side

(*Continued on page 93*)

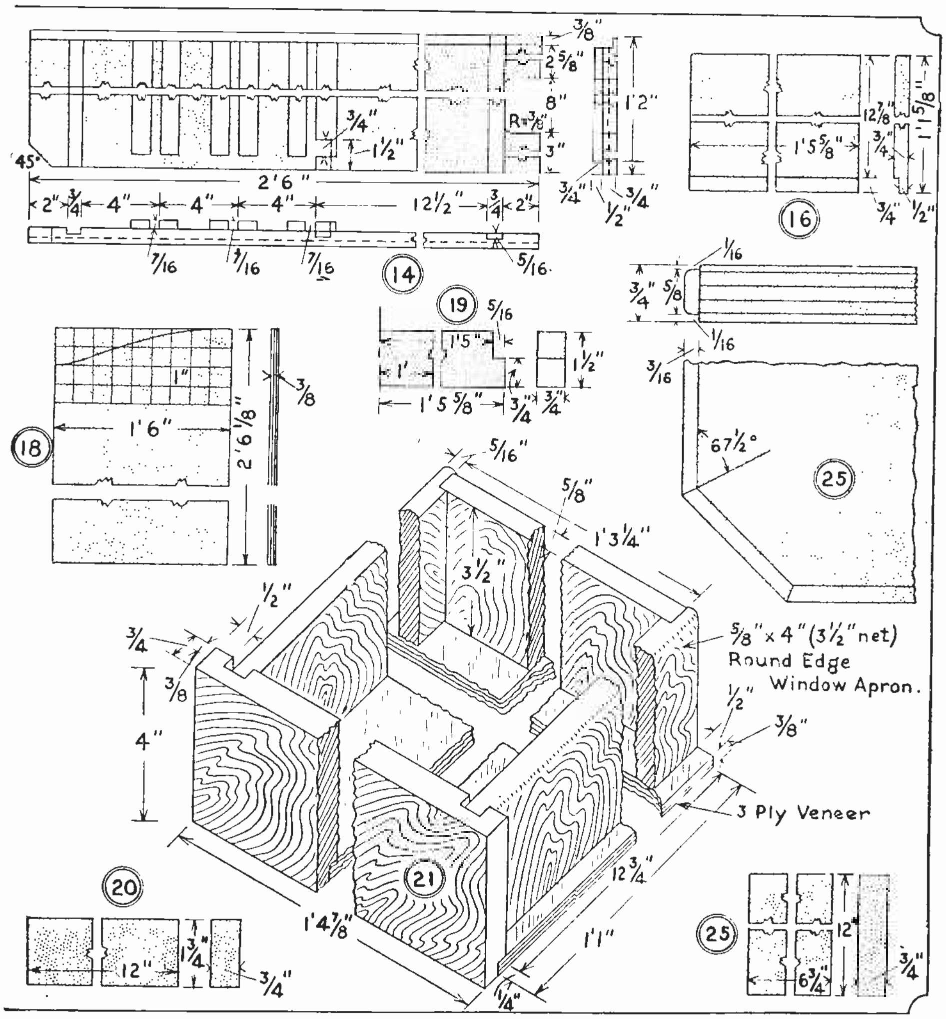


Fig. 14 in the above drawing gives further dimensions of the cabinet size. Fig. 16 shows how the lower shelf is put in place. The back of the drawer is shown in Fig. 18, and the drawer rail in Fig. 19. Fig. 21 shows construction of drawers, and Fig. 25 shows how the molding is glued.

The above photos show successive steps in the construction of the drawing table and utility cabinet. Photo 15 shows the cabinet's sides ready for assembly, No. 17 nailing in the sides, No. 22 getting the drawer length, No. 23 obtaining front lengths of drawers, and No. 24 surfacing the drawer fronts.

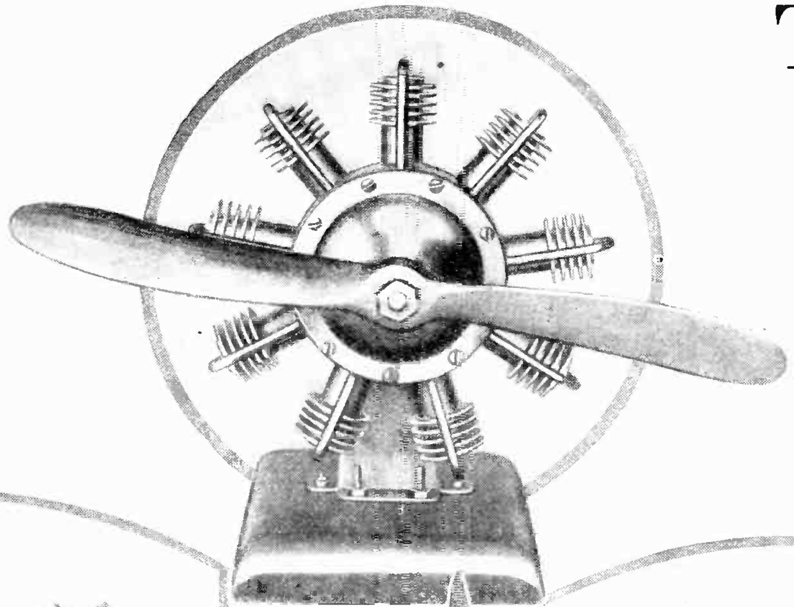
Model Department

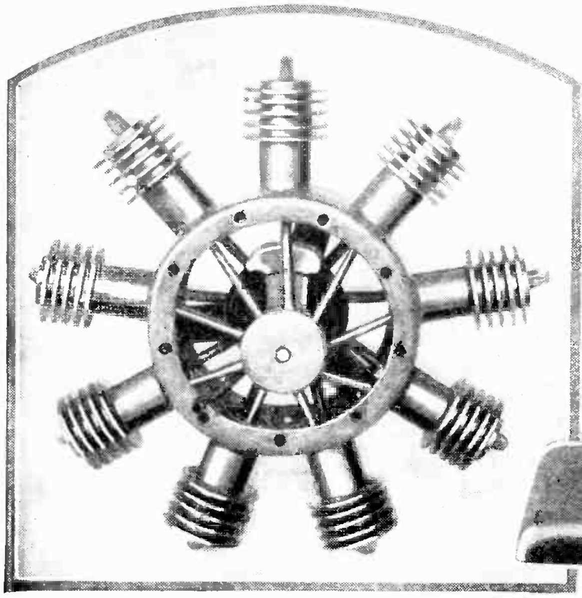
WINS

Airplane Engine Trophy Cup

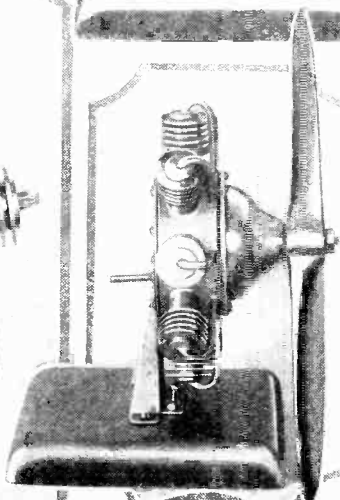
Model Built by Carl Von Bargen of Alliance, Nebraska Similar in Action to Whirlwind Type of Engine; Front View Can Be Seen in Photo at the Right

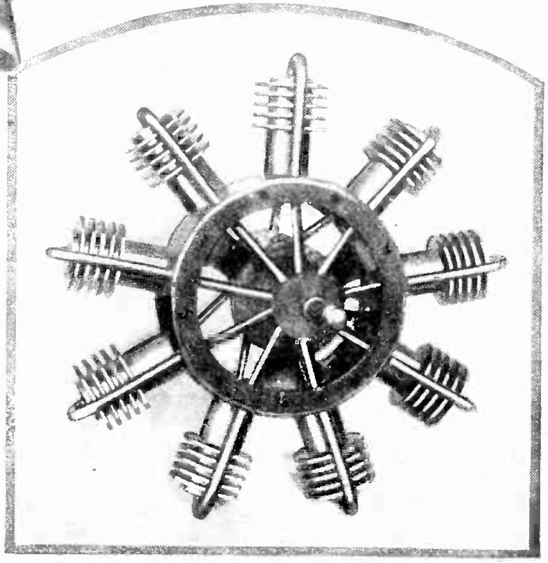
This Month's Award is Made to the Designer of the Engine Shown in Detail on This and the Accompanying Page. See Model Department Contest Rules on Page 68



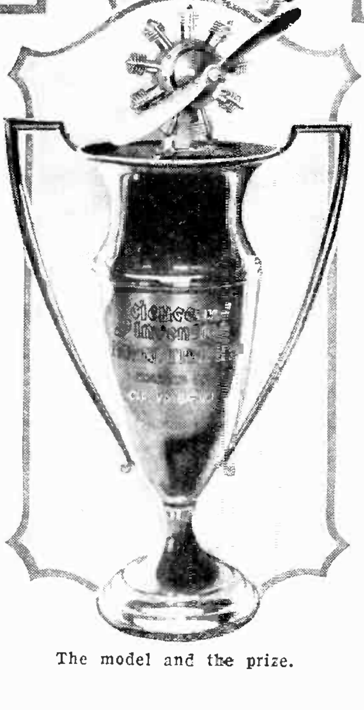


The above photograph shows a rear view of the airplane engine with the case removed. The pipe projecting from behind the case in the photograph at the center is for the air supply.





At the left is a photograph of the engine standing on the cup which it won. Above is a front view of the engine with case removed.



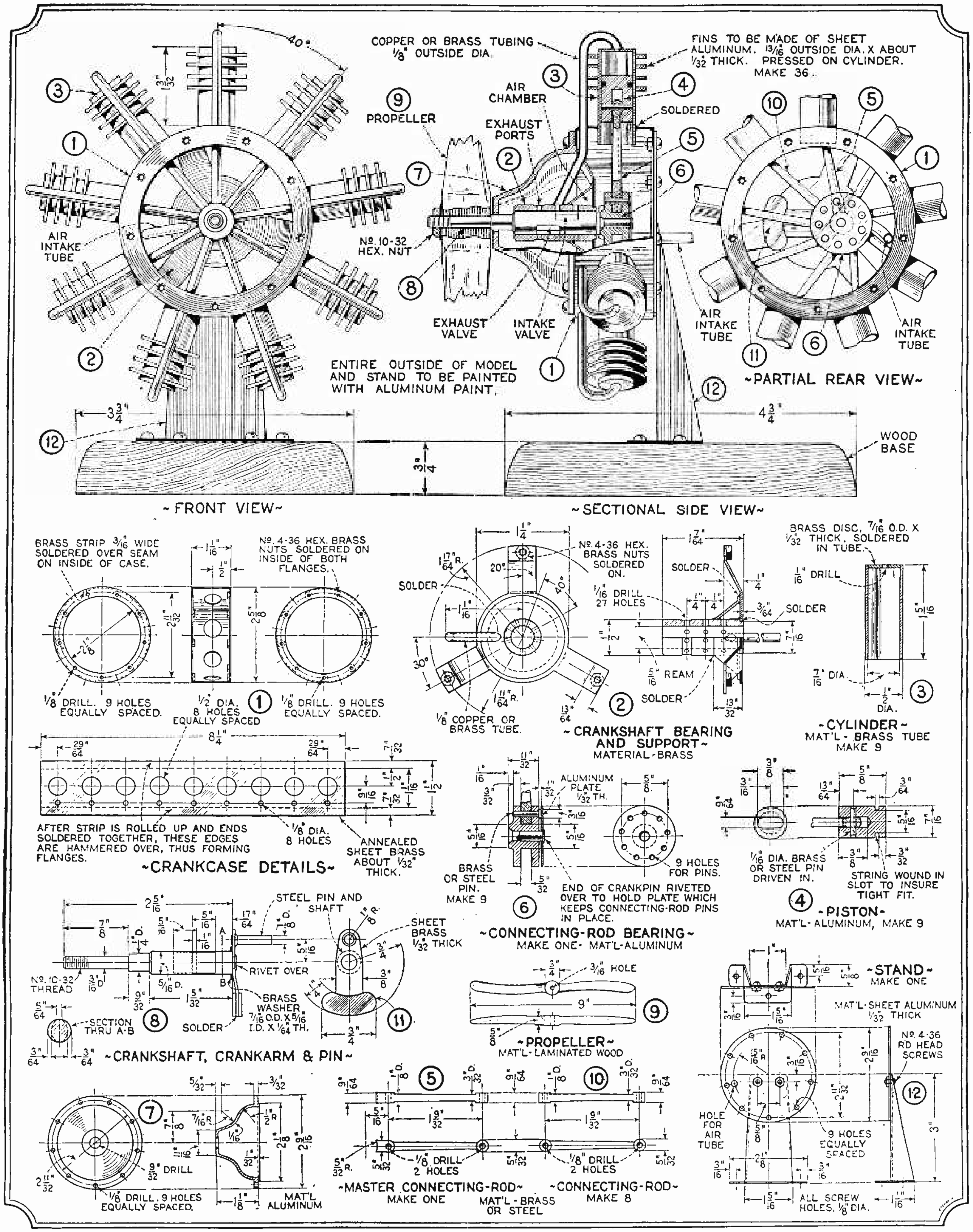
The model and the prize.

THE motor illustrated on this page is made nearly entirely by hand, with the possible exception of the crankshaft, the connecting rod bearing, the pistons, and the nose on the crankcase. These parts were turned out on a lathe. The cylinders are pieces of brass pipe, ½ inch outside diameter. The crankcase is a piece of sheet brass and the valve sleeves and pipes to the cylinder were made of the same material. All other parts are aluminum, except the crankshaft which is iron and the wrist pins which are made from steel wire, and held in place by punching the metal into the holes with a punch. The motor operates from a source of air supply at a pressure of from 40 to 50 pounds. It will be observed in the construction that one of the connecting rods has a master rod keyed to the piece to which they are all connected. All other connecting rods are movable.

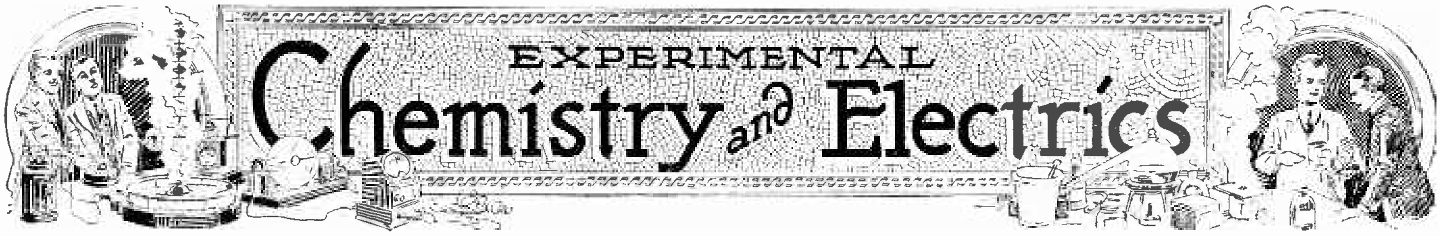
On the accompanying page the complete details of the engine are to be found , and we likewise see the assemblage of this device. The reader will note that the crankcase was made of a strip of annealed brass, 1½ inch by ⅞ inch. The holes were drilled through brass, which was then bent around and soldered. A strip of light material was sweated over the seam on the inside. The pistons themselves are grooved and wound with thread to prevent air leakage. The motor itself weighs but a trifle more than one-half pound, without the base. It could be made a little lighter if aluminum was used throughout, instead of brass, where brass is specified. One experiences no difficulty in turning over the 9 inch propeller, even when blowing into the intake pipe. This gives an idea of how carefully the model was built. The mechanism has no fly-wheel because every ninth part of a revolution we have a power impulse, thus there can be no dead center at any time.

The operation of the motor is as follows: As one piston reaches top dead center, one of the flats on the valve allows the air to flow from the chamber along the flat to a tube, thence to the piston thus forcing it down. On the up stroke, due to the second flat on the valve, the exhaust takes place through a part of the intake pipe, and out through a hole.

Complete Details of Airplane Engine



The above illustration shows the details and the assembly of the airplane engine which won the Model Trophy Cup awarded monthly by this publication for the best model submitted during the month. This engine operates from a compressed air source of supply. As can be seen, the model resembles the Wright-Whirlwind type of engine in that the cylinders are stationary. For this reason it differs from the rotary engines.



A Miniature Telegraph Set; Its Wiring and Construction

By FAUST C. BACABAC

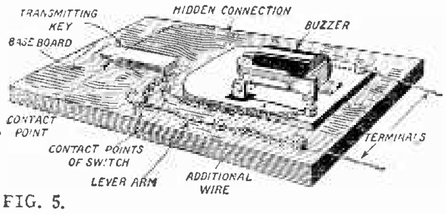


FIG. 5.

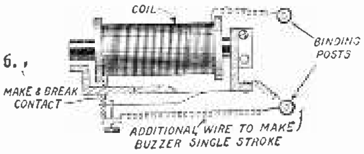
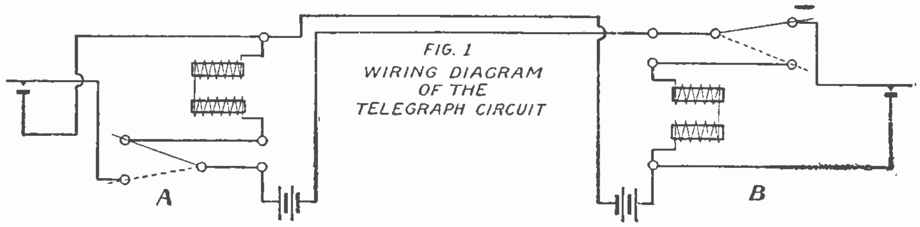
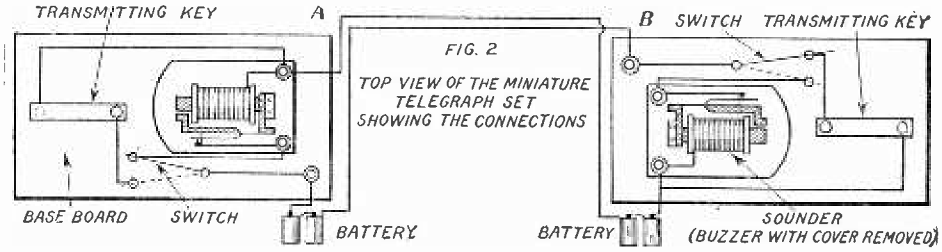


FIG. 6.

The upper figure gives a perspective view of one member of the very simple telegraph set. If the captions are followed out and it is examined in connection with the diagrams and details shown on the right, all will be perfectly clear.

The lower figure shows the arrangement of the electro-magnet, also with captions to explain the action as a sounder.





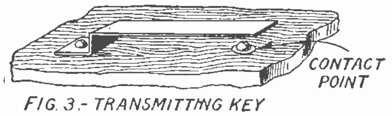


FIG. 3.- TRANSMITTING KEY

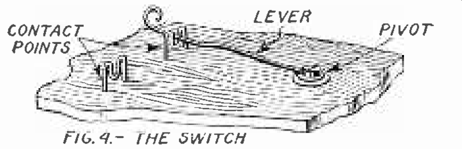


FIG. 4.- THE SWITCH

Fig. 1 shows the circuit of the miniature telegraph set in detail. If it is followed out carefully, and if studied, it will be seen that it takes care of transmitting and receiving, both by the Morse or other audible code. Fig. 2 is a diagram in more detail of the same subject, while below, in Figs. 3 and 4 the very simple transmitting key and the switch are shown so as to make their construction perfectly clear.

A MINIATURE telegraph set which is very useful for students, amateurs, and experimenters can be made from two single coil buzzers. The set is very helpful for students in telegraphy, especially those who are learning the code. A complete diagram of the device is shown in figures 2 and 5.

The buzzers are made single stroke, like all single stroke electric bells, by connecting the base of the contact point (make and break point) and the adjacent binding post by a copper wire (see figure 6). The buzzer with its cover removed, is mounted on a piece of board (7"x4"x½") which serves as the baseboard (figures 2 and 4). A transmitting key is made by bending a piece of tin two and a half inches long by one half inch wide into the shape shown in figure 3. It is fastened to the baseboard in front of the buzzer. A two point switch is made and mounted on the baseboard by the side of the buzzer as shown in figures 2 and 5. The two M-shape contact points of the switch are made of copper wire of suitable strength bent into the shape shown in figure 4. They are fastened to the baseboard as shown. The lever arm is so fastened that it may be swung to either point as desired. The other part of the set is made in the same way as the one just depicted. Wood screws will be very convenient for fastening the materials on the baseboard.

Connect stations "A" and "B" as shown in figure 2. Four dry cells (two in each station) connected in series are sufficient to give the necessary electric current. Figure 1 represents the wiring diagram of the apparatus.

With the position of the switches as shown in figures 2 and 5, a message may be transmitted from station "B" without any perceptible clicking of the armature of the sounder of the transmitting party for no current passes through the local sounder. Likewise a message may be transmitted from station "A" by changing the position of the switches as shown by the dotted lines.

EMERGENCY BRUSH REPAIR FOR GENERATOR OR MOTOR

By RALPH A. LAMBERT

While spending the summer touring in the mountains, one of my generator brushes gave out, and after limping several miles to a garage, I found there was no help, as the proprietor had no brushes! And the next garage was 38 miles away, 6,500 feet down in the valley!

The trouble was remedied, however, with the aid of a hack-saw, drill, and old battery. The dry-cell was broken open and the carbon removed. This carbon is about one inch across and six inches long. A section was cut out somewhat larger than the old brush and filed down to the exact size. The two holes were then drilled in with a hand drill, and the correct angle filed on the commutator end of the brush. Great care must be used in drilling the holes, using very little pressure, as the carbon is so brittle that it cracks very dearily. It is well to drill the holes before sawing out the pieces. This is only a temporary job, however, and the proper brush should be put in as soon as possible. The carbon in the dry cells contains no copper, and is of much higher resistance than the copper-impregnated brushes made for auto generators. The result is that the emergency brush will heat quickly, and clog up the commutator with burnt carbon.

However, it is well worth the trouble of making, when you are stranded!

EXPERIMENT WITH AN ARC

By ROBERT L. LEWIS

The following is an account of an experiment which I made.

An open adjustable arc is constructed to operate on 110 A.C. with suitable resistance or choke. If an alternating current magnet is held below the arc while in operation, a very loud noise is heard and the arc is "blown" away from the magnet making a hot torch. If a permanent magnet is used the arc is attracted to one pole and repelled by the other. If a strong direct current magnet is held to the arc a loud sputtering hiss is heard and the arc is again repelled.

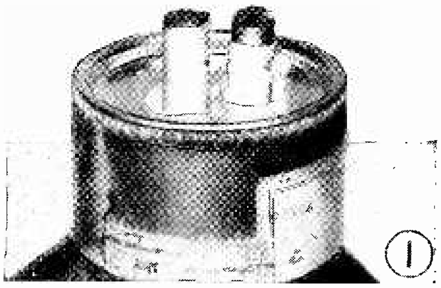
Colored glasses must be worn to save the eyes.

Making a Portable Arc Lamp

Cheap Electric Arc Lamps Especially Useful to Photographers

By RAYMOND B. WAILES

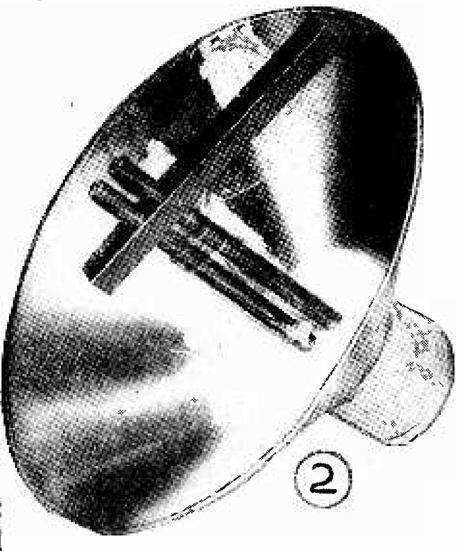
An electric portable arc lamp that is self-feeding and which has a high actinic light value has often been desired by the amateur photographer and experimenter. Such a lamp is easily made and compares favorably with the same type of lamps now on the market which sell for fifteen dollars or more.



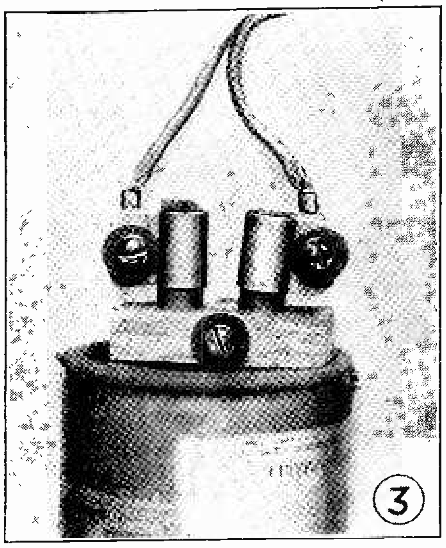
The mould for the rods is made from a cardboard carton. Remove the metal end, if there is one. Wrap the rods with paper before pouring the plaster, so that the holes will be large enough for the carbons to slide back and forth.

The reflector consists of a metal lamp shade of the conical type. If dirty on the inside it should be polished, or if this is not possible, it should be given a coat of a good white zinc oxide paint. The two carbon rods forming the arc are ordinary carbon arc lamp pencils such as used for regular arc lamps. They are held in position by a mass of plaster of Paris which is cast on the smaller end of the reflector-shade.

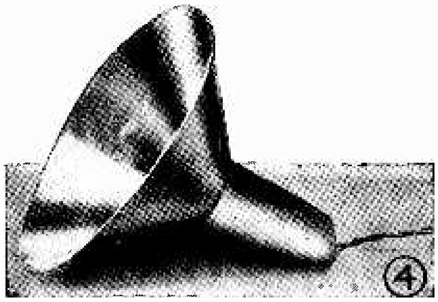
The mass of plaster of Paris which retains the carbons is poured into a mould made by cutting off a cardboard carton and placing this over the smaller end of the shade. Figure 1 shows how the carbon rods protrude from the bottom of the shade and Figure 2 shows the method of holding the carbon rods in position while the plaster is being poured and is hardening or setting. The carbons should be so placed that they are inclined toward each other at their tip ends; they are not placed parallel with each other. The distance between them at the smaller end of the reflector should be about a quarter of an inch, while the distance at the extremities of the rods where the arc is formed should be about an eighth of an inch. Two thicknesses of paper wrapped about the rods before the plaster is poured around them will enable the rods to be withdrawn when the plaster is hard, and at the same time holes in the plaster will be formed which will be, when the paper is removed from the carbons, too large for the carbons. This clearance is used as a means for adjusting the distance between the two carbon rods.



While the plaster of Paris is setting, the carbons are held apart by means of a wooden strip. Enough plaster is used to go well inside the shade so as to give a solid construction.



The adjusting clamp and electrical contacts are clearly shown here. Use heavy, yet flexible wires. The clamp is in two pieces, which grip the carbons firmly when the central screw is turned up.

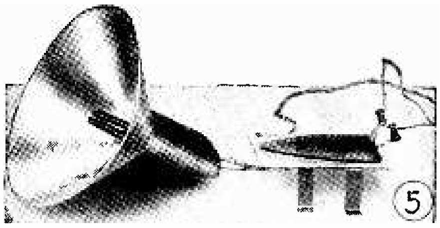


The finished arc lamp. Note the section of inner tube, which serves as handle and protector. The operator might get a severe shock without this protection.

The adjusting of the two rods is carried out by means of two strips of hard wood fastened together with a bolt. The two strips clamp the carbons tightly together as shown in Figure 3. Electrical connections are made with the carbon rods by means of two metal collars or clamps affixed as shown in the same figure. The cardboard carton used as the mould for the plaster of paris can be left on, after the plaster sets, as shown. Figure 4 shows the completed lamp. A section of an inner tube is cut and fitted over the plaster base and the metallic connectors. The plaster thus serves as a hand grip and also to keep the carbons in position.

The arc lamp described is not made to operate directly from the 110 volt, direct or alternating current, house lighting system. A resistance is needed in series with it. A direct short circuit across the carbons will occur, causing the fusing or "blowing" of the house fuses if the lamp is operated without resistance from the house current.

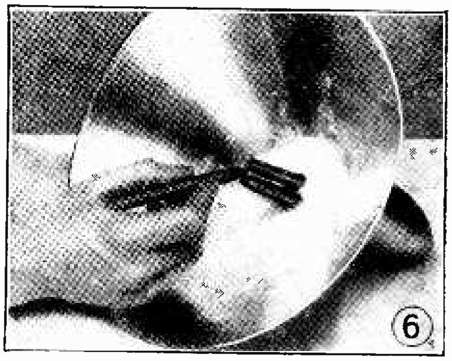
The resistance used in series with the lamp can be conveniently taken from an old electric iron. Its electric resistance element is all that is necessary. This will be found to be wound upon and surrounded by mica sheets. If two binding posts are added to the contact strips of the heating, or resistance element and the element is inserted in series with the lamp, it will be found that the lamp will not light, due to the fact that too much resistance is in the circuit. However, if thirty inches of the resistance ribbon is unwound, removed and discarded from the heating element of the iron, the lamp will operate very well. A stand can be made to support the resistance as shown in Figures 5. Here, two galvanized iron strips were used to form a little four legged table with a sheet asbestos top. The heating element from the electric iron rests upon this asbestos. The asbestos sheet prevents the heat given out by the iron from damaging the object upon which it is placed. The resistance wire becomes red hot.



The lamp with the resistance taken from an electric sadiron. The resistance of the lamp decreases with heat, that of the iron increases with heat, and the opposite actions balance, in a sense.

Starting the arc is very simple. With the current ON, touch a carbon rod to the tips of the two carbon rods of the lamp, and then withdraw it. An arc will be formed, and if the resistance is correct and the tips of the carbons are rightly placed, the arc will remain at the tips. If after repeated trials the carbons do not arc, or the arc is not "struck," then they should be moved nearer each other. This is done by adjusting the wooden clamp at the rear end of the carbons. One might also remove several more inches of resistance ribbon from the electric iron resistance, but it should be remembered that removing wire cuts down

(*Continued on page* 71)



Showing how the arc is struck. A bit of carbon touched to the two ends starts the lamp into action instantly.

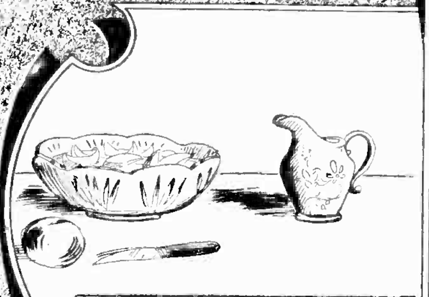
Everyday Chemistry

By RAYMOND B. WAILES

What substance is used to make a solution which when used as a wash for artificial hosiery prevents runs?—This chemical is ordinary alum.

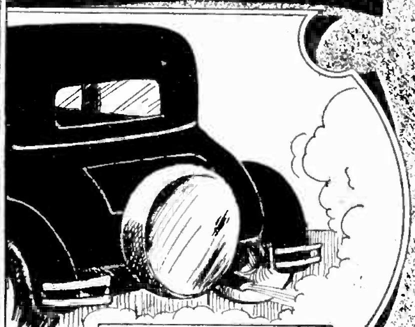
Do you ever eat marble?—Yes, ordinary table salt contains sometimes as much as 1% powdery calcium carbonate. This small amount of impure matter is harmless. Chemically speaking, marble is $CaCO_3$.

Does putty dry out?—Putty hardens because the linseed oil which it contains combines with the oxygen from the air and becomes converted into a hard resinic substance. Nothing can dry out unless at least some of its liquid content evaporates.

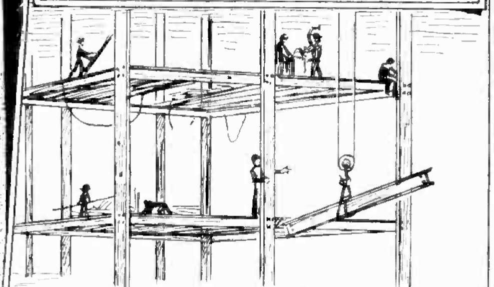


Why does some fruit become dark when sliced?—Because most fruit contains tannic acid, which combines with the iron of the knife blade and forms a soluble black iron tannate. Many inks are made of this substance.

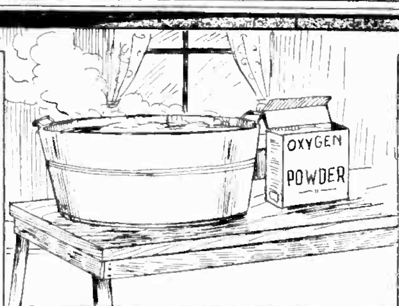
Why are not both wood ashes and coal ashes good fertilizers?—Wood ashes are a good fertilizer because they contain suitable potassium compounds. Coal ashes contain aluminum and silicon compounds but no potassium compounds. Aluminum and silicon are of no benefit.



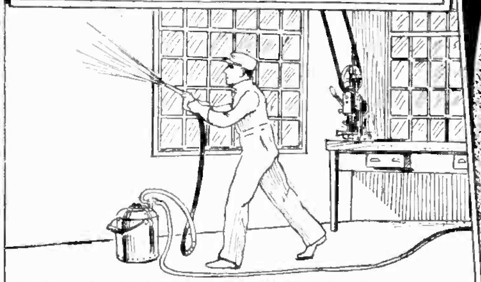
Is the bad smell of an auto exhaust due to carbon monoxide?—No, carbon monoxide has no odor and cannot be detected by smell.



Do bacteria play an important part in the iron industry?—Some iron mines are due to bacteria playing the part of chemists. "Iron bacteria" decompose some forms of iron salts.

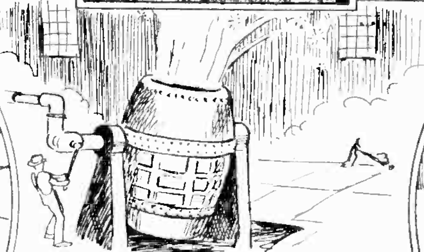


How do oxygen bearing washing powders work?—The oxygen releasing soap powders now on the market contain sodium perborate, chemical sister of ordinary borax, which gives off oxygen when put in water.

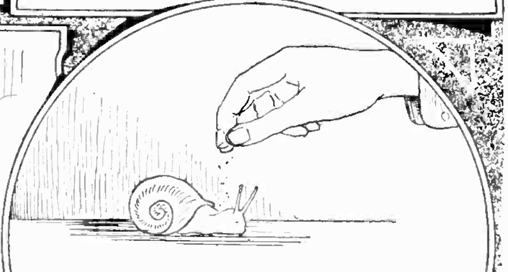


How do factories fire-proof to some extent, their wood structures?—Water glass solution sprayed or painted on woodwork acts as a fire-proofing material. Although the wood beneath will ultimately burn it takes some time for it to do so.

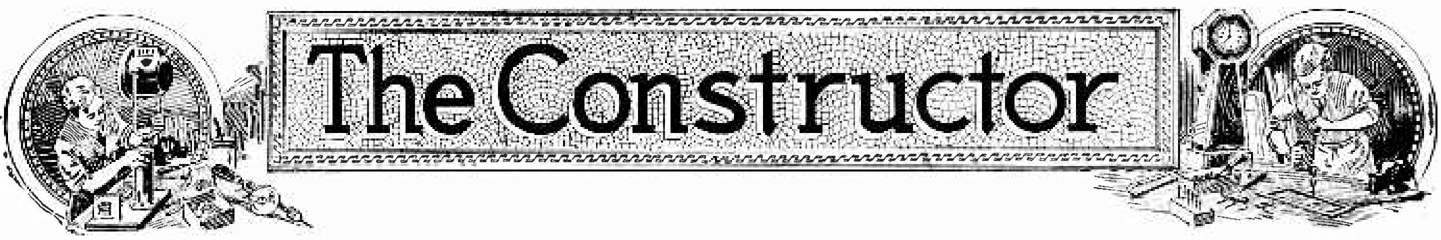
Does concrete dry out when it hardens?—The water in concrete does not evaporate into the air but combines chemically with the cement. Consequently, the water remains in the concrete even after it hardens.



What is the biggest firework sparkler known?—The sparkling portion of the Bessemer converter flame is due to burning particles of iron, and the light of the sparkler is also the result of burning particles of iron.

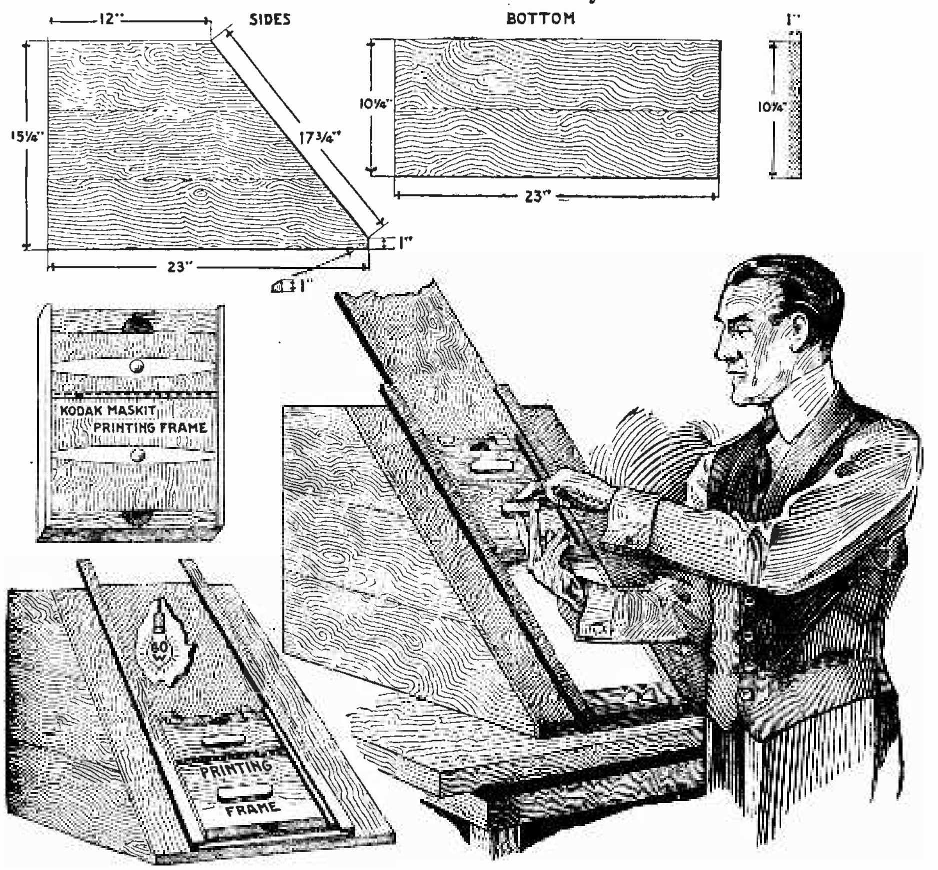


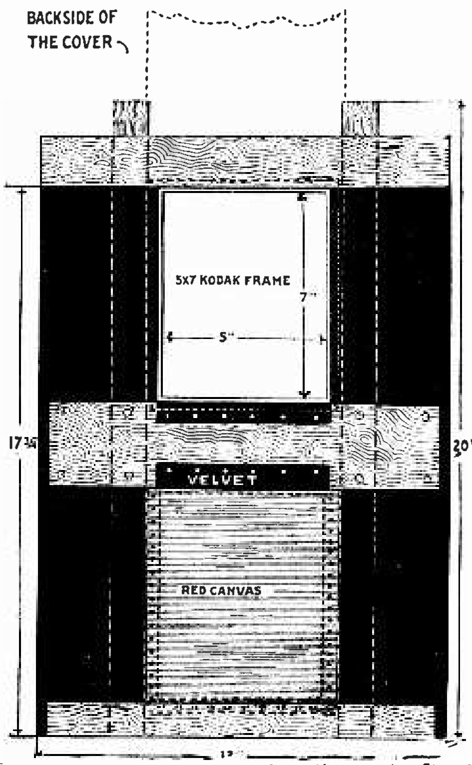
What kills a snail or worm when salt is sprinkled on it?—The liquids within the snail pass through its body to act upon the salt placed on its outside. This is osmotic action and the water in the snail abstracted.



Making A Photo-Printing Machine

By FRANK SCHMID

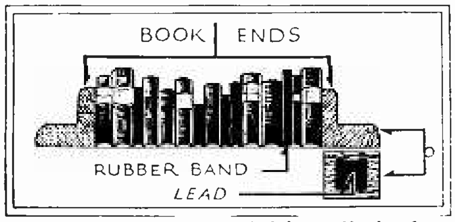




The illustration shown here gives the constructional details of the rapid photo-printing machine. With this arrangement it is possible to produce 30 prints in ten minutes. Black paper should be pasted on the inside of the box to cover any cracks which would admit the light.

THE construction of a photo printing machine is not exceedingly difficult and anyone, at a nominal expense, can make a machine of this nature which will do everything that the expensive manufactured products will. The photo-printing machine shown here is rapid in action and will produce thirty copies in ten minutes by the normal, six to eight second exposure on gas light paper with a 60-watt electric bulb. This bulb should be placed about eight inches from the printing frame, and the use of a kodak maskit frame, 5 x 7 inches, with clamp improvement for holding the films, is to be preferred. For printing from two films, two glasses should be put in the frame and when using plates, one of the frame glasses should be removed. The finished machine should be lined with black paper in order to cover up all the cracks. A strip of red canvas, placed as shown, provides a dark room red light, when the frame cover is opened. The printing frame should be hinged to the sliding front cover, and it is well to place strips of felt or velvet around the frame, so as to be sure that no outside light strikes the sensitized paper while printing. Boards about one inch in thickness will perhaps serve best for the construction. The completed outfit is about 20 in. high and 12 in. wide and about 2 ft. long. The printing machine can be easily made for taking larger size plates and films if desired, but the 5 x 7-inch opening should be sufficient for amateur use. All constructional details are shown in the above cut.

SLIPLESS BOOK ENDS



Book ends may be prevented from slipping by filling with lead or by using a rubber band as shown above.

Wooden book ends are usually too light to hold the books in place. A good way to prevent their slipping out of place is to cut a hole at the bottom of each book end and pour in molten lead. The hole may be covered up by pasting a piece of felt over the bottom of the book end. Another method in which slipping can be prevented is to bore a small hole close to the bottom and nail a rubber band on the bottom of each book end. The elastic tends to tighten and will hold the books firmly in place.—*Oscar Wisbey.*

TESTS FOR TEXTILES

(A) Wool when burned smells like burnt feathers.

(B) Wool can be dissolved in heated sodium hydroxide solution.

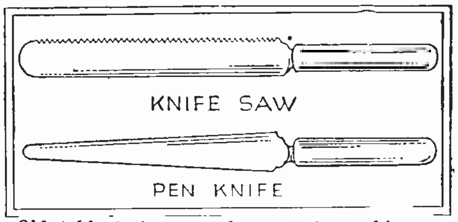
(C) Cotton gives off an acrid smell when burnt.

(D) Cotton does not dissolve in NaOH.

(E) Silk dissolves in heated hydrochloric acid, while wool does not.

Louis Fisch, No. 29367.

USING OLD TABLE KNIVES



Old table knives can be used for making a knife saw and a penknife or letter opener as shown above.

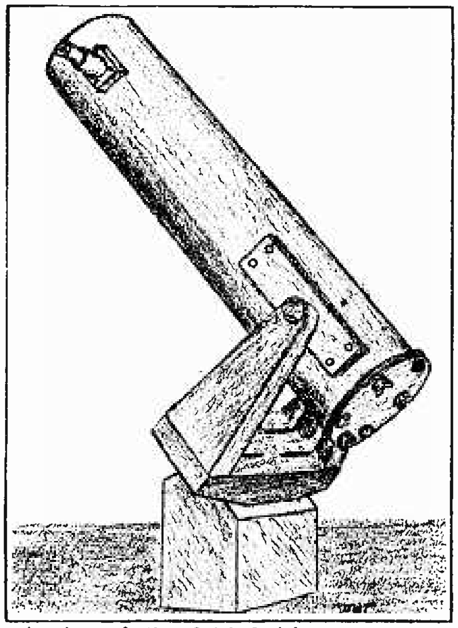
A knife saw and a penknife or letter-opener can be made from an old table knife. Teeth may be filed or cut into the knife, thus making a saw, or the knife can be ground and tapered for making a letter-opener.

A Home-Made Reflecting Telescope

Part Two—THE MOUNTING

By WILLIAM H. CHRISTIE

THE mounting for your telescope may cost anything from a few dollars to several hundred, depending upon how elaborate you intend to make it and also upon your ingenuity. The following description of a simple mounting will serve as a guide in designing a more elaborate



A view of the finished telescope appears above. The mounting may cost from a few dollars to several hundred, depending upon how elaborate it is. (Fig. 11).

one for those who wish to substitute metal castings for the simple wooden parts described here.

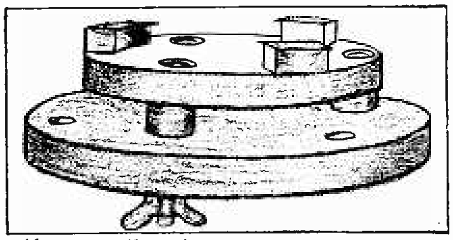
The mirror cells are the first to be described. Cut two hardwood disks, one inch or more in thickness; one two inches the other four inches larger in diameter than is the mirror. Clamp these together concentrically and bore three equally spaced 3/8" holes, near the edge of the smaller, and through both disks. Countersink the holes in the smaller disk to take the heads of 3/8 inch machine screws. Draw a circle the size of the mirror on the smaller disk and then securely fasten three hardwood blocks, with screws, outside this line. These blocks should be hollowed to conform to the shape of the edge of the mirror. Small metal plates screwed to the top of the blocks and projecting over the mirror for an eighth of an inch prevent it from falling out. The mirror should now lie snugly between these blocks but it should not be pinched, a *little* play is preferable.

Obtain three short pieces of vacuum tubing, or heavy air hose, about 3/4 inches long:—a pile of rubber washers cut from an old inner tube will serve. Put three 3/8" machine screws through the holes in the smaller block, screw on a lock nut, then slip the tubing or washers over the screws. Slightly enlarge the holes in the larger disk, pass the screws through these holes, put on a washer, then hold the whole together with three thumb-nuts. See Fig. 8.

For the flat, make a hardwood cylinder equal in diameter to the minor axis of the mirror surface; cut one end off at an angle of forty-five degrees. (See Fig. 9.) Cut another length of the same material to form the upper block. Two circular brass disks will be needed equal in diameter to the above pieces; they should be drilled and tapped as follows. Drill one with a central hole 9/32" in diameter, and drill and countersink three holes for flat-headed screws; hollow out the top of the bevelled block to take the head of a long 1/4-inch machine-screw, slip the screw through the hole in the plate and screw the latter securely to the top of the block, where the head of the bolt should be free to turn. Drill and tap a hole for the 1/4-inch screw in the center of the other plate, and at three equidistant points drill and tap holes for 3/16-inch screws, about 3/16-inch from the edge; three other countersunk holes are drilled for wood screws. Bore holes to take the machine-screws through the upper block, corresponding to the holes drilled in the plate, then screw the plate to it. Thread the 1/4-inch screw up through the upper plate and solder a nut at the end to serve as a thumb-grip. Pass three 3/16-inch screws down through the block and through the threaded holes until their ends press upon the lower plate.

Cut a length of brass tubing into which the upper block will fit snugly, and solder three radial brass strips to this, a little longer than necessary to reach the wall of the telescope tube; drill a 1/4-inch hole near the end of each of these strips and then bend the extra length over at right-angles. This forms the "spider" by means of which the cell is supported in the center of the tube. The mirror is held in position by three small brass strips, bent over at the end and screwed to the lower block.

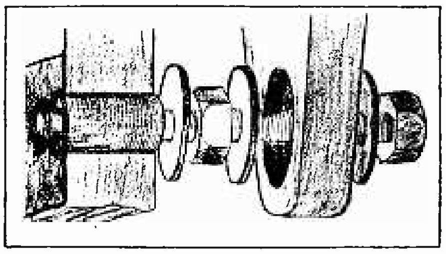
The tube may be a square wooden box arrangement:—anything will serve that will hold the mirrors and lenses in the same relative positions. A tube made of sheet metal by some local sheet metal works will not cost very much and will be neater in appearance, it should have three heavy threaded studs, riveted to the lower end, which pass through holes bored in the larger section of the mirror cell, these serve to bolt the mirror cell securely to the tube.



Above are the mirror cells which are made from two hardwood discs and a clamp. (Fig. 8).

Carefully determine the position of the eyepiece and cut a 1 3/4-inch hole at this point. Drill three 1/4-inch holes for the bolts which hold the spider in position, arranging them so that the flat is directly opposite the hole in the tube.

Two pieces of brass tubing, three or four inches long, form the draw-tube for the eyepiece; one of these is 1 1/4-inch inside diameter and the other large enough for the former to slide in freely. A brass band fitted inside the smaller tube and filed to the correct thickness allows the eyepieces to be fitted snugly into the draw-tube; if the eyepieces are not all the same size an-



The above drawing shows the method of attaching the flat. Two circular brass discs are used. (Fig. 10).

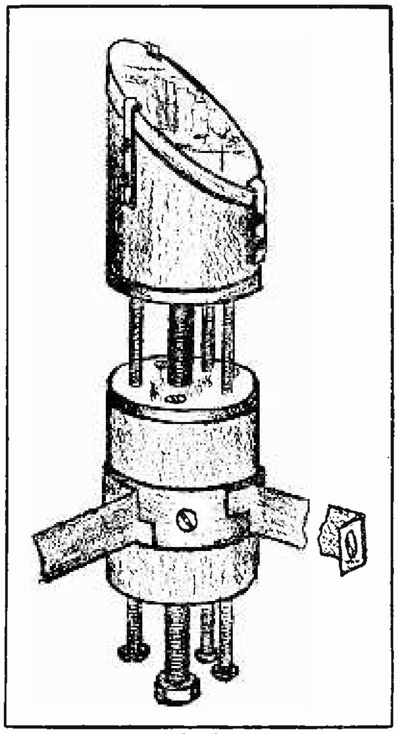


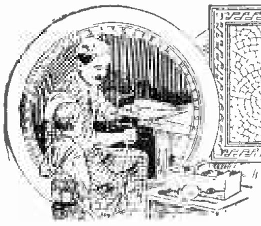
Fig. 9
The mounting for the flat is shown above.

other ring may be fitted in the other end of the tube to take them. Shape a 3-inch square block of wood to fit the tube and bolt.

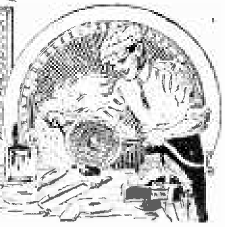
Place the mirror in its cell and bolt it to the tube. Fasten the flat in position and insert the draw-tube. Now find the point at which the tube balances and draw a line around the tube; on this locate two diametrically opposite points. With these as centers drill two 3/4-inch holes. Take two thick pieces of hardwood, about 4 inches by 18 inches for a six-inch telescope, and bore holes in their centers to take a short length of 3/4-inch iron pipe. Shape these "cradles" to fit the tube, and bolt them over the two holes. Screw in two short lengths of 3/4-inch pipe, with their ends flush with the wood. Build up a substantial fork as shown in the sketch of the completed telescope, bracing it well with angle irons. A piece of heavy shafting forms the principal axis and is threaded, or held by two nuts, in the cross-piece of the fork. The tube is now attached to the fork as shown in Fig. 10, any play being taken up with washers. It will be noticed that the tube is not bound by the bolts, which are clamped to the fork, but is free to turn about them as an axis.

Bore a hole for the shafting through a length of heavy timber such as a 6-inch by 6-inch, or larger, making an angle with the axis of the post equal to the colatitude of the place where the telescope is to be erected. (The colatitude is equal to ninety degrees minus the latitude; e. g., the colatitude of a place 42° 30′ north is 90° — 42° 30′ = 47° 30′.) The top of the post is then cut as shown in Fig. 11, and the post erected in the

(Continued on page 70)

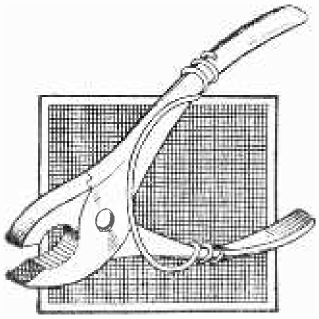


How to make it



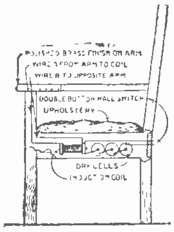
ARTICLES OF INTEREST TO EVERYONE

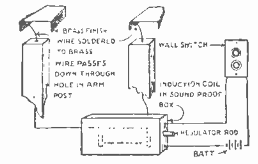
PLIER SPRING



A piece of spring wire fastened to the plier handles provides sufficient spring to keep the pliers open at all times. Equipped in this manner, the pliers do not have to be pulled open whenever a new hold is required.—Contributor kindly send name and address.

ELECTRIC CHAIR

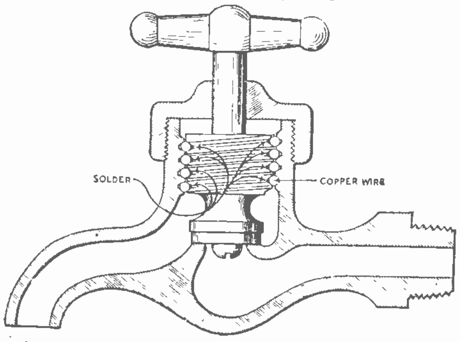




The above drawing shows the constructional details of a harmless electric chair. —L. B. Robbins.

REPAIRING FAUCETS

Water faucets which have had the threads stripped off, may be repaired so that they will again render good service. A piece of brass or copper wire is wound in the worn threads and soldered securely in place. This

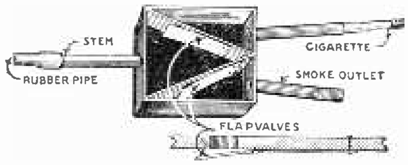


A piece of brass or copper wire is wound in the worn threads of the screw portion as shown above.

should then be smoothed with a file, and you will then have a brand new screw, good for months of additional wear. The drawing shows clearly the method used in repairing faucets.—*Douglas O. McKeown.*

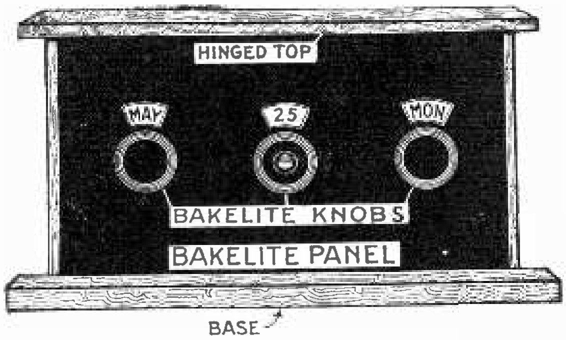
THE SMOKING PUMPKIN HEAD

A novel display device in which a pumpkin head or dummy can be made to smoke a cigarette is shown here. The details of the valve box, which is placed within the head itself, are shown below. The box is constructed of copper, with three copper tubes arranged as shown. The valves may be made from sheets of thin rubber or stiff cloth fastened by small rivets.

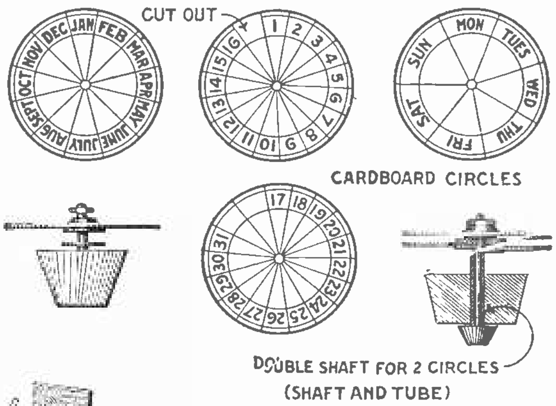


Details of valve box are shown above.

A Library Table Cigarette Cabinet

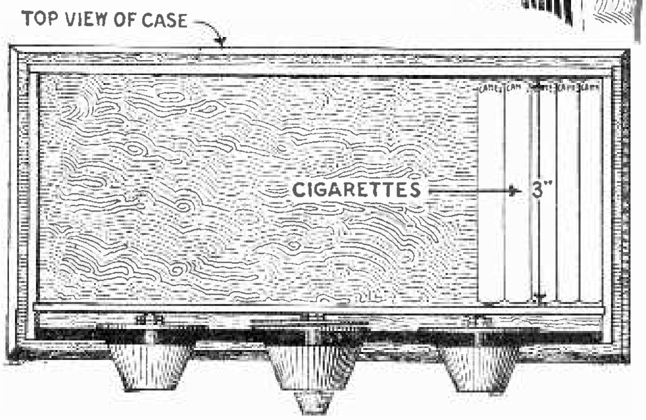


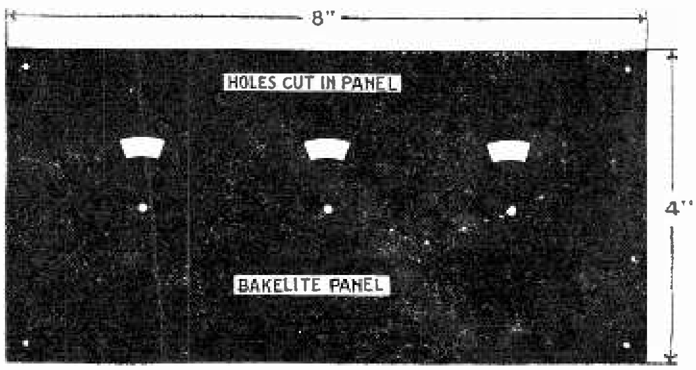
A very novel cigarette cabinet can be made in the form of a small radio receiver, and is a combination cigarette case and daily calendar. The days and months and years are changed by the dials. The complete cabinet is shown at the left.



A top view of the cigarette case appears below. The cabinet is made of wood and the panel may be made of wood, bakelite or hard rubber. The calendar cards are cut from stiff cardboard. Two ordinary knobs with small shafts for their outer ends are required. The middle knob has a hollow shaft through which another smaller shaft is pushed. One of these double knobs can be obtained from an old type variable condenser equipped with a vernier.

Details of the circular cards are given above. The center indicator for the day of the month is double and is regulated by the center knob. One of the center cards is numbered from 1 to 15, and the other from 16 to 31. After the panel is put in place, a strip of wood should be fixed so that it just clears the circular cards and shafts. —Herman R. Wallin.

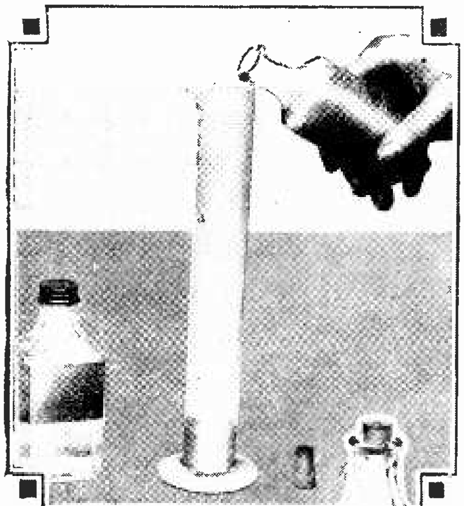




Transferring Drawings and Pictures to Paper

By RAYMOND B. WAILES

FREQUENTLY one wishes to transfer drawings appearing in the daily press to a scrapbook, notebook, or some other cherished volume. Ordinary newspaper clippings rapidly become yellow and even brown with age, due to the iron compounds which the paper contains. If one transfers the cherished drawing by a sort of decalcomania process as described in this article, to a good grade of white rag paper, the drawing can be kept for a much longer time without discoloring.

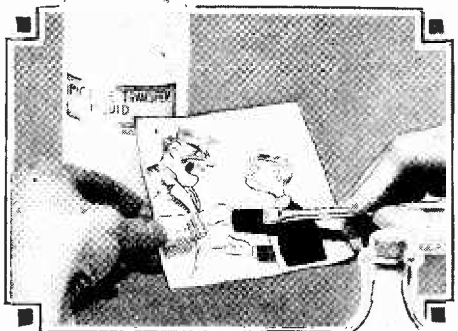


Mix a teaspoonful of spirits of turpentine with a teaspoonful of tincture of green soap. Add two cups of water. Mix. This is very simple, isn't it?

The solution used in this process is extremely simple and inexpensive to make. If the ingredients are bought at a drug store they will cost about twenty-five or thirty-five cents, and will make about a quart or two of solution. Only several drops of the solution are needed to transfer the drawing to another sheet of paper.

The solution is made by mixing equal parts of spirits of turpentine and tincture of green soap, and diluting the resulting mixture to about 500 times its own volume with water. One may take a teaspoonful of each of the two liquids, mix them together, and then add two cupfuls of water, mix well and bottle. For those scientifically inclined, 5 cc. of tincture of green soap and 5 cc. of spirits of turpentine mixed together, and diluted to 500 cc. with water, will make a very good solution to work with. The solution should be shaken when desired for use.

One should clip the cartoon or drawing—newspaper line drawings make excellent transfer pictures—and apply the solution with a soft brush, wetting the whole of the picture thoroughly. The excess of liquid should then be removed by means of a blotter applied very gently to the picture. The paper bearing the picture is then laid face downward upon the paper to which the picture is to be transferred, and the back of the paper bearing the picture is rubbed gently but yet firmly with the bowl of a spoon for about half a minute. This rubbing process is the cause of the transferring of the picture. The solution merely loosens the dried vehicle of the printer's ink, and by rubbing, the ink is transferred from one paper to the other. By carefully lifting up one corner of the paper, one can see just how the transfer is coming about. If a white spot is seen, or the transfer appears faint at spots, these portions should be rubbed more. When the desired intensity is reached, the original paper is lifted from the new, and the transferred picture allowed to dry. Only one copy can usually be taken. The original drawing is only made a bit fainter by the process, as the above pictures show.



The original cartoon is thoroughly soaked with the picture transfer fluid, by means of a small soft brush. The excess mixture is carefully removed with a blotter.

Some of the pictures shown here have been clipped from the Sunday comic section, advertisements, and other sources. Only one original picture, clipped from a paper, is shown. The remaining illustrations are all transfers. The transfers are much better than they appear on this page, for the act of making them into magazine illustrations causes them to lose detail.

The picture above shows an ordinary newspaper cartoon and the illustration at the left shows the transfer made from the original cartoon. Note that transfer is reversed.

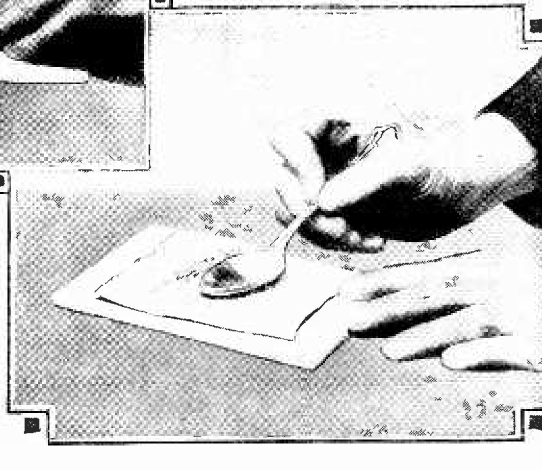
The transfer of any cartoon or printed matter will appear as a reflection of this matter. This, of course, is of no importance unless the reading matter must be legible on the transfer. There are times, however, when legibility is necessary, and this condition may be obtained by making a transfer from the first transfer. This retransfer is made in the same manner in which the original transfer was made, only of course the transfer is used in place of the original print. This second copy is somewhat more indistinct than the first, but if the process is carefully carried out, by a person who has had a little experience with this method, satisfactory retransfers may be produced.

The quality of these transfers, and especially the retransfers, depends somewhat upon the quality of the printer's ink. The length of time since the picture was printed, does not seem to affect results to any noticeable extent.

It has been observed by some that this transfer of a cartoon shifts the objects on the right-hand side of the original, to the left-hand side of the transfer, while objects at the top of the cartoon are not shifted to the bottom of the transfer. At first thought this seems to be an unreasonable discrimination, but a moment's reflection will remove any confusion on this point.

By using this process, pictures may be copied on ordinary paper. Coated stock gives a finer reproduction.

The surplus solution is very gently removed by using clean blotters as shown above. By this time the printer's ink has been softened and the cartoon must be handled carefully.



When the ink of the original cartoon has been softened, the cartoon is placed face downward upon the surface which is to receive it, and rubbed with the back of the bowl of a spoon.

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.

SOUND OR NOT SOUND

Editor, SCIENCE AND INVENTION:

Your article "If We Had No Ears!" is not convincing. Why? You and your critics differ on a fundamental definition of sound. You find sound in the vibrating object and the physical results through a conducting medium. Your critics find sound only in the terminal result on a sensorium or nerve apparatus, with distinct emphasis on the mental factor.

If a tree falls on an uninhabited island, does it make a noise? You say distinctly, yes. Drawing a sharp line as they do, they would say, "Yes, the falling tree produces vibrations that, were the appropriate sensorium present, would give the final subjective result, sound. As the sensorium is missing, the final result, sound, also is missing."

WJZ and WEAF may broadcast till the cows wake up tomorrow; but unless you have the appropriate instrument in your corner, the radiated energy won't register and there is missing the terminal effect due to the instrument.

In like manner, the precisians would say, "The microphone and the phonograph do not register sound or noise, but vibrations that, were the appropriate sensorium present, would result in sound or noise."

"If the rod extending from the bell" in the evacuated bell-jar "should be gripped by the teeth, then the sound will be distinctly heard. This would indicate conclusively," you declare, "that the object within the jar is producing a sound even though we do not hear it."

Again your critics retort, "you are wrong. It indicates conclusively that the object within the jar is producing not a sound, but vibrations that, conducted to a sensorium, produce sound."

From the vibrating bell, through every step of the process to the final mental result, let us say a pleasing musical sound, what part. what parts or should the entire process be considered as sound? Isn't that the question for you and your critics to answer before deciding about the falling tree and exploding bomb?

On page 30 of Laemmel's "Einstein's Relativity Theory," there is a picture entitled, "The earth in a sea of light." The late Edwin J. Houston, professor of physics in the Philadelphia Central High School, declared we could not *see* light itself. To explain the paradox, he described this experiment: Shoot a beam of light lengthwise through a dustless, dustproof and otherwise clean black box; an observer looking transversely, i. e., across the direction of the supposed beam, cannot find it! "There ain't no sech animile." But streaming from the opposite exit into a dusty room, lo! There is a beam of light. What then is the explanation of the paradox? The energy responsible for the visibility or illumination which we specifically call light, is itself invisible. Something —a ball, a sign, a flag, a speck of dust, a chunk of atmosphere—must get in the way of that energy, to reflect, refract or diffuse it before we call it light.

(Nevertheless it is there even if we can't see it.—EDITOR.)

Everyone of us can perform the experiment on a much grander scale. On a clear, moonless night, with Venus well above the horizon, any one of us standing within the earth's shadow-cone can look transversely across the line that joins Venus and the sun. But not a ray, beam nor streak do we see. Why? Out there in interplanetary space there isn't enough dust or anything else to get in the road of the sun's radiant energy to produce the illumination we properly call light. Clearly, in the picture in Laemmel's book, the sea of "light" is not light, but an invisible energy that becomes light only when something gets in the way.

A precisian—and of all men shouldn't a scientist be precise?—will go a step farther. Just as in the case of sound, so he continues for light, viz., until the physical vibration registers in an appropriate sensorium, it should not be called light.

"We cannot see," you continue, "the ultra-violet or the infra-red rays of light, neither are they discernible through any of our senses. We cannot see the X-rays; we cannot hear radio waves if transmitted from the antenna of a broadcasting station. Would any of our readers question the production of any of these?"

Certainly not; but they are questioning your judgment in applying the terms "sound" and "light" to other than the terminal effects. "Inaudible sound," and "invisible light" are contradictions in terms. To your critics, X-rays, ultra-violet and infra-red rays are not light, but forms of vibrant energy that cannot become light unless they produce the subjective result to which the critics restrict the term.

Let us not stop with sound and light, but proceed to smells and tastes and varied tactual phenomena, e. g., hardness, substantial resistance of many kinds. Revolving these phenomena into separate sensations, I may readily derive a solipsistic idealism in which you and indeed everything else in the universe exist only as phenomena in my mind. But this highly subjective world splits or "polarizes" into a seeming-subjective and a seeming-objective world with distinctions not a whit different from those of the real world. You see a brick fall and you dodge the brick; the solipsist would dodge in the words of Mill, "a permanent possibility of sensation."

Our sturdy common sense cuts the Gordian knot. In some way or other it confirms the realities. No matter how entangled they may be with psychic processes, yet there they stand, independent of the processes. When, however, you put the question, "If every living thing were stone deaf or dead as a door nail, would there exist the special, terminal effect called sound?" The same sturdy common sense answers with an emphatic "No."

RICHARD P. LOCHNER,
Philadelphia, Pa.

(We didn't say "terminal effect called sound," we used the word "sound".)

(The whole controversy around the article "If We Had No Ears" is based entirely on a misunderstanding of what is meant by the term "sound." According to Webster's Unabridged Dictionary, which is used in court today, we find two definitions. First: the sensations produced through organs of hearing. Second: the physical cause of this sensation. Waves of alternate condensation and rarefication passing through an elastic body, whether solid, liquid or gaseous, but especially through the atmosphere.

In the first definition, any vibration is not a sound unless the ear is situated somewhere within the range so that it can hear that sound. Coincidentally, vibrations above or below human audibility are not sounds, even if animals can hear them or if they can be recorded and reproduced at lower frequencies.

Medical men today, physicists in general throughout the world, and scientific scholars hold that the second definition is the most informative. It is this second definition which was, therefore, used in developing the article on sound. In this definition all vibrations as described would be sounds, whether sixteen per second or 40,000 per second, to which some human ears respond, but which latter are absolutely meaningless to the majority.

Assuming the first definition to hold, then to a deaf man there is no sound; hence such a thing as sound does not exist, yet that same deaf man can put sound to work. He can make it record. He can make it vibrate a diaphragm or change bands of light. He can feel the diaphragm vibrating and even understand what some of those vibrations represent but, of course, the sound does not exist for him; hence, he only believes that he is feeling vibration. Those, therefore, that adhere to the first definition, would have us hold that our unfortunate subject is a victim of a strange hallucination.

We cannot hear the language used by ants. We do not know whether dogs or cats speak or converse with each other, but does that mean to say that they do not do so? Supposing a sensitive microphone were able to pick up the noise made by ants (above human audibility range) and suppose it were to heterodyne this noise and bring it down to the limits of audibility as dictated by our individual chorda tympani and the nerves communicating therewith and suppose, subsequently, that we were able to understand the language of these ants, would you have us believe that we are understanding something which does not exist because we could not hear it in the first place?

Our critics are not proven correct when they find sound only in the terminal result on a nerve apparatus.

You state that WJZ and WEAF could broadcast till the cows wake up, but unless we have the appropriate instruments, we will be unable to hear. Correct—but that does not prove that these stations are not broadcasting, just as the fact that light cannot be seen when it passes through a dustless box, does not prove that the light does not exist therein. Any means of demonstrating the presence of that light, whether by the only one of our senses capable of perceiving it or all of them or a combination thereof or by instruments, proves the presence of that light, and it is light because it produces all of the effects of light, such as those on silver salts, light recorders, spectrum bands, etc.

A scientist is precise and it is for that reason that he accepts the second definition rather than the first, because, what is sound to you, may be inaudibility to me and maybe noise to another party. Modern usage of the words sound or light apply to all effects produced by frequencies in any medium in the bands alloted to the phenomena, sound generally taking from 16 to 40,000 vibrations per second, and light due to ether waves of various frequencies.

Of course, we could argue this question indefinitely, depending entirely on which of Webster's two definitions you choose to accept. If you would be a true scientist you must accept the second.—EDITOR.)

ELECTRIC BELT

Editor, SCIENCE AND INVENTION:

I am enclosing a clipping which I saw in the "Wide World." Whether it is a swindle or not I don't know, but I thought you might be interested.

I think your work in helping protect the credulous public is a great thing.

C. H. B. BULLOCK,
Halifax, Canada.

(Mr. Bullock enclosed a clipping of an electric belt with the usual two electrodes at the back and one at the front and a series of wet cells surrounding the belt. Investigations on electric belts have been conducted by a great many organizations. In so far as their curative properties are concerned, the psychical effect on the wearer is without a doubt the all-important factor. The belt actually does produce a small amount of current, but it is extremely doubtful whether this current is of any value to the human organism whatever. These cells polarize very rapidly, and a short time after they are placed on the belt they lose most of their original kick, after which they must be again removed from the belt and dipped into vinegar. This is the method by which the batteries are charged. Previous issues of SCIENCE and INVENTION Magazine contained exposés on these belts.—EDITOR.)

LIKES MODEL DEPARTMENT

Editor, SCIENCE AND INVENTION:

Contrary to one of the letters published in the Readers' Forum, February issue, I think that the Model Department is a splendid item in your magazine. Although no serious damage would be done by its removal, I think that many of the readers would be disappointed. I am of the same opinion of the other departments mentioned. Magic by Dunninger may not be wholly a scientific phase, but it offers a certain amount of amusement to the readers. I, myself, enjoy the department very much, and I'm sure that the majority of your readers do also. I think that you do very well in your endeavor to meet the approval of all your readers.

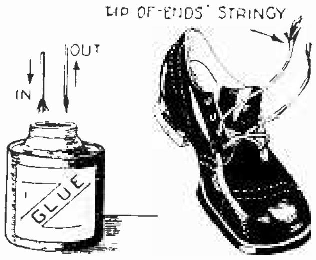
I wish you every success.

BOYD HARMON,
Salt Lake City, Utah.

(It is always our aim to try to get the approval of the majority of our readers. It is only in this manner that we are able to get a bigger and better SCIENCE and INVENTION Magazine, and it is up to the readers to tell us what they like and what they do not like, so that we can follow their suggestions.—EDITOR.)

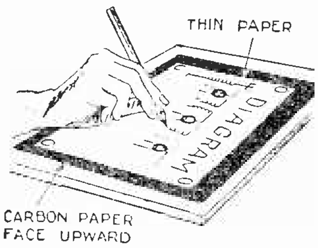
Wrinkles
RECIPES & FORMULAS
Edited by S. Gernsback

FIXING SHOE LACES



The ends of shoe laces which have become unravelled because the tips have been lost, may be dipped in glue and allowed to dry. A new point is thus made at the end of the lace, and the process may be repeated if necessary.—Wilson G. Walters.

DRAFTING AID

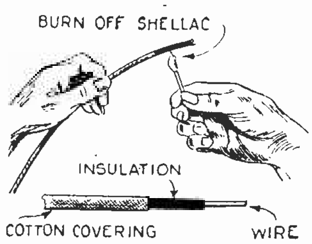


When tracing sketches or drawings, an excellent impression can be made upon the paper, by placing a sheet of typewriter carbon paper, face upward, under the paper. — George L. Nixon.

CLEANING THE TYPEWRITER

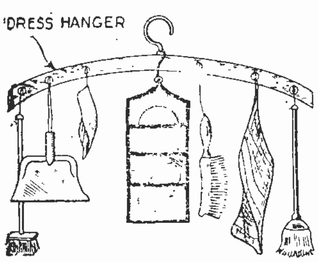
If the type on a typewriter is wiped clean about once a week with a rag soaked in benzine, it will be found that the machine will make a much more distinct impression.—Dale Pollack.

WIRE KINK



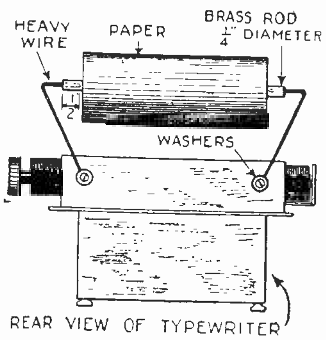
To prevent the ends of test leads from fraying, they should be coated with shellac and then ignited to allow the alocohol to be consumed. The wire can then be stripped. No damage will be done to the rubber insulation.—W. S. Koop.

UTENSIL HANGER



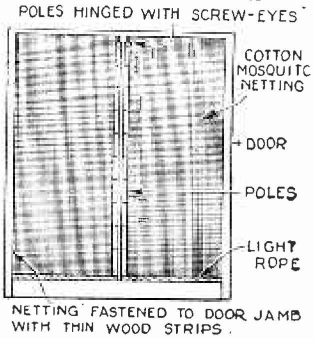
A wooden dress hanger makes an excellent kitchen utensil support. Several small hooks are screwed in the wood and provide hangers for small brooms, dustpans, dusters, and the like. It may be carried conveniently from room to room while house cleaning, and will find many adaptations about the home.—T. B. Marsden, Jr.

ROLL ATTACHMENT



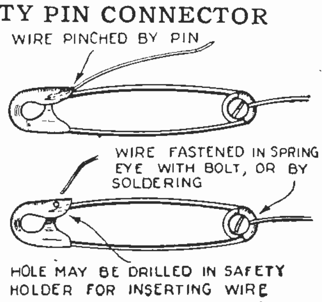
The above illustration gives the details of a paper roll attachment to be used with the typewriter. The paper is fed from the roll as the typewriter knob is turned. This should be especially valuable to radio and telegraph operators, and can be used for taking rough notes directly on the typewriter.—Herman R. Wallin.

MOSQUITO-PROOF DOOR



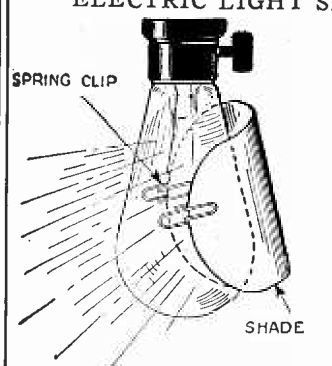
A mosquito-proof door is easy to construct as shown at the right. Cotton mosquito netting is fastened to two sides of the door jamb, slit in the middle and two poles fastened to the ends. — Herman R. Wallin.

SAFETY PIN CONNECTOR



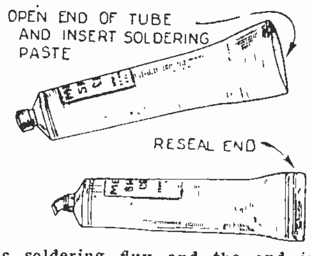
A safety pin provided with a small bolt and nut as shown, makes a good test connector. The pin is opened and a wire is inserted. The pin is closed for making a connection. — L. A. Collins.

ELECTRIC LIGHT SHADE



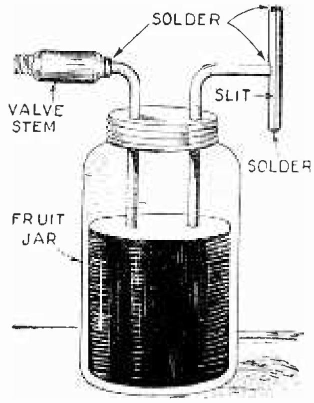
An emergency light shade can be made from two springs clips and a piece of paper or cardboard as shown in the illustration at the left. The shade can be readily adjusted to any position and will fit any size bulb. A number of these shades are very useful around the house and the draughtsman or student will find them useful.—L. A. Collins.

SOLDERING PASTE CONTAINER



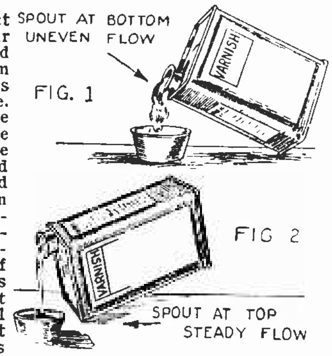
An old tooth-paste or shaving cream tube provides a handy container for the soldering paste. The rear end of the tube is opened, and the tube thoroughly cleaned. It is then filled with this soldering flux and the end is resealed.—Wm. J. Ahearn.

PAINT SPRAYER



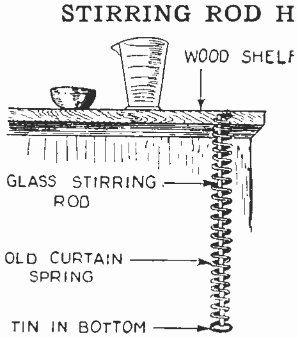
The glass is removed from the cover of a preserve jar and two holes are drilled in the cover. A valve stem is now soldered to a piece of copper tubing which in turn is soldered to the zinc cover. Another piece of tubing is also soldered in place as shown and a smaller piece of tubing is soldered to the end of it. Both ends of this small piece of tubing should be soldered closed and the tube split as shown.—David Sally.

POURING KINK

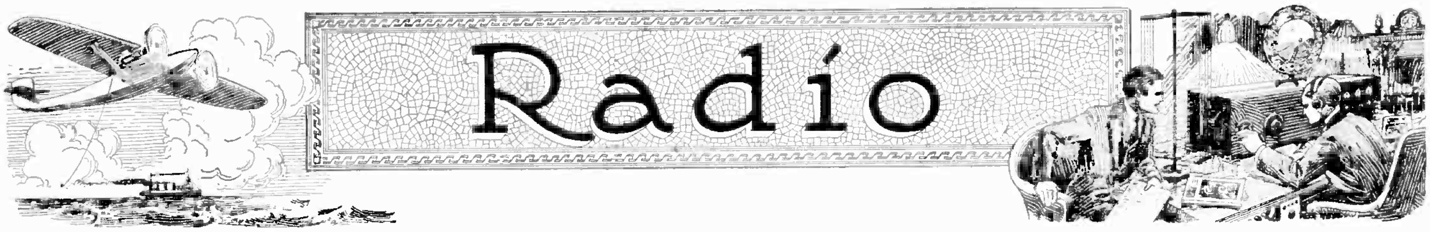


The correct way to pour the liquid contents from a can is shown here. Most people pour with the spout at the bottom, and the liquid comes forth in a most unexpected manner. The correct way of pouring is shown at Fig. 2. It will be found that when this method is adapted, the liquid contents will flow out evenly. Practically all containers for liquids have the spout offset.—Lawrence A. Heinle.

STIRRING ROD HOLDER



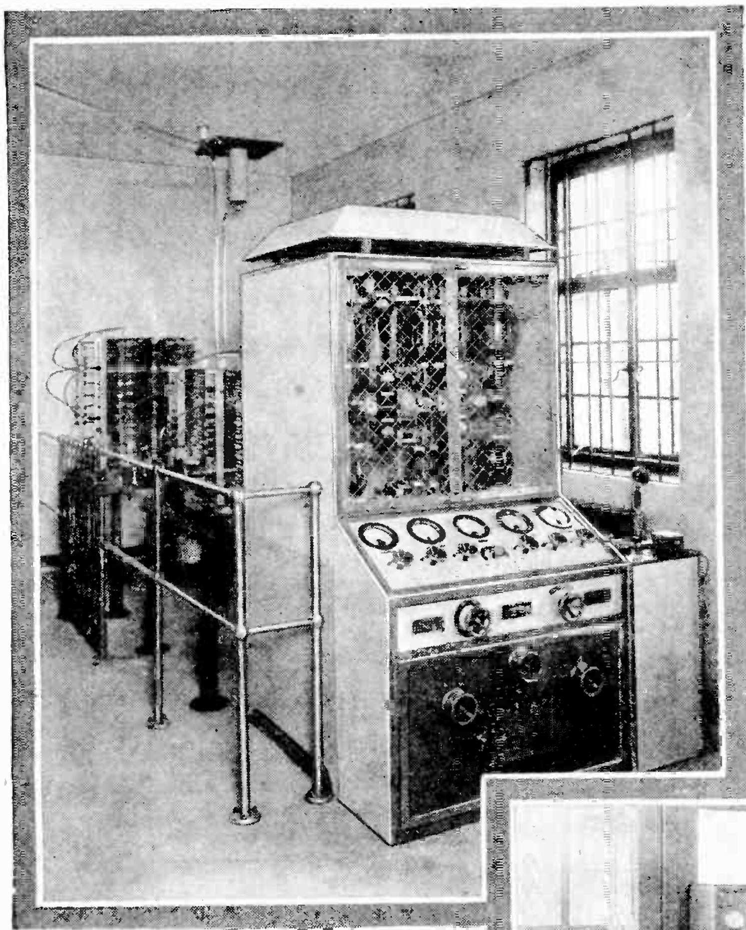
Nothing gives the amateur photographer or chemist more trouble than his glass stirring rod. Take an old curtain spring, stretch it out to a length a little less than the rod; clinch a small piece of tin to the last coil of the spring on the bottom, and turn the top coil out for about a quarter of an inch and file a point, so that it may be forced into the wood. This will make a good holder for the fragile glass rod.—Frank W. Bentley.

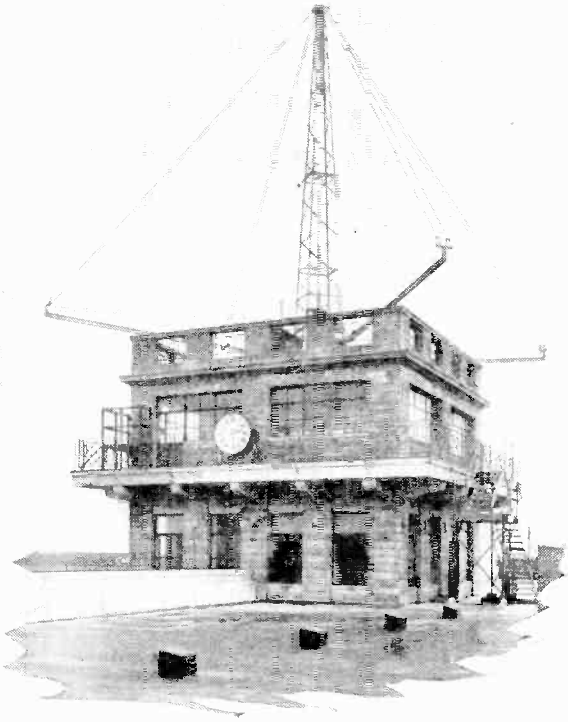


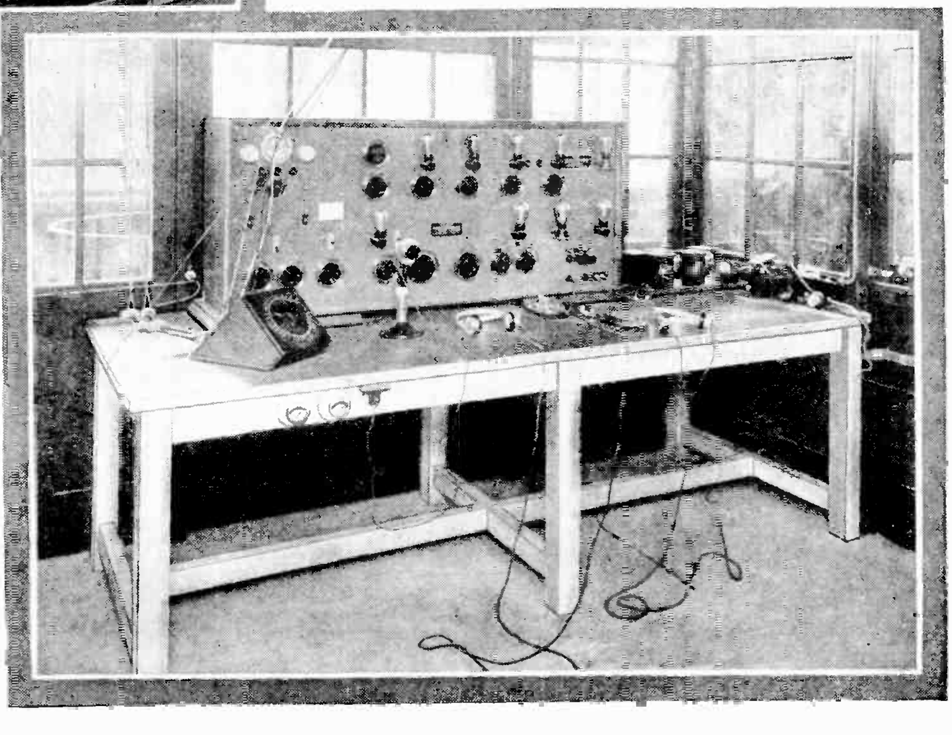
Croydon Airplane Radio

Airdrome Station Uses Remote Control Transmitter and Directive Receiver

There has recently been erected, at the London airport in Croydon, a new radio transmitting station which maintains communication with planes while in flight. The control tower is shown below at the right, and the Bellini-Tosi triangular loops may be seen. These loops are used for directional radio reception. A horizontal aerial about 100 ft. long is also used in connection with the station.



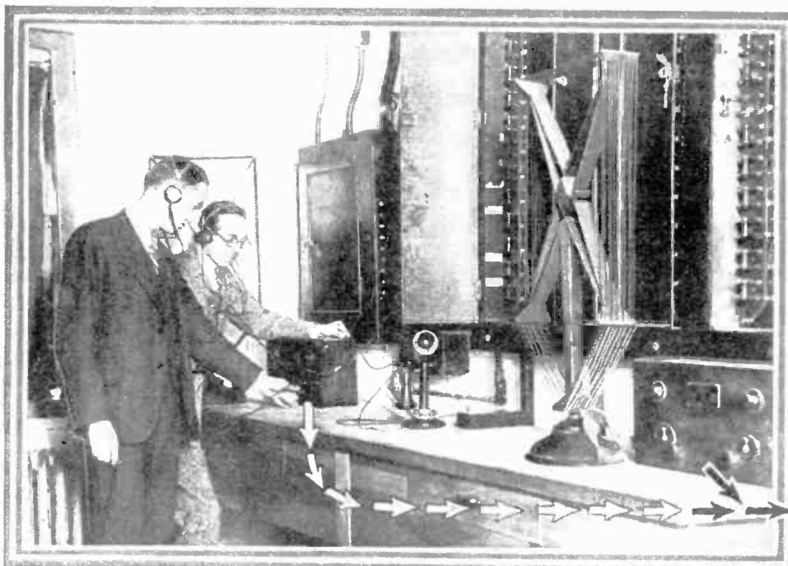




THE photograph above shows a view of one of the four 3-kw. airdrome ground transmitters installed near the airport. The top part of the transmitter contains the various tubes and the controls are arranged on a sloping panel. The transmitter works on any wavelength between 800 and 2,000 meters and can be used with phone, C. W. or I. C. W. At the right we have a view of the receiving set which employs nine tubes. This is placed within the control tower. From this tower, the four transmitters at the radio station, in Mitcham, 2½ miles from the airdrome, are operated by a remote control system, and thus, communication with the airplane in flight is maintained. Each of the four transmitters is rated at 3 kw. and independent drive circuits are incorporated to maintain a constant frequency. The receiving portion of the radio station was specially designed by the Research Department of the Marconi Co. and is remarkably selective. It is so arranged that two or more receivers can be operated on different wavelengths for the reception of telephony and telegraphy on the same aerials. By means of the directional loop shown in the photograph, it is possible to ascertain the position of the airplane while in flight, and the pilot by taking a number of readings can find his bearings even at night or in foggy weather. It is claimed that Croydon now possesses the most complete airdrome radio equipment in the world and has considerably extended its range of communication with other terminal airports and with planes in flight.

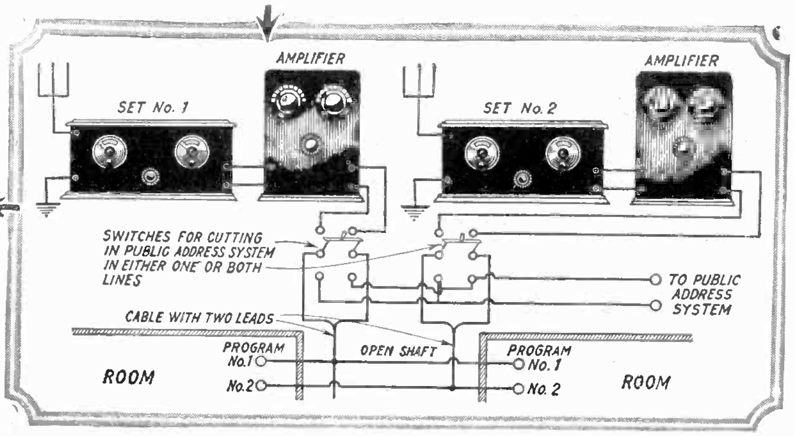
Broadcast Programs Now

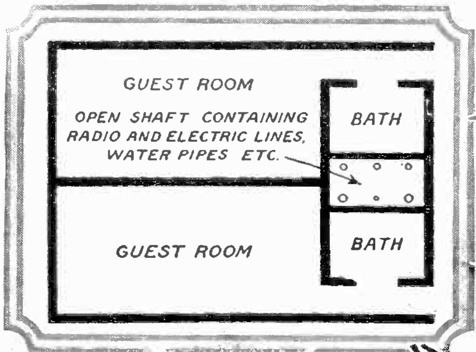
Radio Receiving Apparatus Supplies

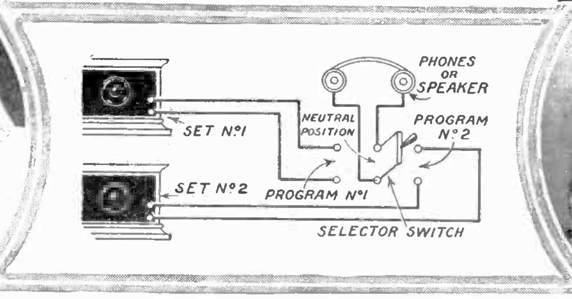


RADIO is now part of a service rendered by the modern hotel to their guests. The Statler hotel chain is now equipped with radio, as are other hotels throughout the country. The photographs reproduced here show a number of views of the radio installation in the Pennsylvania Hotel, in New York City. This hotel has a total of 2200 rooms, 2000 of which are equipped with head phones and the other 200 with loud speakers. The photograph above shows a view of the radio control room with Karr Parker the designer of the radio service at the controls of one of the receiving sets. The installation of the radio wiring system was simplified by the construction of the rooms themselves which are built in units of two with an open shaftway between. In this shaft are placed the steam and water pipes, electric wires and the radio lines. A plan view of the room construction is shown below. To the right and below is a simplified wiring diagram of the radio receiving system showing how either radio lane may be switched out of the circuit and the public address system cut in.

Above is a view of the control board used in conjunction with two radio receivers and public address system.







The photo at the left shows one of the guests "listening-in." Above, details of selector switch are given and to the right is a photo showing one of the speakers with the switch on top.

Available to Many Hotel Guests

Programs Day and Night for Patrons

ENTERTAINMENT in the form of radio programs is now available to hotel guests in many of the leading hotels throughout the country. The Statler chain in particular are all equipped with this radio service and the same installation and apparatus has been used in each of them. The installation of the complete system was not as difficult as might be imagined, because the rooms are constructed in units of two as shown on the opposite page. An open shaftway is placed between each pair of rooms and contains all the piping and wiring for the hotel, including the radio cables. Thus, it was possible to install the radio lines without tearing the floors or walls apart. From the wiring in the shaft, leads are taken off and run to the selector switches in the various rooms. The selector switch is simply a double pole, double throw switch, making it possible for the guest to choose between two radio programs. When not in use, the switch is thrown into neutral position. In a room on the top floor of the hotel, are situated two superheterodyne receivers, which pick up two different programs. These are then amplified and sent through two separate wiring systems to the hotel rooms. In each room is a pair of head phones placed in the bureau drawer. Loud speakers have only been installed in the employees rest and lounging rooms. It would be impossible to install loud speakers in every room because of the fact that 2200 speakers operating at the same time would obviously offer many disadvantages, especially in the summer with the windows open.

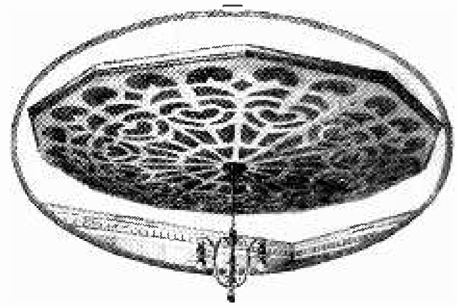
The receivers may be operated with either an antenna or loop aerial, and at the present time, two outside antennas are being used at the Pennsylvania Hotel. The installation is flexible, inasmuch as the operator may make special announcements through either radio line, or pick up programs in the hotel, through the use of a public address system. By means of this address system, the operator can tap any event going on in the hotel. An operator is on duty every day from 10 A. M. to midnight and provides the programs for the guests. He can tune in on almost anything being broadcast and switch in on either of the amplifying units for transmission to the rooms, after making his own announcement, giving program and source of station. The engineers experienced trouble at first with reradiation. The brass piping in the hotel picked up the programs and acting as an antenna system retransmitted them, causing some difficulty. However, this trouble was speedily done away with, and the radio system has been working efficiently ever since.

A variety of programs are offered to the guest, because the operators refer to the programs printed in the newspapers and tune in contrasting offerings. By means of the small selector switch, the guests can choose programs of their own liking. The results so far have proved to be gratifying and hotel owners feel satisfied that the installation is worth many times what it cost. In the Pennsylvania installation 33,674,840 ft. of special wire was used and 5,970,000 ft. of flexible and rigid conduit, 260 radio tubes, 7,700 room switches and 153,860 terminals of different types.

A Piano Reproducer

The photograph at the left shows a young lady attaching a new piano board loud speaker unit to one of the struts of the sounding board. The unit is so constructed that it can be clamped on one of the ribs or struts of the piano and will produce the deep natural tone of the piano sounding board. This unit has the advantage over others of its kind, inasmuch as it does not fasten directly to the sounding board and hinder its proper operation. Excellent reproduction of radio programs is now obtained with the new speaker unit.

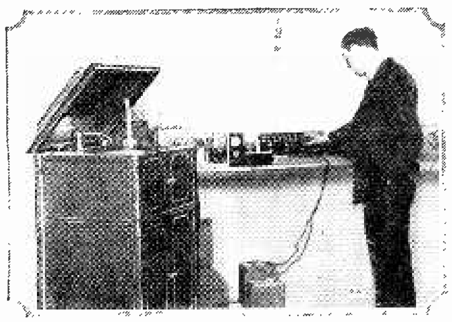
Largest Cone Speaker



The photograph above and to the right shows a loud speaker which has been built into the ceiling of the room, above the lighting fixture. This is a cone speaker of large size, said to be the largest one of its kind at the present time. In order to protect the paper cone, the owner has covered it with an artistic grill work, as may be seen in the photo.

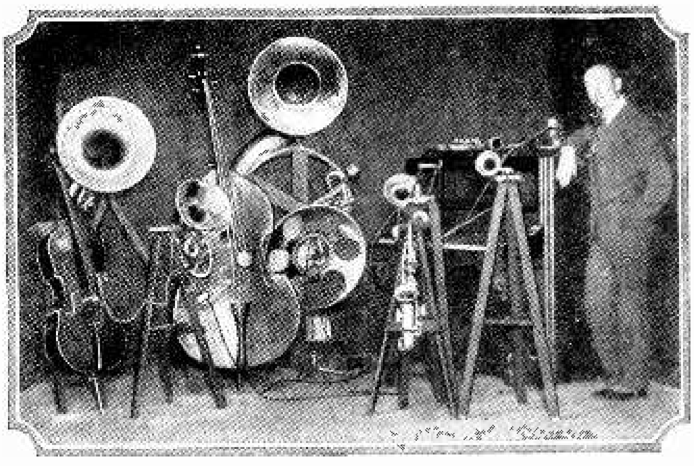
Exponential horns, especially of the folded type, lend themselves to many methods of concealment, as further explained in an article which appeared in the April issue.

A Manless Radio Orchestra



The above photograph shows W. D. Smith at the controls of his radio receiver which picks up the programs for his manless orchestra.

Mr. W. D. Smith has introduced something entirely new to radio with the invention of his so-called "manless orchestra." The orchestra reproduces radio orchestral programs through individual instruments. Each instrument in the orchestra has a unit attached to it, and thus the instrument responds more readily to the corresponding instrument in the orchestra broadcasting the program. The effect of the orchestra producing music without human players is rather uncanny, but those who have heard the phantom musical ensemble are unanimous in their opinion that it reproduces musical programs with greater fidelity than a single speaker would. The Photograph shows the inventor at the controls of his radio receiver.

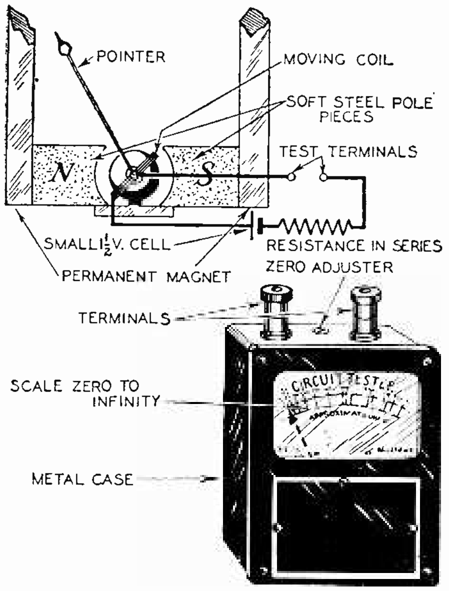


The inventor and his phantom orchestra appear above. It will be seen that each instrument has a separate unit attached to it. With an arrangement of this nature it is possible to reproduce musical programs better than can be done with a single unit.

NEW RADIO DEVICES

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

NEW CIRCUIT TESTER

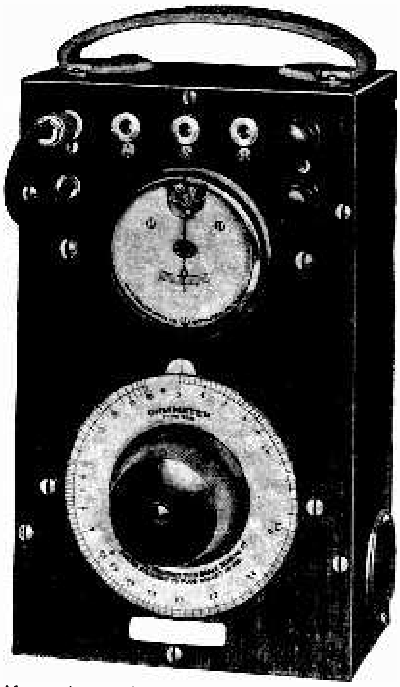


A front view of the new circuit tester, together with a schematic hook-up of the internal connections, are given in the above drawing. The instrument consists of a small D'Arsonval type voltmeter connected in series with a small dry cell. The instrument measures 4½" x 3" x 1½" and weighs but 19 ounces. It may be fitted in the pocket and can conveniently be carried anywhere.

A NEW portable direct-reading circuit tester has recently been placed on the market by one of the leading meter manufacturers. The instrument is enclosed in a heavy sheet metal case, which contains also a small flashlight cell. This cell can be replaced by removing the instruction plate on the front of the meter. The scale is divided into fifty uniform divisions of arbitrary value, and resistances up to 10,000 ohms may be calculated. When the terminals are short-circuited, the pointer should indicate full scale, and if not, adjustment may be made by simply turning the zero adjuster on the top of the meter. Besides showing whether or not the circuit under test is complete, the circuit tester also gives one an idea of the ohmic resistance. The instrument is small and may be carried in the pocket.

PORTABLE OHMMETER

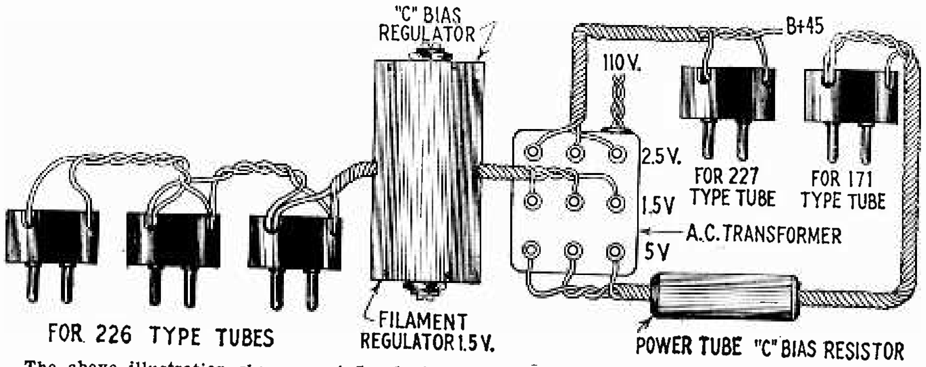
A PORTABLE ohmmeter made by the manufacturer of the circuit tester is shown at the right. The instrument is 5¾ in. wide, 9¾ in. long, and 4¼ in. high. The total weight is 3½ lbs. There are four resistance ranges available, .5 to 50 ohms, 5 to 500, 50 to 5,000, and 500 to 50,000 ohms. The battery for this instrument is contained within the case and consists of two flashlight cells. With this portable instrument, resistances may be read, to within an accuracy of 1% of their value.



Above is a view of the portable ohmmeter which is housed in a case of black walnut. A leather carrying handle is attached to the top and heavy rubber feet are provided on the bottom of the instrument. The device is a form of slide-wire Wheatstone bridge.

A.C. ADAPTER HARNESS

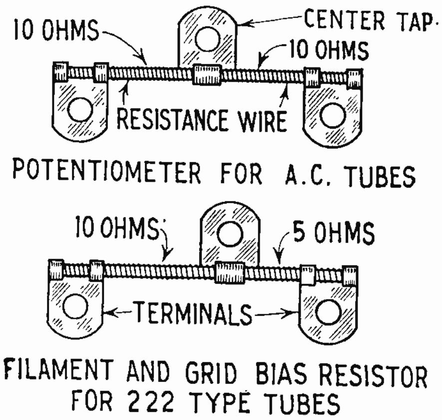
ONE of the leading Chicago radio manufacturers has recently put on the market an A.C. harness which makes it possible to easily convert your present receiver to A.C. operation, using A.C. tubes. The adapter harness for a five-tube set is illustrated here. The harness contains all the necessary resistors, so that the proper C bias is obtained, and also provides a filament voltage regulator for the 226-type tubes. When installing the apparatus, no structural or wiring changes in the set need be made. Conversion is simple and may be made by anyone in a few minutes' time. The filament leads of the harness should be connected to the corresponding terminals on the filament transformer. The "A" battery binding posts or terminals on the radio receiver are not used.



The above illustration shows an A.C. adapter harness for converting sets to A.C. operation.

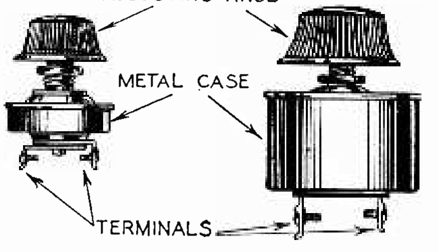
MIDGET RESISTORS

A CHICAGO manufacturer has placed on the market two types of midget resistors. The 20-ohm center-tapped potentiometer is made for A.C. tubes, and takes up very little space. The resistor is sturdily built and, as it is small, will save much space. A resistor for the filament circuit of 222-type tubes has also been developed. This is a 15-ohm wire-wound resistor, tapped at 5 ohms to provide the correct "C" bias for the tube. The midget resistors will do everything that the larger ones will do.



Two of the midget resistors are shown in the above drawing. One is a 20-ohm center tap resistor for the filament circuit of A.C. tubes, and the other is a filament and grid bias resistor for the new 222-type shielded-grid tubes.

POWER RESISTORS



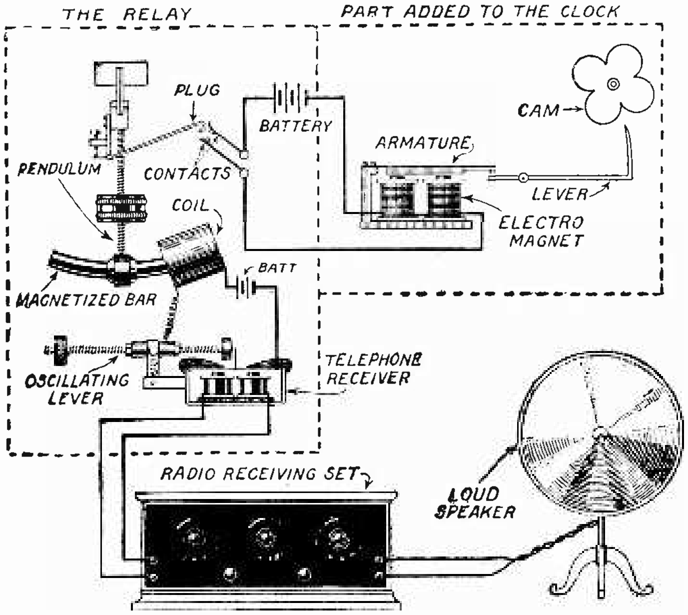
In the drawing above are shown two types of the new variable resistances. The one at the right is for use in "B" eliminator work and is capable of handling 40 watts. The smaller resistance is used as a volume control.

OF the two variable resistances shown in the illustration, the large one is designed to be used in "B" eliminators and in radio transmitters. It is capable of handling 400 milliamperes of current, when adjusted to any resistance less than 250 ohms. The model shown here is of the low range type, having a resistance of 25 to 500 ohms. The smaller resistor shown, is designed essentially to be used as a volume control in all radio receivers. It has a resistance range from 0 to 500,000 ohms. This resistor will handle up to 20 milliamperes.

The resistors are enclosed in metal cases and have bakelite adjusting knobs for varying the resistance. They are all equipped for one whole mounting.

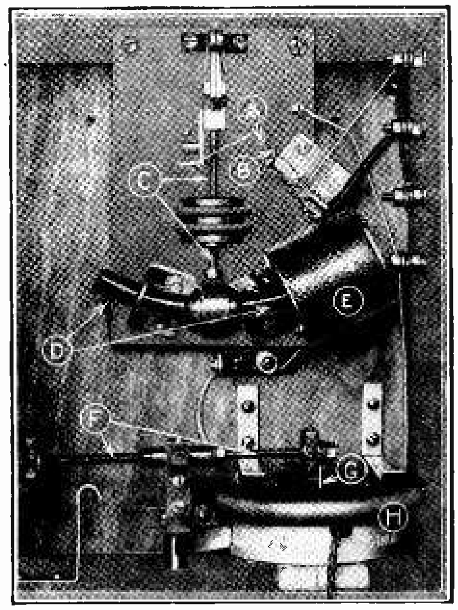
Names of manufacturers of parts supplied upon request.

Electric Clocks Timed by Radio



Above is the schematic diagram showing how the electric clock is set by radio. By means of a special relay, the minute hand of the clock can be set right once every day by signals sent out from the Eiffel Tower.

IN France there are now many clocks which are timed correctly once a day by radio signals sent out from the Eiffel Tower. Up to this time a special and complicated apparatus was needed to regulate a clock in this manner. Quite recently Mr. Lavet has invented a system of timing clocks by radio which is simple, non-expensive and can be used in every home. Anyone possessing a radio receiver can install this special relay and have it operate the minute hand of a clock, so as to set it right once every day. The regulating signal can be sent out between programs transmitted from the broadcast station. The principal organ of the system is a strong relay placed between the receiving set and the clock. This relay contains a pendulum which makes one hundred and twenty-two oscillations per minute. The arrangement of the apparatus may be seen in the diagram given here. This system is, of course, not absolutely accurate. —*Lucien Fournier.*



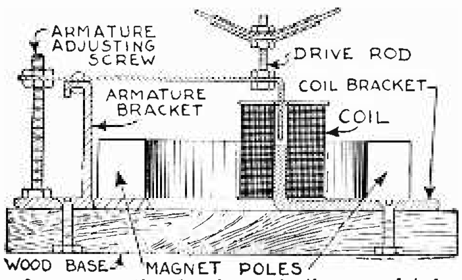
The above photograph shows a close-up view of the relay and other apparatus. An ordinary telephone receiver connected to the radio set operates a lever, as shown in the diagram. The relay contains a pendulum which makes one hundred and twenty-two oscillations per minute.

Making A "Flivver" Cone Unit

By R. EDIS FAIRBAIRN

A SERVICEABLE cone speaker unit may be built for next to nothing by anyone possessing a magnet from a Ford magneto, and a discarded spark coil, with a few pieces of scrap metal. The figures tell the whole story, but a few hints on methods may be of value.

Break open the coil box, and dig the coil and condenser out of the pitch filling. Don't break the condenser leads. A couple of these condensers in parallel, with one of the



A cross-sectional view of the completed speaker unit is shown above. The finished instrument is mounted upon a piece of hard wood.

coils for a choke, make a satisfactory output filter. But that is something else! The coil is wound in two sections, side by side on the iron core. Pull out the core, and cut the coil sections apart. One of them will be sufficient. Wind off the hair-like enamelled wire on to an empty bobbin. The wire will unwind more easily if you cut down towards the center of the winding with a sharp knife just clear of the wire on the ends, so as to get rid of the stiff edge of paraffined paper and pitch. Put the coil on a large nail, and fix the bobbin in the chuck of a hand drill, and the job can thus be handled very easily.

To make the coil form for the unit, first get a few inches of cold rolled steel 5/8" by 1/8". Wrap a turn or two of thin hard cardboard 7/8" wide on this and fix with glue. Make two ends of stiff cardboard, fiber, or hard rubber 1½" by 7/8" and cut a slot in the middle of each so that they can be forced stiffly on to the form center. Make two pairs of fine needle-holes in the end of one of the form ends before cementing the ends on the center. Fix the form, when the cement is hard, in the chuck of a hand drill, with a small bolt through the center of the slot, just tight enough to prevent the form from slipping. Arrange the drill on a box, with the filled bobbin of fine wire on a nail underneath. Fasten the drill so it will not wobble about, and proceed to wind the coil. Let the wire pass between your finger and thumb with slight pressure. Do not attempt to wind evenly; it couldn't be done anyhow. Jumble-wind the coil until full, and anchor the ends in the needle holes. Cut a piece of steel strip 1½" long, and bend at right angles half an inch from the end. Insert the half inch end in the coil slot with a touch of shellac to make it fast. The inch end of the bracket should have a screw hole bored in it.

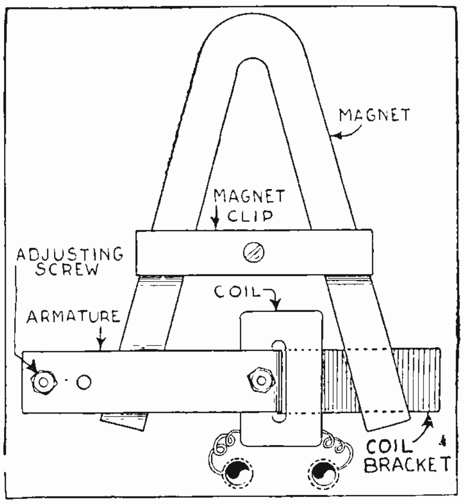
For the armature bracket cut another strip of steel 2⅜" long. Bend at right angles at 7/8" from one end. Bend the other end for ⅜", not at right angles, but rounded, as shown.

Bore the 7/8" end for a screw, and in the middle of the rounded part for a small rivet.

For the armature proper, get a piece of steel 1/16" thick, or less, 5/8" wide, and 3" long. Bend at right angles ½" from one end. Bore it to pass a piece of 6/32 threaded rod at ¼" behind this bend, and the same size hole at ¼" from the other end. Bore for the rivet at 7/8" from the end opposite the bend. Rivet the thin strip on to the rounded top of the bracket. Then insert 1½" of 6/32 threaded brass rod through the end hole, fixing it to the bottom part of the bracket by rivetting it in, or soldering it. A couple of nuts above and below the armature spring will make adjustment possible, since the rounded part of the bracket permits a certain rocking motion.

Now arrange the coil and armature upon a 6" by 4" piece of hardwood, as in the figure. The bend of the armature enters the slot in the coil form, but must not touch it anywhere. Screw down the brackets. Lay the magnet with one pole upon the coil bracket, against the coil, and the other against the armature bracket. To even it up, insert a packing piece under the pole against the armature bracket, and under the bend of the magnet. Fasten the magnet with a clip of brass or hardwood.

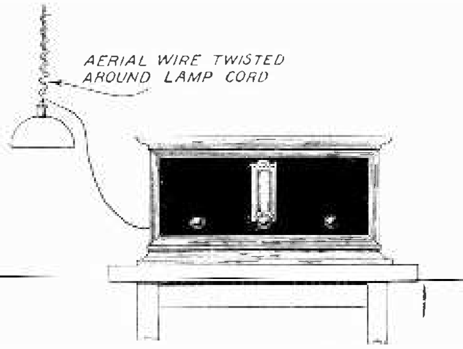
(*Continued on page 71*)



Above is a top view of the unit, showing the location of the magnet, coil, coil bracket, adjusting screw, and the armature.

Try These Aerials

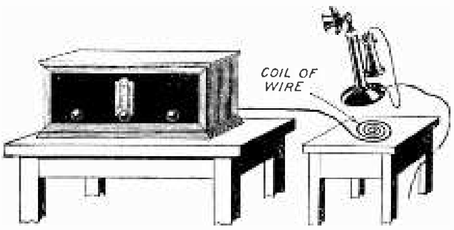
How to Construct Novel Antennas for Indoor Use



An aerial wire, twisted around the lamp cord, serves as a suitable indoor antenna.

IN radio communication, it is necessary as we all know, to have a device to radiate electric waves and another device to receive these radiated waves. The devices which are used for this purpose are called antennas or aerials. Antennas may be divided into two general classes. Those consisting of one or more wires stretched between two supports are called aerials or antennas, and act as electric condensers. Those aerials which act as electric inductances are called coil antennas or loops, and consist of a number of turns of wire wound on a rotatable frame which gives a directional effect.

In the old days, it was a simple matter to climb upon a roof and erect an aerial of any length desired and in any direction. With

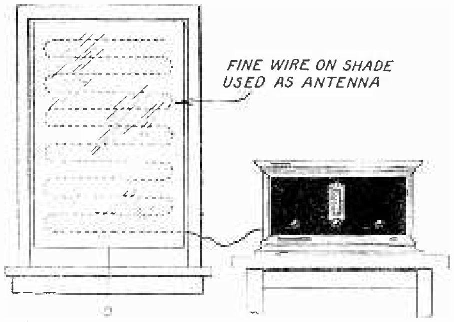


A small coil of wire, placed beneath the base of a telephone, serves efficiently in the capacity of an antenna.

the advent of the modern apartment house and an increased number of radio sets, the antenna problem has become more and more serious, and we are giving here a number of hints for those who cannot have an outside aerial. Any one of these may be used satisfactorily as the antenna.

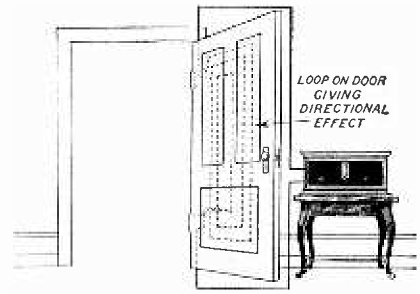
The electric light wires coming into the house may be used for radio reception and probably furnish the easiest solution to the antenna problem. These lines pick up considerable energy and high frequency currents are induced in them by passing radio waves. However, they should not be connected directly to the set, as they might ground or short circuit. A small fixed condenser should be connected in series with one of the wires, as it forms a barrier to low frequency lighting currents, but permits the passage of radio frequency currents. A special plug for this purpose may be purchased and is simply screwed into the light socket, the antenna connection being made to a binding post on the plug provided for that purpose. One of the simplest methods of using the electric light lines as the antenna is to simply twist a section of wire around the lamp cord, connecting one end to the radio set, and leaving the other end free.

Telephone wires can also be used in much the same manner, but the connection should preferably be made to the metal box hous-

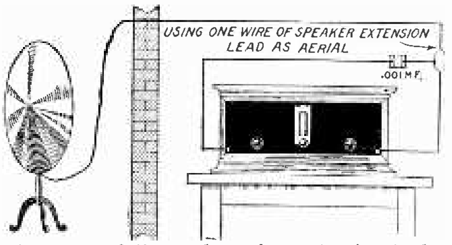


A fine wire zigzagged across the window shade can also be used as an aerial. It should be sewed or otherwise fastened in place.

ing the bell. One of the common methods of using the telephone's wiring as an antenna is to place a metal plate beneath the phone and connect a wire from the plate to the aerial binding post on the set. The use of a metal plate, however, is not necessary and is often a nuisance. The end of a piece of wire can be wound in a coil or spiral fashion and the phone placed directly upon it. In both cases the ground connection should be made to the set as usual. Any inside wiring in the house may be used as an aerial. The door bell wiring system or a wire strung around the molding both serve satisfactorily as antennas. Bed-springs and metallic clothes lines sometimes can be used advantageously.

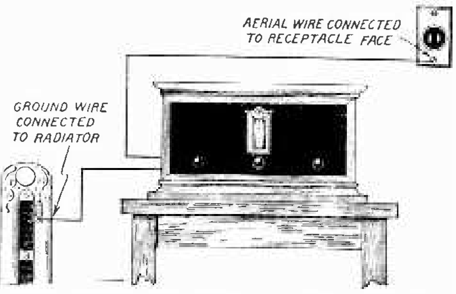


A loop giving directional effect may be wound on a door as shown above.



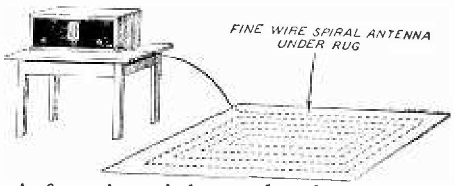
One wire of the loud speaker extension lead may be used as an aerial as shown above.

If a loud speaker extension cord is used with the speaker in a different room from the set, one wire of this cord can be employed as the aerial. A small fixed condenser, having a capacity of about .001 micro-farads is connected in series with one of the leads, one post connected to one of the speaker extension cords, and the other to the aerial binding post on the receiver. Still another method of concealing the antenna is to sew fine wire on one of the window shades, as shown in the illustration. The shade antenna will give good results, and can be rolled up when not in use. By using a door, one can easily construct a loop aerial having directional effects by winding the wire in a spiral fashion. The two ends of the loop can then be soldered or otherwise fastened to the wings of the hinges on the door and two wires led from the other part of the hinges on the door jam to the radio set. Thus there are no loose leads to break as would be the case if the two wires from the loop were brought directly to the receiver. In order to obtain a directional effect, it is simply necessary to swing the door to and fro.

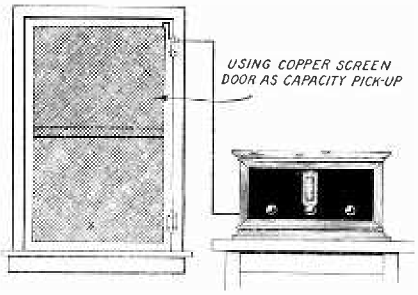


Two grounds are shown as used with the receiver, no aerial being necessary. One wire is connected to the radiator and the other wire to a switch face-plate.

Another good way of concealing the aerial is to wind a fine wire spiral under the rug. This will be found to give good results. During the summer, copper screen doors or large copper window screens may be used advantageously as a capacity pick-up for radio signals. A wire leading from the aerial binding post on the radio set is simply connected to some portion of the screen wire. Screens other than copper may be used, but results will probably not be so good. In all of the above mentioned systems, use has been made of an aerial and a ground. However, it is possible to operate the receiver satisfactorily by using two grounds, one wire connected to the radiator or water pipe, and the other to an electric light receptacle, faceplate or any other piece of metal which is grounded. It is doubtful whether the gas pipe can be used as a ground, because there will probably be packing between the joints of the pipe, and especially where the pipe enters the gas meter.



A fine wire spiral, wound under the rug, will not be noticed and can be used as an antenna with radio receivers.



The copper wire on a screen door or large window screen can be used as a capacity pick-up for the reception of radio signals.

RADIO ORACLE

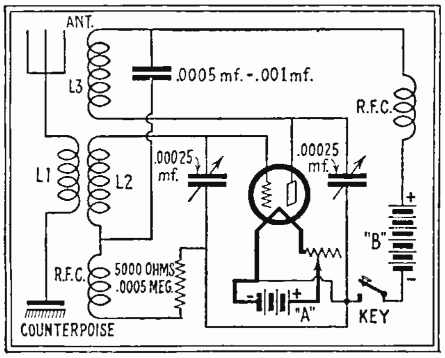
In this department we publish questions and answers which we feel are of interest to the novice and amateur. Letters addressed to this department cannot be answered free. A charge of 50c. is made for all questions where a personal answer is desired.

SHORT-WAVE TRANSMITTER

(619) W. E. Kopek, Zion City, Illinois, asks:

Q. 1. Will you please publish a diagram of 40 meter wave radio transmitting set?

A. 1. On this page you will find given a schematic diagram of a short-wave oscillating circuit, which is a modification of the Colpitts circuit. The two tuning condensers have a capacity of .00025 mf. each. The antenna coupling coil which is 3" in diameter consists of 1 to 6 turns, depending upon the type of antenna used. L2 and L3 consists of 7 turns each, 3" in diameter. These coils may be wound with No. 14 copper wire or larger. Radio frequency chokes are of the basket weave type and consist of 40 turns of No. 22 S.C.E. wire. These chokes are 1¾" in diameter and are wound on 8 pegs. The grid leak should have a resistance of 5,000 ohms, which is equal to .005 megohms. For short-wave transmission, a single wire about 30 ft. long should prove effective. If a counterpoise is used instead of a ground, it should be of about the same dimension as the antenna. A series antenna condenser of about .00025 mf, capacity may be connected between the counterpoise and the coupling coil. A coil, antenna or loop can be used for transmitting over short distances. When the tube is lighted and the key is closed, the transmitter should oscillate, and the condenser settings should then be varied until resonance with the antenna circuit is obtained. A small flashlight bulb, a thermo galvanometer, or a D.C. milliammeter will show the resonant point. The thermo-galvanometer may be inserted in series with the antenna. Maximum deflection indicates resonance. A D.C. milliammeter of 0 to 50 connected in series with the "B" batteries will show resonance by deflecting sharply when the resonant point is passed over.



Above is the hook up of the forty-meter short-wave radio transmitter. The circuit is a modification of the Colpitts circuit. A single wire about 30 feet long should be used for the antenna.

SKIP DISTANCES

(620) Chas. McCormick, Proctor, Utah, writes:

Q. 1. Will you kindly explain the meaning of "sunset effect" and short-wave skip distances?

A. 1. It has been demonstrated a number of times that short waves are decreased in strength as the distance from the transmitter is increased, until a certain point is reached. At greater distances beyond this point, the signals gradually increase in strength to a maximum. Beyond this point, the strength usually decreases. The distance between the transmitter at the beginning of the rise in signal strength is called a skip distance. This zone is not sharply defined and is found to be longer at night than in the day, and is usually longer in winter than in the summer. In most cases, the skip zone is a region where signals are entirely absent. The shorter the wavelength, the greater the skip zone distances will be. Long waves do not have such skip zones as true attenuation begins at the transmitting antenna. This accounts for the greater distances covered by short waves even during daylight.

During the period of transition from daylight to darkness, "sunset effect" is often observed. About an hour before sunset there will be a noticeable rise in signal intensity, which will drop just about as the sun sets, after which, it will rise until a maximum strength is reached about an hour later. During the night a further gradual rise in signal strength will go forward, until several hours before sunrise. A "sunrise effect" similar to the "sunset effect" will then be noticed, but the phenomenon will be reversed.

LOUD SPEAKER CONSTRUCTION

(621) R. W. Anderson, Traverse City, Michigan, asks:

Q. 1. Will you kindly give me the essential construction of the new loud speaker which recently was used in throwing sound across the Hudson River.

A. 1. The speaker to which you refer is undoubtedly that which was perfected by the Bell Telephone Laboratories, and is now being used successfully in Vitaphone and Movietone productions. In its present form, the loud speaker is of the horn type. The engineers who developed it say that it is capable of converting into sound about 50 per cent of the electrical energy supplied it. The moving diaphragm or armature of its unit is not made of a magnetic material but consists of a sheet of very light aluminum alloy, about two-thousandths of an inch thick, and so constructed that it moves laterally, somewhat like a piston. Attached to the diaphragm is a small coil of aluminum strip wound edgewise and insulated with varnish. This coil lies in the magnetic field produced by a powerful electromagnet.

Telephone or voice current passing through the small aluminum winding causes the diaphragm to vibrate. The plunger-like motion of the diaphragm and the special shaping of the air chamber between the diaphragm and the mouth of the horn result in an efficiency many times greater than that obtained with other types of loud speakers. The load carrying capacity of the device arises from the fact that the small aluminum coil lies very close to the heavy iron pole-pieces of the field magnet. In addition to its large capacity, the loud speaker is notable for its fine reproducing qualities. It encompasses the range of frequencies from 60 to 6000 cycles per second without distortion and reproduces down to 40 cycles and up to 8000 cycles with a distortion so slight that it is doubtful if the ear can detect it.

POWER OUTPUT

(622) W. R. Mansbridge, So. Norwalk, Conn. asks:

Q. 1. What is meant by power output and how can the maximum output of an audio frequency vacuum tube be ascertained?

A. 1. The maximum output obtainable without the introduction of serious harmonics in the plate wave current is generally considered as the conventional power output of an audio frequency amplifying tube. The method of measuring this output is necessarily a relative or an arbitrary one, but gives a useful comparison among the various vacuum tubes employed. The procedure is given as follows:

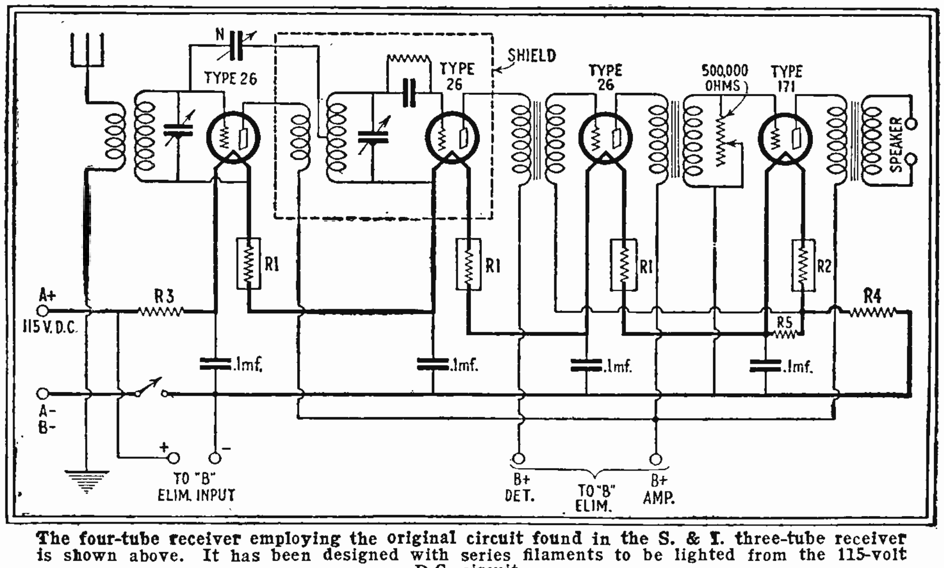
The normal external plate resistance (non-reactive) is inserted in the plate circuit. If the value of this resistance is not specified by the manufacturers, it should be chosen as twice the normal plate resistance of the type of vacuum tube under test. The filament voltage is adjusted to its normal value; and the plate supply voltage is adjusted to give normal plate potential at the plate (that is, equal to the normal plate potential plus the voltage drop in the external resistance). A sinusoidal alternating voltage and a grid bias voltage equal to the maximum alternating voltage are impressed in the grid circuit and are adjusted together until the direct component of the plate current is 5% higher than when the alternating voltage is removed. The power in the external plate resistance due to the fundamental component of plate current is then taken as the conventional power output.

D.C. RECEIVER

(623) Wm. F. Kephart, Clearfield, Pa., writes:

Q. 1. Will you publish a diagram of the Science and Invention 3-tube A.C. D.C. set with an added stage of radio frequency and with tubes lighted direct from the D.C. 115-volt lighting circuit. I wish to use a power tube of the 171-type in the last stage. I desire to have the circuit non-regenerative.

A. 1. On this page you will find illustrated a diagram showing a 4-tube receiver meeting with the above requirements. The detector coil should be placed in a shield and the shield walls should not be any nearer to the coil than a distance equal to the coil's diameter. If no shield is used, the radio frequency and detector coils should be placed at right angles and as far from each other as possible. Type 226 tubes are used in the radio frequency, detector and the first audio stages. A type-171 power tube is employed in the last audio stage. R1 are filament ballasts of the A.C. type rated at 1.05 amperes, R2 is a filament ballast of the half ampere type, R3 is rated at 83 ohms capable of handling 100 watts, R4 has a resistance of 16 ohms and is rated at 20 watts, R5 is rated at 9 ohms and 5 watts. The two tuning condensers have a capacity of .0005 mf. and the neutralizing condenser, a capacity from .000002 to .00002 mf. From the filament end of the secondary of the detector coil to the neutralizing tap the same number of turns should be used as are employed on the primary coil. A variable resistance of 500,000 ohms placed across the secondary of the second audio frequency transformer serves as a volume control. The set can easily be made regenerative by employing a tickler coil. A switch should be installed in series with the A- and B-leads. With the circuit as shown here, it is possible to light all tubes from the direct current line, and to obtain the necessary "C" bias.



The four-tube receiver employing the original circuit found in the S. & I. three-tube receiver is shown above. It has been designed with series filaments to be lighted from the 115-volt D.C. circuit.

Scientific Humor

TOUGHNESS+TEETH=AGE

PAT: "How do you tell the age of a turkey?"
MIKE: "By the teeth."
PAT: "Turkeys have no teeth."
MIKE: "No, but I have."
—*Ernest Fedcroff.*

HOW DO YOU MEAN?

GIRL STUDENT: "Ruth told me yesterday that she had paid ten dollars for a beautiful handkerchief."
SECOND GIRL STUDENT: "My, that's an awful lot of money to blow in."—*Andrew Jacob, Rep. No.* 9606.

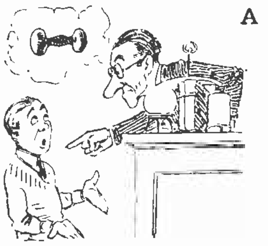
GETTING AWAY WITH IT

HOUSEHOLDER: (from above, disturbed by voices downstairs): "Who's there?"
BURGLAR (with great presence of mind): "WRNY now closing down. Goodnight everybody."
—*William Short.*

SWELL

"Ah, boys!" said the kind-hearted old gentleman. "Where are you taking that goat?"
"Down to the lake, sir," answered the innocents.
"Good!" the K. H. O. G. smiles. "To give it a drink I suppose?"
"Yes, sir, and if you come along with us, mister, you'll see some fun! This 'ere goat's just been an' et a 'ole crate of sponges, and—My, but something's bound to 'appen when he's 'ad a quart or two of water!"
—*J. E. Lovett.*

A COLLAR-ARY



CHEMISTRY PROFESSOR: "Name three articles containing starch?"
BRIGHT STUDE: "Two cuffs and a collar."—*August Schellenberger.*

USE THIS ON JULY 4th—PUNK

"A little bird told me what kind of a lawyer your father was."
"What did he say?"
"Cheep! Cheep!"
"Well, a duck told me what kind of a doctor your father was!"—*Clifton Ask.*

MODERN PHARMACY
FIRST PRIZE, $3.00

Wotcha doing? Learning the drug business.
It must be highly technical.
Yes, it is. I am learning to compound stews and assemble sandwiches.
—*George Corbe.*

SIMPLE!

LIFE GUARD: "How much can you carry?"
MERE MAN: "Two hundred pounds."
LIFE GUARD: "Suppose there was a woman out in the water drowning and she weighed four hundred pounds. How could you save her?"
MERE MAN: "I'd make two trips."—*P. J. Higginbotham.*

TO ELIMINATE SOME?

DRUGGIST: "Now here's a new thing in lipsticks. There's some sort of a chemical in it to kill the microbes."
FLAPPER: "But really! I wouldn't want to kill all of the fellows.—*Gleason Pease.*

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.

"DANGER—DETOUR"

The editor of the By-Town Weekly received from one of the local talent a soul-stirring, heart-throbbing lyric entitled, "I Wonder If She'll Miss Me."
In due course the would-be poet received reply:
Dear Sir:—
"If she does, she should never be trusted with firearms again."—*W. Harrison LeClair.*

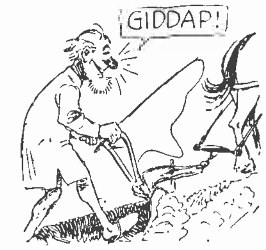
EVEN TO THE END

JONES: "I'd like to be cremated, but I'm sure my wife wouldn't like it."
SMITH: "Why not?"
JONES: "Well, she's always complaining about my leaving my ashes around!"

WHAT DOES GREEN MEAN?

YOUNG LADY: "Have you any green lipsticks?"
CLERK: "Green lipsticks!"
YOUNG LADY: "Yes, a railroad man is going to call on me tonight!"—*Clifton Ask.*

A HEALTHY MISTAKE



A doctor left a thermometer with the wife of a patient, and told her to take her husband's temperature every hour. When he returned in the morning the patient was gone, and the doctor asked what had happened.
"I broke the thermometer," said the woman. "So I used the barometer. It registered 'very dry,' so I gave him about a pint of corn liquor, and he got up and went out and started plowing in the back field!"
—*Clifton Ask.*

TRUE ADVERTISING

Jones answered an advertisement and sent a dollar for four pairs of socks. When they arrived Jones looked them over, and then wrote the advertiser: "Socks received. The patterns are vile. I wouldn't be seen in the street with them on."
Back came the answer: "What are you kicking about? Didn't we guarantee you wouldn't wear them out?"—*Robert Goldsmith.*

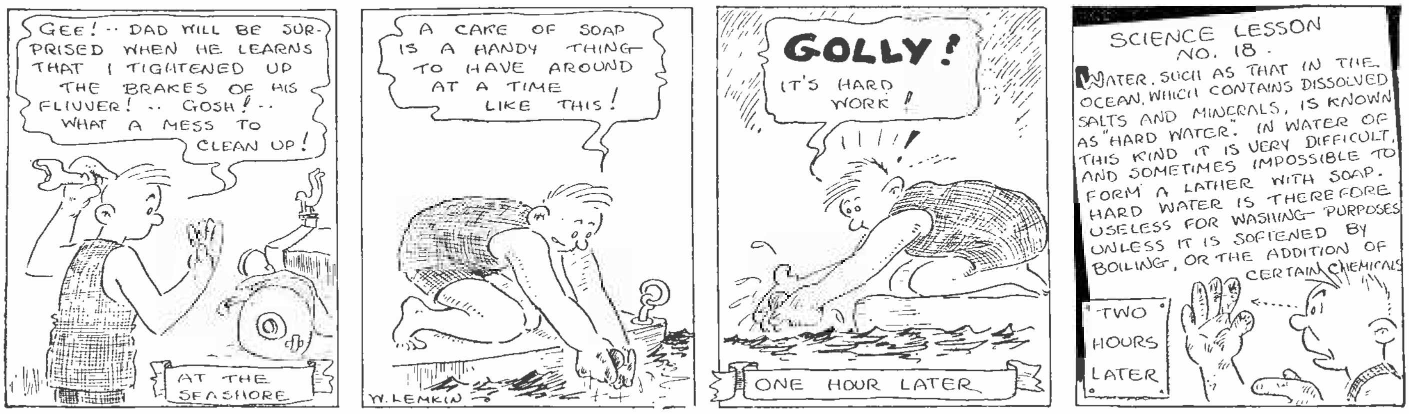
ELECTRIFIED HIM

SHE: "My father's an electrician."
THE BRUTE: "I see, you're his first shock."
—*Joseph Wallace.*

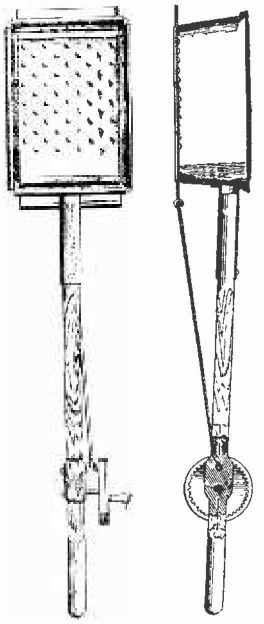
FOR NO GOOD REASON

"How is your car running?" asked one motorist of another.
"That's what puzzles me!" replied the other.—*Archie Sofman.*

SCIENTY SIMON, Scientist

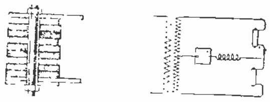


POPCORN SHAKER



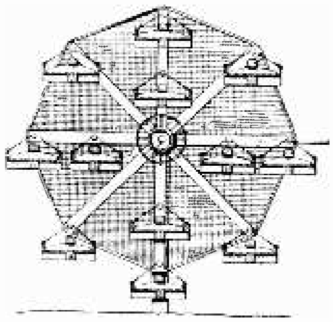
No. 1,653,442, issued to Alex Steger. The popcorn shaker shown above has a reciprocating bottom whereby the kernels may be agitated. A crank fastened to the handle moves the bottom of the shaker when it is turned.

ALTERNATING CURRENT RECTIFIER



No. 1,658,647, issued to Levi B. Miller. The invention shown here is a dry rectifier which comprises layers of silicon carbide and graphite, or carbon, joined together. The hook-up is also shown.

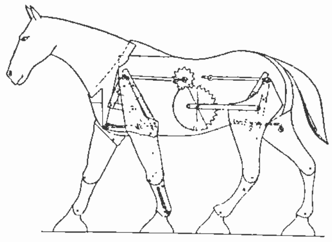
FOWL ROOST



No. 1,658,515, issued to Thomas D. Caton. This improved roost provides a means for accomodating a maximum number of fowls in a minimum space. A number of trays are hung loosely from the sides of a rotatable roost. It is so constructed that the trays and supports may be easily cleaned.

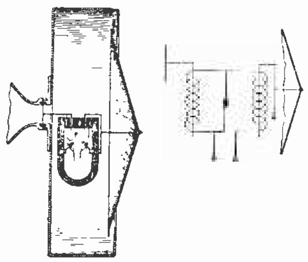
MECHANICAL ANIMALS

No. 1,638,332, issued to Vittorio Gobbato. This invention relates to a mechanism for reproducing the movements of quadrupeds. All body members are capable of life-like motion. One construction of the invention is shown below.



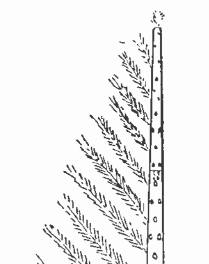
SOUND REPRODUCING UNIT

No. 1,655,403, issued to Paul G. Andres. The sound-reproducing unit shown below comprises a number of sound-reproducers, each having different resonant points. The hook-up is also shown. Each coil is designed to operate a loud speaker.

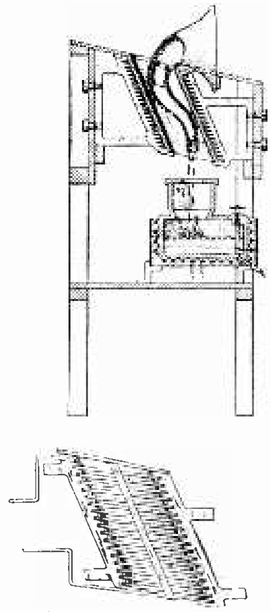


ARTIFICIAL TREE

No. 1,656,310, issued to August Anderson. The artificial tree shown below comprises a base and a trunk, so formed, so as to receive the ends of branches of a natural tree. Teeth are also provided for retaining the branches in their respective sockets.

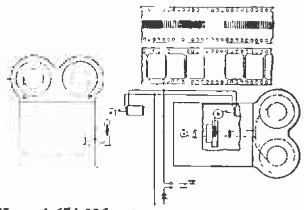


METHOD OF REMOVING METAL CORES



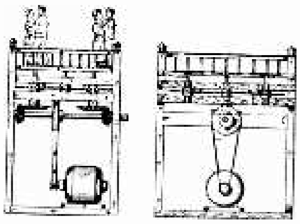
No. 1,656,312, issued to Charles D. Black. This invention relates to molding operations, whereby the fusible metal cores used in the process are melted by means of high frequency alternating electric currents.

TALKING MOTION PICTURE



No. 1,654,926, issued to Theodore J. Engel. This invention is a combination of a motion picture camera and a sound recorder, with a light-sensitive element. The shutters on the camera and sound recorder are controlled by electromagnets.

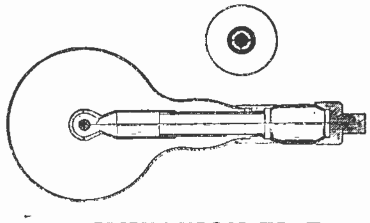
MECHANICAL DANCING DEVICE



No. 1.655,292, issued to George Przybylko and Stanley Michalek. This device is a toy embodying dancing figures and a means for revolving the same figures. They are mounted on a disc which is turned by an electric motor. The toy may also be manually operated.

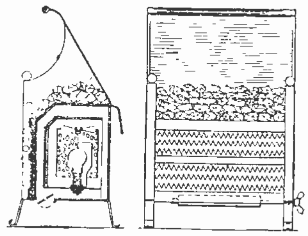
INCANDESCENT ELECTRIC LAMP

No. 1,653,365, issued to Charles Frederick Lorenz. The object of this invention is to provide a lamp which will have a concentrated light source and reduce blackening of the bulb to a minimum.



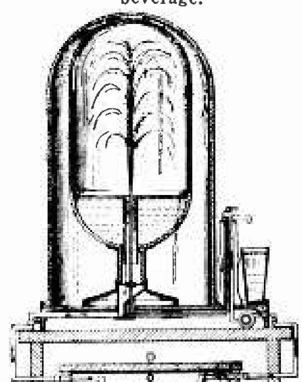
IMITATION FIRE

No. 1,655,987, issued to Hubert Ashley Dickinson. This invention relates to imitation fires, and has two opaque screens behind which rotates another screen, between the outer screens and light source. The light passing through the screen reflects on pieces of broken colored glass and produces the illusion of flames.

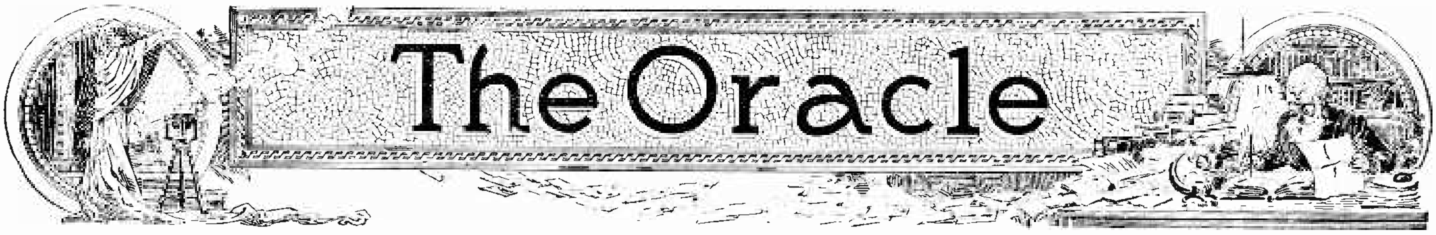


DISPLAYING APPARATUS FOR BEVERAGES

No. 1,654,379, issued to Wincenty Matzka. The device shown below is a dispensing apparatus for beverages which provides a continuous stream or fountain, while affording means for dispensing from a cooled container. The apparatus is encased in glass to display the beverage.



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.



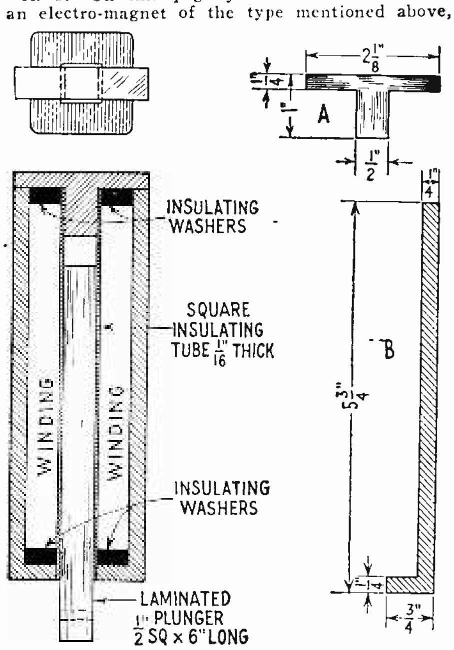
The "Oracle" is for the sole benefit of all scientific students. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:
1. Only three questions can be submitted to be answered.
2. Only one side of 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.

A.C. TRACTIVE MAGNET

(2246) J. Yust, San Francisco, Calif., asks:

Q. 1. Please illustrate in your columns an A.C. tractive electro-magnet having a three inch stroke and capable of lifting two pounds. This is to be used with the usual 60 cycle 110 volt alternating current circuit.

A. 1. On this page you will find illustrated an electro-magnet of the type mentioned above,



In the above drawing, details of an A.C. tractive magnet are given. This magnet has a 3" stroke and is capable of lifting two pounds.

having a three inch stroke and a two pound pull. The magnet is made of two types of laminations. 62 "L" shaped laminations and 31 "T" shaped laminations are used. The plunger consists of 31 laminations, each 6 inches long. The "T" shaped laminations are shown at A in the diagram, and the "L" shaped laminations at B. All laminations should be cut from silicon steel .015 inch in thickness. It will be noted that the plunger and opening have a square cross-section. The winding is made upon an insulating tube of hard rubber, bakelite, or fibre, and is insulated from the laminations by the washers placed as shown. No. 20 enameled wire is used and it will be found that 13 layers will be necessary, each layer having 160 turns. If the magnet tends to chatter this may be eliminated by using a shading coil which consists of a turn of heavy wire embedded in the stop. All dimensions have been marked upon the drawing.

ALLOY COMPOSITION

(2247) S. Koine, St. Paul, Minn., writes:

Q. 1. Will you please give me the composition of the following alloys: aluminum-beryllium, duralumin and alpax.

A. 1. Alloys of aluminum and beryllium are light and strong and are suitable for use in the manufacture of airplane parts. In the various patents covering these alloys, an alloy of 90 per cent aluminum and 10 per cent beryllium is mentioned and also one of 85 per cent aluminum, 10 per cent beryllium and 5 per cent copper. The composition of the alloy duralumin may vary slightly. One analysis by J. L. Jones, of the Westinghouse Elec. & Mfg. Co., gives the following proportions: aluminum 94.60 per cent, copper 3.90 per cent, iron 0.45 per cent, magnesium 0.75 per cent, silicon 0.21 per cent, and a trace of manganese. In a paper presented before the Inst. of Mining and Metallurgical Engineers, the composition is given as follows: Copper 3 to 5 per cent, magnesium 0.4 to 1.0 per cent, manganese 0 to 0.7 per cent; aluminum, remainder; iron (as impurities), 0.4 to 1.0 per cent, silicon 0.3 to 1.0. Its density is given as about 2.85. Alpax is an aluminum silicon alloy, fine grained and ductile, containing about 87 per cent aluminum and 13 per cent cent silicon. It is usually made by the addition of a rich alloy of silicon and aluminum to ingot aluminum. A modification of the alloy is known as "aluminac" and is used for making die castings of aluminum alloy. The silicon-aluminum alloys are difficult to machine, as they tear and cling to the tools, so adding copper has been tried and found to impart better machining qualities.

REWINDING GENERATOR

(2248) H. Ohrt, Flatwillow, Montana, asks:

Q. 1. How can I change my six volt generator into a 32 volt generator?

A. 1. In order to make this change, it will be necessary to rewind both the armature and the field. You will have to use 5.3 times as many turns in the armature slots as there were originally. In order to fit this increased number of turns on the armature, it will be necessary to use a wire with a cross-sectional area about one-fifth the area of the original wire used. The cross-sectional area of the wire for the field windings will also have to be reduced to about one-fifth of the size originally used. The field should be rewound so as to have 5.3 times as many turns as were used originally.

FABRICATED METAL PROPELLERS

(2249) O. D. Osbourne, Mound City, Illinois, writes:

Q. 1. Will you please describe briefly the construction of a fabricated metal propeller, such as used on modern airplanes?

A. 1. Although a great many types of fabricated metal propellers have been constructed the only one which has come into general use is the Leitner Watts type which was developed in England. This propeller is made up of a number of thin sheets, one above the other, one set of sheets being used to form the back face of the blade, and the other the pressure face. The sheets for these two faces were pressed out in dies and were welded together along the leading and trailing edges. In the latest construction, the blades are made separately from the hub, having a cylindrical flange at the hub, so that they may be set at any desired pitch when assembled in the hub. The centrifugal force is taken up by a single shoulder at the end of the blade. The hub consists of a central plug made up externally to a standard form and bored internally to fit the particular engine on which it is to be used. These propellers are usually equipped with steel hubs and aluminum alloy propeller blades. The propeller is quite strong and the aero-dynamic efficiency is about equal to that of a wooden one. This type of propeller is used quite extensively in England and France, but in the United States the more efficient, solid metal types are preferred. Micarta propellers are now being used on many American planes.

AUTOMATIC SILVER RECOVERY

(2250) B. Insley, Lopez, Penna., asks:

Q. 1. Please give me an outline of the process used in automatically recovering silver from old hypo baths.

A. 1. Of the many methods of treatment those using zinc dust or sodium sulphide are the most popular. The hypo solution is permitted to accumulate until the tank is full, reagents are added, and the desilvered hypo allowed to flow to waste after settling over night. The scheme described here uses the conventional sodium sulphide method but performs the operation continuously and automatically. Waste hypo is allowed to drop into a measuring vessel fitted with an automatic syphon which flushes at a predetermined head. During the flushing operation waste developer and sodium sulphide are sucked in and the mixture discharged into a reaction vessel. From here the solution and precipitate trickle slowly down a funnel to a settling tank. The precipitate collects as a thick brown sludge below the funnel and is drawn off into a bucket with a perforated bottom covered with absorbent cotton. The clear, desilvered hypo flows to waste from the top.

TELEVISION DISC

(2251) A. Smith, Detroit, Mich., asks:

Q. 1. Can you give me some information in regard to the number of holes which have to be drilled in the discs used with television apparatus? Your book on television mentions fifty holes, but I have read of a number of other machines which use discs having forty-eight or forty-six holes.

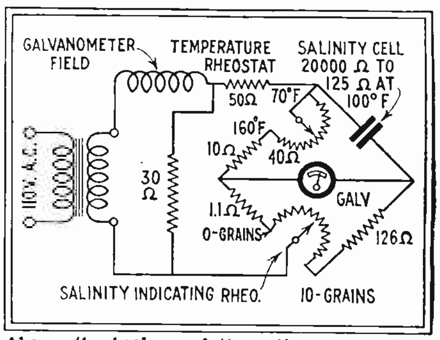
A. 1. The number of holes to be drilled in each disc, as specified in the book on television, is fifty, and is the same number which was used in the Bell Laboratory apparatus demonstrated last summer. With any appreciably smaller number of holes than fifty, the grain of the picture will be too coarse. If a greater number of holes than fifty are used, the grain will be finer. The engineers of the Bell Telephone Laboratories have tried both a larger and smaller number of holes than fifty, and finally came to the conclusion that fifty was the best for all around purposes. If forty-eight or forty-six holes are used, the grain of the picture will be made slightly coarser.

SALINITY INDICATOR

(2252) A. R. Mandell, Hartford, Conn., writes:

Q. 1. Kindly publish a diagram showing the connections of a salinity indicator, such as that used by the U. S. Navy, employing what is known as the zero method.

A. 1. On this page you will find illustrated a salinity indicator of the Wheatstone bridge type, employing the zero or null method. This system is built about the Wheatstone bridge principle and when the bridge is balanced the galvanometer is balanced to zero deflection. The object of the transformer is not only to furnish a suitable ratio of A.C. volts to the system, but is primarily for the purpose of completely insulating the power supply from the indicator and cell, thus avoiding the possibility of cross currents



Above—the hook-up of the salinity indicator.

from power line grounds. To obtain an indication of salinity, it is necessary to first set the temperature compensating rheostat to the marked value, approximating the temperature of the feed water, in which the cell is located, and then adjusting the salinity rheostat until the galvanometer shows no deflection. At this setting the grains of salinity per gallon is observed from the calibrated dial of the salinity rheostat. These indicators have been used by the Navy to a great extent for quantitatively measuring the impurities of the feed waters used in the boilers and for determining the quantity of sodium chloride. Many other types of salinity indicators are made at the present time, some being automatic in their action, and furnished with automatic alarm signals and signal lights.

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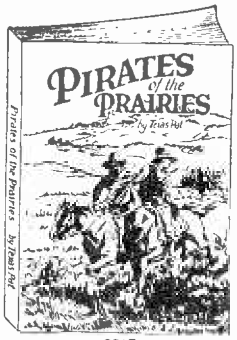

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..C280 The Forest Avenger. D
..C281 Sharp Snout. D
..C282 Madman of the Colorado. D
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..C284 A New York Boy Among the Indians. D
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..C302 Hunters and Redskins. D
..C303 The Panther Paleface. D
..C304 Bloody Brock. D
..C316 Three Fingered Jack. B
..C317 Pirates of Prairie. Texas Pat. B
..C318 White Falcon. Texas Pat. B
..C319 Trail of Gold. Montana Charley. B
..C320 Redhawk's Nest. Montana Charley. B

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..N207 Breezy Frank. D
..N208 Life in New York. D
..N209 Desmond Dare. D
..N210 A Remarkable Shadow. D
..N211 Tom the Young Explorer. D

Boys' Adventure

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..B150 Helping Himself. H. Alger A
..B151 The Store Boy. Horatio Alger. A
..B152 The Telegraph Boy. H. Alger. A
..B153 The Young Acrobat. H. Alger. A
..B154 The Young Explorer. H. Alger. A
..B155 Driven from Home H. Alger. A
..B156 Facing the World. H. Alger. A
..B157 The Train Boy. H. Alger. A
..B158 Facing Death. Horatio Alger. A
..B159 Grit. Horatio Alger. A
..B160 In a New World. H. Alger. A
..B161 Julius the Street Boy. H. Alger. A
..B162 Tom the Bootblack H. Alger. A
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..B166 The Young Musician. H. Alger. A
..B167 Facing Death. G. A. Henty. A
..B168 Out on the Pampas. G. A. Henty. A
..B169 Outward Bound. Oliver Optic. A
..B179 Bound to Rise. H. Alger, Jr. A

Adventure

..B173 Secrets of Monte Carlo. LeQueux. A
..B174 Sheriff of Wasco. Jackson. A
..B175 Taking Chances. C. Cullen. A
..B178 Pavillion on the Links. R. Stevenson. A
..B176 Murderers in the Rue Morgue. E. A. Poe. A

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..C306 Mystery of Crimson Blind. White. B
..C307 Mr. Marx's Secret. Phillips Oppenheim. B
..C308 Mysterious M. Sabin. Oppenheim. B
..C309 Prince of Swindlers. Boothbey. B
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..N2 How to Play Poker. E
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..B120 New Parlor Tricks and Magic. E
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Best Movie Sellers

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..N84 Tell It to the Marines. C
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..N87 Don't Tell the Wife. C

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..C221 World Cruise. Capt. Lawton. D
..C222 Iceberg Patrol. Capt. Lawton. D
..C223 On a Submarine. Capt. Lawton. D
..C224 Aboard a Detroyer. Capt. Lawton. D
..C225 On Battle Practice. Capt. Lawton. D
..C226 War Swept Seas. Capt. Lawton. D
..C227 Marooned in Tropics. Forrester. D
..C228 Boy Scouts in Great Flood. Shaler. D
..C229 On Aero Service. Capt. Lawton. D
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..C255 Mill Street Mystery. Sargeant. A
..C256 The Bag of Diamonds. Fenn. A
..C257 The Red Lottery Ticket. Boisgobey. A
..C258 The Haunting Shadow. Old Sleuth. A
..C259 Joe Phoenix, Police Spy. Atkin. A
..C260 Joe Phoenix, Detective. Atkin. A
..C261 The Wolves of New York. Atkin. A
..C262 Chin Chin, Chinese Detective. By Albert W. Atkin. A
..C263 Electro Pete. Morris. A
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..C265 The Man Hunt. Dick Donovan. A
..C266 Mystery of Hansom Cab. Hume. A
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..N13 The Gold Bug. Edgar Allen Poe. D
..N14 Dr. Jekyll & Mr. Hyde. Stevenson. D
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..B139 The Leighton Homestead. Holmes. A
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..B142 Bad Hugh. Mary J. Holmes. A
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..B145 Ethelyn's Mistake. M. J. Holmes. A
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..B147 Millbank. Mary J. Holmes. A
..B148 Dora Deane. Mary J. Holmes. A
..C233 Kidnapped at the Altar. Libbey. E
..C234 Gladiola's Two Lovers. Libbey. A
..C235 Lil the Dancing Girl. Hart. E
..C236 Aleta's Terrible Secret. Libbey. E
..C237 For Love or Honor. C. Hart. E
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..C239 Little Princess. Caroline Hart. E
..C240 Sweetheart or Wife? Libbey. E
..C241 Love's Rugged Path. Hart. E
..C242 Married at Sight. C. Hart. E
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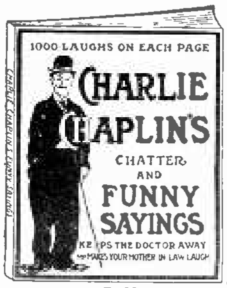
..C244 The Loan of a Lover. Libbey. E
..C245 Vendetta. Marie Corelli. E
..C246 The Girl He Forsook. Libbey. E



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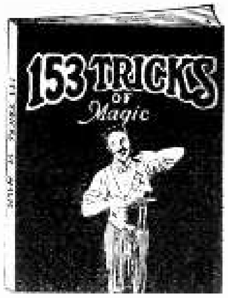


N29

POPULAR BOOK CORPORATION

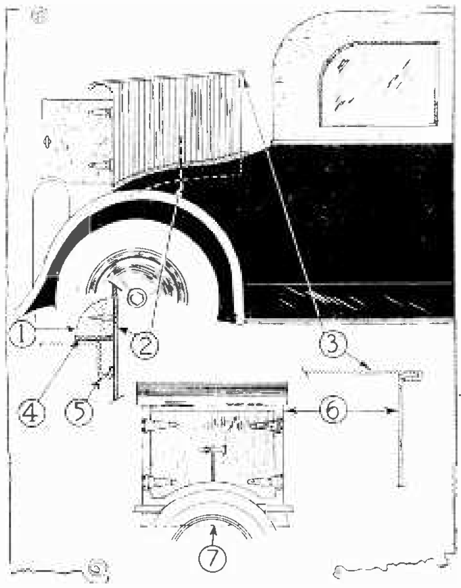
102 PARK PLACE
NEW YORK

MOTOR HINTS
CONDUCTED BY GEORGE H. LUERS
(*Continued from page 35*)

The box-like container is fitted in place of the usual lid to the rear storage compartment. It is made up of sheet iron, bent and fitted to the rear body. The top is also of sheet iron, sloping to the rear. Two wide sheet metal doors on hinges provide access and also permit it to be locked. A closing strip of one inch quarter round, with a felt edge, makes quite a weather-proof job.

Light sheet metal can be used and all joints double seamed as in roof work.

This fixture is detachable as desired, but a neat coat of paint to match the car avoids any unsightliness.



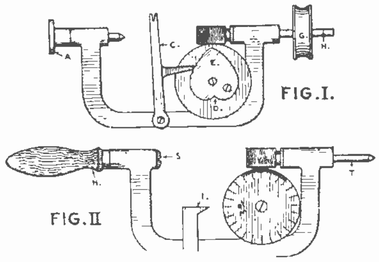
The drawing at the right shows how a coupe or roadster can be fitted for carrying extra luggage. No. 1 is a piece of quarter round molding, 2 is the joint; 3, seam at upper edge; 4, felt strip; 5, body of car; 6, sheet or galvanized iron. Fig. 7 shows a rear view of the baggage carrier now that the summer season is approaching, this idea should prove particularly interesting to all motorists.

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

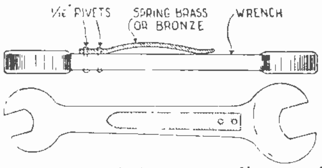
SPEED INDICATOR



Figs. 1 and 2 above show how a speed indicator can be made from an ordinary sewing machine.

A speed indicator can be made from a sewing machine by removing heart shaped plate E and substituting a graduated disc. The thread spindle is removed and a pointer arranged as shown. The shaft H is pointed and a handle is provided.—Contributor send name and address.

WREN CLIP

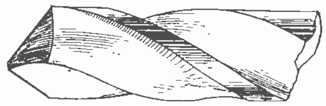


Details of the pocket wrench clip are shown above. Two rivets are used to hold the clip to the wrench.

Small wrenches have a habit of becoming lost or misplaced. The idea shown in the illustration provides a novel clip arrangement for holding the wrench securely in the pocket. The clip is made of spring brass or bronze and is held to the wrench with two 1/16" rivets. It is clipped in the pocket in much the same manner as a fountain pen or pencil.—Contributor send name and address.

EXTENDING DRILL SIZE

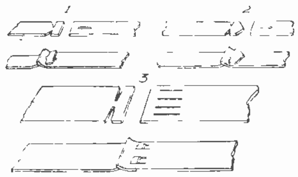
The size of an ordinary drill may be increased by using the following method: If a 1⅛" hole is to be drilled and a 1" drill is available, the drill may be ground until one side is 9/16". It will then cut a hole to the size wanted. In this manner, holes can be drilled ¼" larger than the drill size.—*Calvin Thompson.*



SUBSTITUTE DRILL

In drilling small holes for finishing nails, the head of one of the nails may be cut off and the nail itself used instead of the drill point. It works as well as any drill point would and the hole made is of the exact size wanted.—*Richard Simpson.*

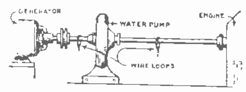
JOINING LEATHER BELTS



Figs. 1, 2 and 3, in the above illustration, show methods of joining leather belts.

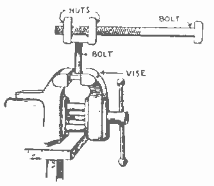
Narrow leather belting may be joined by simply cutting a slit in one end and shaping the other end as shown, at 1 and 2. Fig. 3 shows method of joining wide belts.
—*Wilbur S. Stump.*

KEEPING SHAFTS BRIGHT



Revolving shafts can be kept bright by simply placing a loop of heavy brass or copper wire over the shaft and applying a few drops of oil. The loop works back and forth keeping the shaft clean.—*H. L. Ketcham.*

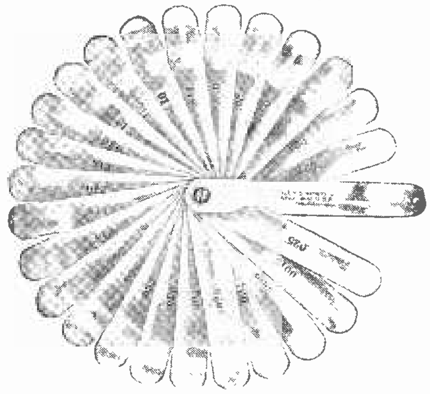
SUBSTITUTE WRENCH



A substitute wrench can be made from two nuts and a bolt as shown in the illustration. The nuts may be adjusted to any size.

—*Lincoln Robinson.*

FEELER GAUGE



A Handy "Feeler" Gauge

(Manufacturers name on request)

LIFTING THE VEIL OF VENUS

By DONALD P. BEARD

(*Continued from page* 31)

When distant objects, say a remote range of hills or some group of buildings, are viewed through an intervening strata of atmosphere they are indistinct and sometimes even rendered invisible by the veil of dust particles and mist particles, which diffuse and scatter the short blue light waves reflected from these objects to the observer's eye.

As will be noted in the accompanying photos by Prof. W. H. Wright, this effect is rendered startingly apparent through photographs made with selective filters. In the violet light photograph (Fig. 1-a) San Jose, California, a city nestled in the oak-environed Santa Clara Valley west of the Lick Observatory, was invisible, as though shrouded in an ocean fog, although the day was clear. However, in the infra-red image (Fig. 1-b) the buildings and trees in the plain clear to the coast range are minutely rendered.

The same method, applied to Mars with the great 100-inch reflector on Mt. Wilson, yielded to Prof. Wright an image through the violet filter (Fig. 2-a) some six per cent larger than the infra-red image (Fig. 2-b), indicating a Martian atmospheric shell almost 140 miles deep!

When the planet Venus reached her greatest eastern elongation (45 degrees of arc east of the sun) on August 5th, 1927, she achieved her greatest brilliancy. At this time Venus set more than three hours behind the sun, and in the telescope revealed a crescent similar to that of our moon about five days after "new" moon. The weird copper color of the unilluminated portion of Venus seen when the planet is a narrow crescent just before inferior conjunction has been a mystery to observers. On February 28th, 1806, Harding, at Gottingen, Germany, using an 8-inch reflector, saw this dark-side glow—upon which Schroeter bestowed the term *kuentsliche Feuer* (artificial fire)—shining with a reddish-gray color like that of the moon in total eclipse. Now, these observations can be interpreted only in the light of recent discoveries as indicating an enormous volume of infra-red radiations from the dark regions of Venus!

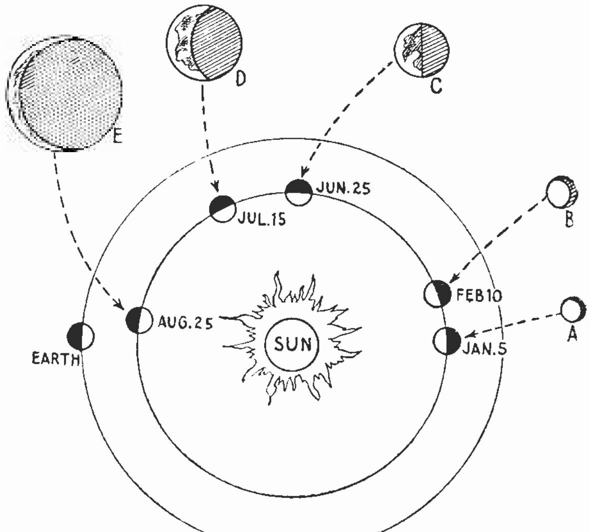


Fig. 4. Diagram of the orbit and successive positions of Venus during the recent apparition. The corresponding phase of the planet as seen from the earth is appended to each of the five principal positions by arrows.
A—"Full" phase near superior conjunction.
B—"Gibbous" phase.
C—"Half-Moon" phase previous to E. elongation.
D—"Crescent" phase near E. elongation.
E—"Decrescent" phase just before Infer. conjunction.

Furthermore, M. Hansky of Russia, about ten years ago, found that the visibility of the "dark light" was greatly excited and augmented during years of sunspot activity, such as 1927. All observers of Venus should have carefully noted the visibility of the dimly lighted area of the planet enclosed in the thin sickle of her narrowing crescent previous to September 10th, 1927, when inferior conjunction occurred.

The dark-side radiation from Venus, when measured by the vacuum thermocouple attached to the great 100-inch reflector located on Mt. Wilson just before and after inferior conjunction about July 1st, 1924, gave important results. Dr. Coblentz of the U. S. Bureau of Standards found the volume of infra-red radiations from the dark regions were of abnormally great wavelength; indeed, almost three times greater than that reflected to us from the bright sunlit crescent!

A careful examination by Dr. Coblentz revealed that the amount of planetary heat radiated earthwards at inferior conjunction (E) is very nearly the same as that sent us at superior conjunction (A) when Venus is more than six times as far away, or (Fig. 4) some 67,000,000 miles beyond the sun. (See chart, Fig. 4.)

In short, these observations indicate a nearly uniform temperature over the surface of Venus harmonious with the existence of sentient animal life there. This dense and perhaps permanent cloud-canopy tempers the terrific solar radiation, producing an equable climate of relatively narrow temperature variations, not unlike that of San Francisco, as a terrestrial example.

The above mentioned fragmentary facts concerning Venus that have been evoked by aid of infra-red photography and the radiometric measures by Coblentz permit us to indulge certain fascinating speculations on life-conditions upon Venus.

Dense cloudiness prevailing over Venus, combined with the appearance of great ice-caps and glaciers about the polar areas of the planet, predicates a planetary development similar to that of the Carboniferous epoch on the earth some ten millions of years ago. Upon our planet this stage was vividly manifest in a vigorous and grotesque flora and fauna; a world dominated by the nightmare saurians of Conan Doyle's "Lost World," while exuberant tree ferns and calamites grew tumultuously beneath a humid, cloud-filled sky from which descended never-ceasing deluges of rain.

Immense glacier sheets extending over thousands of square miles apparently blanket the polar areas of Venus, although Prof. Ross's recent photographs seem to indicate rather an extensive southern cloud area about the south pole. Years ago, De Vico thought he observed mountain peaks on several occasions which apparently upthrust themselves like Jungfraus and Everests, high above the cloud envelope, their everlasting snow-peaks appearing as dazzling diamond-points amidst the billows of grayish vapour.

Could we descend upon Venus in a projectile and emerge upon her surface we would, in the opinion of Dr. Landerer of Vienna, find ourselves at once plunged back into the fantastic scenes of the Jurassic epoch on earth. Overhead the atmosphere would be dense with vapours, while an oppressive steaminess, an overwhelming hothouse heat, would stifle our breath.

Arrhenius of Stockholm, in a masterly analysis of the question, infers that a great part of the Venusian planet is covered with dense swamps more luxuriant than the Amazon jungles, and corresponding to those once on earth, whose complex fossils are preserved in the great Devonian coal stratas. No dust clouds are ever lifted up by the active air currents through the steaming atmosphere of Venus to lend it a distinct color like that of the earth's azure skies. The blinding white reflections from the cloud envelope above reaches the outer spaces, imparting to Venus her high albedo of 92 per cent of absolute reflection. This is an astronomical term expressing the ratio, which the light reflected from an unpolished surface, bears to the total light falling upon it.

The visitor upon Venus would encounter round about him towering tree ferns such as exist only in our parks and conservatories at present, or in warm, fog-shrouded valleys of Australia, Africa, and New Zealand, greatly diminished from their mighty progenitors that towered to heights of perhaps 300 feet. A forest of tree-ferns that flourishes in San Francisco is shown in Fig. 6.

In the remote aeons during which their antecedents ruled triumphant over a saurian-infested earth, a mild and temperate climate apparently prevailed throughout all Europe, Russia, Mongolia and Siberia and as far north as Spitzbergen and Kotzebue Sound, where the builders of coral reefs and tree-ferns, now fossil, dwelt in latitude above 80 degrees north, where at present stretch only desolations of ice. And from the lofty mountain ranges of Venus extensive glaciers would hang in vast sheets, their long fangs of ice depending over deep gorges like those of the Himalayas, whose white turbans sweep the turquoise skies of India.

Perhaps upon our neighbor planet, Venus, the gigantic palms and ferns were ushered in ages after they gave up the struggle on an earth that grew less humid and more sunshiny, and have there attained the stature of our mighty redwoods and firs. The dense clouds mask effectively the Hesperian planet's surface, preserving like a thermostat its equable greenhouse temperatures throughout aeons against the day when a race, now in the womb of time, shall appear and play out its drama upon Venus.

Thus, in a little beam of infra-red "light" reflected to the earth from distant Venus, lies the romantic possibility that man will presently rend aside the tantalizing veil hiding the coy features of the Love-goddess's world.

EARTHQUAKES PREDICTED HOURS IN ADVANCE

BY JAMES NEVIN MILLER

(*Continued from page 11*)

instrument called a clinograph, developed by another Japanese scientist, Prof. Ishimoto. With the clinograph a very slight tilting of the earth can be measured even to an accuracy of one part in a million—which is more precise than is necessary in predicting earthquakes of major importance.

Prof. Evans has suggested that a bell might be attached to the new device that would ring automatically and attract the attention of an observer when such a tilting of geological strata occurred. If the observer is satisfied that there is sufficient evidence of an approaching earthquake, a general alarm might be sounded. Prof. Evans explains:

"The interval between the commencement of the warning tilt and the shock is usually brief. But in most cases the interval would be long enough to enable loss of life to be largely, if not entirely prevented."

Prof. Imamura, at a recent international conclave of scientists at Prague, Czecho-Slovakia, said: "The Earthquake Research Institute of the Tokio Imperial University is attempting to have a network of stations, each equipped with a pair of clinographs and other auxiliary instruments necessary for carrying on the study of earthquake predictions."

Some of the great earth cracks, or "faults," which are the cause of earthquakes, are known simply because they have been responsible already for one or more quakes. There may be many other lines of weakness which remain as yet undiscovered. So no portion of the earth's surface is entirely free from the menace.

There are well-known faults in the vicinity of many of America's largest cities and they may prove far more serious than their activities up to date have indicated. Who knows but what the fault which extends throughout the St. Lawrence valley in New England might one day be responsible for a disastrous quake in Canada, which might affect American cities along the American coast as far south as New York City? In point of fact, New York felt a slight earth tremor, just a few years ago. In addition, the palisades of the Hudson form one side of a geological fault which lies approximately along the line of the river.

An earthquake in the vicinity of New Madrid, Missouri, many years ago, revealed the existence of a fault which, if it became active today, might cause an earthquake in St. Louis, Memphis, or throughout a great stretch of surrounding territory. Nor should the well-known San Andreas fault in the vicinity of San Francisco be forgotten. It extends well into the ocean—an indeterminate but substantial distance.

EARTHQUAKES IN ALASKA

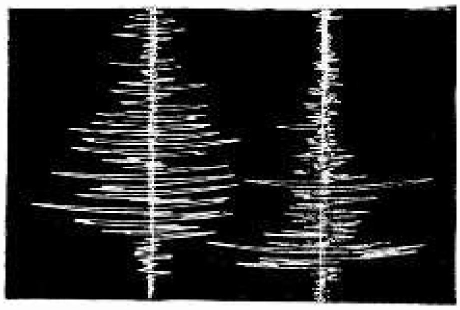
ALASKA compares favorably, or perhaps we should say, unfavorably, with Japan in the matter of frequency of earthquake occurrences. Although many Alaskan earth disturbances are severe, thus far they have done very little damage to life and property because the country is sparsely settled. However, Alaska is growing fast, achieving good roads, increasing its commerce steadily, and with the proposal to build a railway to Alaska from the United States, our most northerly possession is well on the way to a population so substantial as to one day be menaced seriously by earthquakes.

Up to date, science has relied pretty largely on the seismograph in its earthquake calculations. Unquestionably, in conjunction with the clinograph it could be used to infinitely better advantage. Placed in a concrete block buried in the ground, care is taken to cut off the seismograph thoroughly from all structures, so that the block will be entirely free.

The earthquake's first manifestation is the production of a wave through the earth similar to the action of a sea wave, although of course each earthquake wave is considerably longer and is invisible to the eye. This first wave penetrates the earth's substructure. Shortly thereafter a second wave acts similarly, and finally, a third wave goes around the earth's surface. Occasionally a wave makes a complete circuit of the earth before registering on the instrument.

RECORDS OF THREE STATIONS REQUIRED

THE seismograph records the time ensuing between these various waves. Knowing the intervals and the rate of speed of each wave, scientists can compute the distance of the disturbance. However, it is impossible for one instrument, unaided, to locate the earthquake's position. To locate an earthquake accurately, the aid of at least three seismograph stations is required. When an earthquake of major importance occurs, America's authoritative earthquake investigation center at the U. S. Coast and Geodetic Survey, Washington, receives telegrams or cables from almost every good-sized station in the world. Whereupon the government experts take an ordinary globe of the world and draw the arc of a circle within the radius extending from each station as a focal point. Where the lines of these arcs cross is the location of the earthquake. This reckoning takes but a short time, but is not precisely accurate—perhaps within two or three degrees of the exact longitude and latitude. The reason is that the small globe itself is not precise enough for minute computation. In fact, were you to stick a pin into the average globe used by seismologists, the resulting pinhole would represent an area on the earth's surface of about six to eight miles in diameter.



Photographic picture of the earth's movements as recorded by a seismograph during the disastrous Japanese earthquake of September 1, 1923.

The rough position having been determined, the experts study the various seismographic reports that stream in from all parts of the world. Within 24 hours they are prepared to give a far more accurate picture of the earthquake's location — no matter where on the earth's surface the tremor took place. The final computation is a highly technical mathematical process. Taking into consideration the convexity of the earth, an extensive geodetic reckoning measures the distance.

As for the exact mechanical operation of the seismograph—in the Galitzin, the most sensitive instrument we have today, the magnetic principle of photographic recording is involved. That is to say, when the earth trembles, a tiny finger of light within the device quivers. The finger is directed through a slot onto a moving photographic film known as a seismogram. Thus when the film is developed, the path of the quivering finger reveals itself as an irregular black line.

Seismographs are spread at strategic points throughout the country, as indeed they are in all the important cities of the world. So far as the clinograph is concerned, it now seems important to equip every city in a "fault district" with the instrument so that the population might be warned of an impending earthquake in time to prevent such great catastrophes as the Tokio quake of September 1, 1923, in which more than a hundred thousand lives were lost and a like number of buildings destroyed.

THE CLINOGRAPH

THE clinograph might be operated in connection with the weather bureaus of large cities. Many sizable towns today have special committees to deal with emergencies and major disasters. Boston is highly organized in this respect and the people are being trained and mobilized to act efficiently in any disaster of consequence. New York City has a similar organization, as has also Los Angeles.

Did you ever stop to think what would happen if the New York City water supply suddenly were cut off entirely because of an earthquake? In addition to the fire hazard, there is no question but that a large portion of the great city's millions would die of thirst. The nearest adequate water supply is some 40 miles away and a pilgrimage of that length in time to avert catastrophe would be physically impossible for seven million people.

WHAT TO DO IN AN EARTHQUAKE

PICTURE, on the other hand, the situation in the case of the city of the future if a major earthquake were to occur. The committee on public safety would educate the populace through agencies like the school and the press not to fear earthquakes but to prepare for them. The people will have been told that when an earthquake warning reaches them—via the radio, for instance—they are to turn off all electricity and gas jets, to put out all furnace fires, to turn off the water supply and to get out in the middle of the street or in a public park. The police and fire departments will be mobilized to act quickly and efficiently. Traffic will be stopped and people will be warned not to traverse the sidewalks because of the danger from possible falling cornices or bits of masonry. They will be told to get into an automobile, because, strangely enough, that is the safest place in the world to be during an earthquake, since rubber tires and springs take up shock to an amazing degree.

With all life-preserving connections turned off and no open fires to worry about, the fire hazard will be greatly reduced and the city should emerge from the earthquake with no more damage done to it, perhaps, than the shaking down of a few poorly constructed buildings. Concerning these, mention already has been made to the effect that certain authorities believe the pyramids of Egypt were planned to withstand the ravages of earth tremors. For a like reason, the Mayas of Central America constructed their temples in pyramid shape and with exceptionally thick walls.

These ancients were either fortunate or wise, for of all man-made buildings the pyramid form is the best adapted to resist earthquakes. Its low center of gravity makes it practically impossible to tip over or shake down. Fundamentally, the shape provides the same type of diagonal bracing as is used in ship-building, where the necessary principle is to insure the ship's holding up under the terrific buffeting of the waves.

AMERICAN BUILDINGS QUAKEPROOF

CURIOUSLY enough, in America today, our architects are developing a type of structure not unlike those of the ancients. Our new pyramid-like buildings represent the very last word in safeguarding against earth disturbances, even though the form originally was developed as an aid in solving our city traffic problems and to provide more light and air space in our heavily congested streets.

Then again, the art of earthquake-proof construction has seriously engaged the attention of engineers and architects for many years. Indeed, the construction of such buildings will be one of the major topics for discussion by the engineering section of the Pan-Pacific Commercial Conference in Los Angeles in 1928. So it is reasonable to believe that the time is not far distant when our buildings in great part will be constructed along lines of well nigh perfect security and safety.

It has been suggested, in view of our growing airplane commerce, that it might be desirable to establish landing fields on the tops of big buildings. This general procedure, of course, would seriously hamper efforts towards widespread building of pyramidal earthquake-proof structures. However, the more sensible plan, perhaps, and one for which our grandchildren would bless us, would be to continue the pyramid type of building on a scale as large as possible, and to establish landing fields on the ground over regions where geologists have determined that cracks or faults exist that might slip and do serious damage.

In any case, with predictions of earthquakes seemingly an avowed reality, according to Professors Imamura and Evans, science now holds out to mankind surcease from fear of the one major catastrophe which has defied the best of his "prediction instruments."

CONTROLLING HOUSEHOLD PESTS

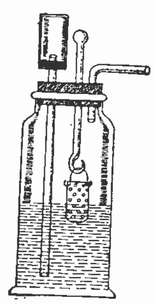
By DR. ERNEST BADE

(*Continued from page* 17)

attack colors and fade them. Pouring kerosene in casters on which the bed stands is useless. The bed bugs simply crawl to the ceiling and drop on the bed and then hide in the bed. It is much better to brush the cracks of the bed and furniture and other suspected hiding places with a mixture consisting of one ounce of corrosive sublimate, one pint of alcohol and one quarter pint of spirits of turpentine. If desired, a sulphur candle may be lit to fumigate the room. Or a little sulphur may be placed in a pan set on a brick in a dish of water and a little denatured alcohol poured over the sulphur, about a small cup full is sufficient. Lighting the alcohol will ignite the sulphur. About two pounds of sulphur for 1,000 cubic feet of space is required. The room should be sealed for eight or ten hours at least. The best way to close cracks around windows or doors is to take old newspapers, soak in water and press around the cracks. The wet paper will stick tightly for many hours. Here it must also be mentioned that not only are certain metals like silver tarnished, but certain colors are bleached. This must be taken into consideration. Perfectly dry material will not be bleached.

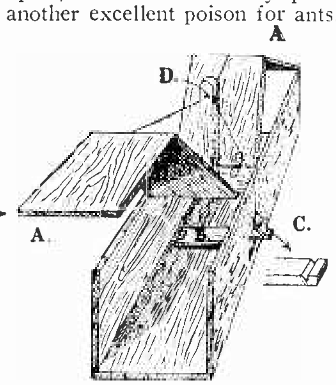
ANTS

OF ants little need be said except that several species become annoying in the home. A syrup made by dissolving sugar in water and adding borax attracts and kills many. Kerosene is also effective when sprayed into their nesting holes or opening through which they enter. This is especially good for ants on the lawn. In the latter case a wad of cotton saturated with kerosene effectively keeps them out. Tartar emetic, one part, mixed with twenty parts of honey is another excellent poison for ants.



The rat trap illustrated here consists of three hinged parts. AA fall down and catch the rat when the hinged part B holding the bait is disturbed, which releases the holder C, connected by a string to point D, where the hinged ends AA are held in position. When the bait is taken the balance is disturbed, the small block C, shown enlarged, falls out, releasing the string at D and the trap is closed.

The mechanism at the left shows the arrangement for assembling the device to produce gas in quantities. This gas varies in accordance with the chemicals used, and some of the gases produced at constant pressure by such an arrangement can be used for insect extermination.



RULES FOR MODEL CONTEST

(*Continued from page* 40)

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 model as related to the efficiency of the device which the model simulates, and D—the care exercised in design and in submitting to us sketches and other details covering the model.
2. Models of all kinds may be entered. They may be working models or not, according to the subject that is being handled.
3. Models may be made of any available material, preferably something that is cheap and easily obtainable.
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 by parcel post, express or freight prepaid. Models will be returned when requested.
6. Models for entry in any particular contest must reach this office on or before the 25th of the third month preceding date of publication. For instance, models for the July contest must reach us on or before the 25th of April.
7. Address all entries to Editor Model Department, c/o Science and Invention Magazine, 230 Fifth Avenue, New York City.

Science Frauds Exposed by Uncle Sam

By K. M. PAINTER

(*Continued from page 27*)

reau of Chemistry analyzed all fourteen of these compounds, and found each to contain the same ingredients—25 per cent alcohol; 25 per cent water; 50 per cent olive oil; and one to four drops of flavoring, which changed the color and taste, constituting the only variation.

Preying on the religiously inclined, John F. and Kate A. Braun sold "blessed handkerchiefs" under the names of Reverend D. R. Schiller and Hulda DeMoth. Kate Braun, alias Hulda DeMoth, blessed the handkerchiefs, which were endorsed by her husband, and mailed to sufferers at a cost of \$5 to \$15. These squares of unhemmed muslin were to be placed over the affected parts, and the individual was instructed to "rest in a reclining posture." Details as to time of treatment were vague—eventually the pair were sentenced to a prison term of three years for their chicanery.

It is a well-known fact that female lima beans are preferable, and this little instrument is especially valuable to the farmer, who may establish the sex of beans before planting," read an advertisement of "Sex Indicators." Probably the name of this device appealed to the public, for the instrument was too absurd to be accepted by even the most generously credulent person. A small wooden ball or arrowhead was attached to a string and the accompanying directions said: "Hold this instrument over any object—if the indicator (ball or arrowhead) describes a circle, the male sex is indicated. If the indicator moves in a vertical direction, the object is female." Several manufacturers put out "Sex Indicators"—several fraud orders have been issued by the Post Office Department.

A solution of ninety per cent hydrant water, 5 per cent salt; and 5 per cent sugar proved highly profitable when advertised as Professor Samuel's Eye Water. All diseases of man were "cured" (according to testimonials) when 2 drops of this liquid were put in each eye four times a day. Depending upon his buyers, Professor Samuel charged \$5 to \$25 for two ounces of his "Eye Water," which cost him about 5 cents a gallon. His product was so generally accepted that he amassed over \$1,000,000 during the time he was in business. After having been released from prison, where he served his sentence for fraud, Professor Samuel has retired from activity and is living comfortably on his profits.

IMPORTANT

TO NEWSSTAND READERS

IN order to eliminate all waste and unsold copies it has become necessary to supply newsstand dealers only with the actual number of copies for which they have orders. This makes it advisable to place an order with your newsdealer, asking him to reserve a copy for you every month. Otherwise he will not be able to supply your copy. For your convenience, we are appending herewith a blank which we ask you to be good enough to fill in and hand to your newsdealer. He will then be in a position to supply copies to you regularly every month. If you are interested in reserving your copy every month, do not fail to sign this blank. It costs you nothing to do so.

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To .... Newsdealer

Address ....

Please reserve for me...........copies of SCIENCE AND INVENTION every month until I notify you otherwise, and greatly oblige,

Name ....

Address ....

A Home-Made Reflecting Telescope

(*Continued from page 46*)

ground so that the hole points to the pole of the heavens. If you do not know how to locate this point set the post up so that you can see the Pole Star (Polaris) through the hole; this will not be accurate, as Polaris is a little over a degree from the Pole, but it will be accurate enough for your purpose unless the axes have been carefully arranged at right angles to each other, when greater refinement is justifiable. The shafting now becomes the polar axis of the telescope when set into the bearing, the other axis becoming the declination axis. The meaning of these terms will become clear after you have read the introductory chapters of one of the elementary text books on astronomy that will be recommended later.

The next step is to adjust the mirrors, and this had better be done in the daylight until you become familiar with the process. Fasten the mirrors securely to the tube and, with the eyepiece removed, turn the cell holding the flat until it faces you as you look down the draw-tube, adjusting it with the screws until it appears to be concentric with the tube. Turn it until you see the image of the pincipal mirror, then further adjust it until this image is central. You may, or may not, see an image of the flat and spider, in the image of the mirror; adjust the tilt of the principal mirror, by the aid of the three adjusting screws, until this image is in turn central. The draw-tube, flat, image of mirror and image of flat should now all be concentric, and an image of the eye should be seen in the image of the flat when you hold it on the axis of the draw-tube about a foot away from the tube.

You are now ready to try out your telescope when night falls. Point it at some star and insert the lowest power eyepiece. The star will probably appear as a disk of light with a hole in it. Slide the eyepiece in or out until the star appears as a brilliant point of light; it will then be in focus. (Don't expect to see the stars as disks, for the most powerful telescopes in existence will not show them thus, they are much too far away. Even the nearest, if magnified ten thousand times, would still appear as though it were two thousand seven hundred million miles away!) If you do see a disk, turn to a *star*, for the object you have seen is not a star, but a planet, unless there is something radically wrong with your mirror. If the star appears to have "wings" you have either not adjusted the mirrors properly or else the flat is poor. Try to adjust the mirrors until the wings disappear, and if that is not successful try one of the other flats. The flats may now be tested by means of the knife-edge at the focus, with the telescope turned upon a bright star. If your mirror is O.K., any shadow patterns that appear will be due to irregularities in the flat.

Don't expect too much of your telescope at first; remember that you will have to learn how to use it before you can get the most out of it. The eye must also be trained. Don't look at the moon when it is full and expect to see the mountain ranges and craters; look at it when you can view the region about the boundary between the Lunar day and night, called the "terminator," to see them at their best.

If you wish to use your telescope to the greatest advantage learn a little about the oldest of sciences, Astronomy. Let me recommend "Moulton's Introduction to Astronomy," or better still, "Astronomy," by Russel, Dugan and Stewart; the finest book of its kind, which has but recently been published.

Making a "Flivver" Cone Unit

By R. EDIS FAIRBAIRN

(Continued from page 55)

For a drive rod to connect a cone or roll with the unit, use another piece of 6/32 threaded brass rod. This can be affixed to the armature with a couple of nuts, or it may be soldered.

You can hear this unit go into action immediately upon connecting it with your set, and without any paper cone. That connection is right which gives the louder result. A little patience in getting the best adjustment will repay the effort. A free-edge cone can easily be supported by this unit. If the edge of the cone is fastened to something, then the armature spring may be much more flexible than if the cone is perfectly free. You may have to file down the thickness of the armature if it is too stiff. Resonance will be much improved if the unit is mounted in a case of thin wood, but be sure there are no loose joints, or you will get a false vibration.

Springtime Garden Suggestions

(Continued from page 22)

purpose and the effect is improved if a certain amount of foliage is added. Now invert the glass shade and fill this to the brim with water. Let the bouquet down into the water until the dish is resting on the shade. The whole thing may now be turned up the right way for the pressure of the air will keep the water from running out of the shade. The bouquet will appear to be set in a block of ice and a very fine table ornament is secured in this way. The flowers will remain fresh for a long while and when in the end they do fade, it is easy to start the water bouquet again with a new lot of blossoms according to S. L. Bastin.

Making a Portable Arc Lamp

By RAYMOND B. WAILES

(Continued from page 43)

the resistance of the whole circuit, and thus allows more current (amperes) to pass, and if a certain point is reached, either the fuses will blow or the resistance wire will melt. Figure 6 shows the method of striking the arc. No rubber glove is needed. You will not be shocked.

The carbons taper toward one another. The arc will burn at the spot where the carbons are the nearest each other. Consequently, as the carbons burn away, the arc approaches the interior of the shade. It will be found however, that a goodly number of hours service can be gotten from the lamp before the arc recedes or the carbons burn up to the plaster.

For use in photography as a source of artificial light, it will repay the operator to soak the carbons in ferric chloride or uranium nitrate solution and then dry them. These substances cause the arc to emit more light falling in the ultra-violet region of the spectrum. It is this portion of the spectrum which has the highest actinic properties. It is well known that an arc lamp gives harsh shadows in photography. But this type of lamp will not cause harshness if the precaution is taken to bathe the subject all over with the light, by swinging it or playing it around about the subject. The arc is extinguished by blowing it out as one does a candle flame.

The Metal Emperor

By A. MERRITT

(Continued from page 33)

and like a dozen little thinking hammers, the pyramid points at their ends beat down upon as many thimble shaped objects, which they thrust alternately into the unwinking brazier and then upon the central block to shape.

A goblin workman, so intent upon, so busy with its forgings!

There were scores of these animate machines. They paid no slightest heed to us as we slipped by them. We passed a company of Shapes which stood two by two, and close together. Their tops were wide and translucent, colorless ingots—the substance it seemed to me of which Norhala's shadowy walls were made, and the crystal which formed the base of the Cones. The ingots passed between the whirling faces, emerged from them as slender, long cylinders and were seized, as they slipped down, by a crouching block, whose place, as it glided away, was instantly taken by another.

In many bewildering forms, intent upon unknown activities directed toward unguessable ends, the composite, animate mechanisms

labored. And all the place was filled with a goblin bustle, trollish racketings, ringing of gnomish anvils and clanging of kobold forges. A clamorous cavern filled with metal Nibelungs!

We came to the opening of another passage, a doorway piercing the walls of a workshop. Its incline, though steep, was not dangerous. We stepped into it, and climbed onward. Far ahead of us appeared the outline of its further entrance, silhouetted against and filled with a brighter luminosity. We drew near, and stopped cautiously at its threshold, peering out.

Well it was, that we had hesitated, for before us was open space—an abyss in the body of the City. The corridor opened into it like a window. Thrusting out our heads, we saw an unbroken wall both above and below. A quarter of a mile away was its opposite side. Over this pit was the misty sky, and not more than a thousand feet above us, and black against the heavens, was the lip of it—the cornices of this great chasm.

Beneath us, at all levels, the Horde threw itself across the abyss in webs of curving arches and girder-straight bridges. Gigantic we knew these spans must be, yet they were dwarfed to slender footways by the distance. Over them moved hurrying companies, from them came flashings, glitterings, prismatic.

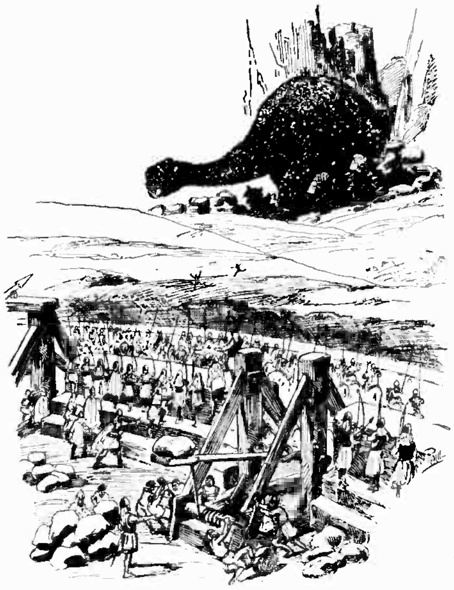
Some golden, plutonic scarlets, others molten blues; javelins of colored light piercing upward from unfolded cubes and globes and pyramids, crossing the bridges or from busy bearers of the shining fruits of the workshops.

And as they passed, the bridges swung up, and coiled, and withdrew themselves from sight through openings that closed behind them. On their going other spans whipped out, so that always across that abyss a score of shifting webs were hung.

We turned slowly and made our way back along the sloping corridor. A hundred yards, perhaps, we had gone before we stopped, gazing at an opening in the wall beside us. The passage had not been there when we had gone by, of that I was certain.

We peered through it. The passage was narrow. Its pave led downward. For a moment we hesitated, the same foreboding in both our minds. And yet—among the perils that crowded in upon us what choice had we? There could be no more danger there than here.

Both ways were—alive. Both obedient to impulses over which we had no control, and



"Set at intervals behind the parapets were squat, powerful engines of wood and metal, and beside them heaps of huge, rounded boulders. Catapults around which swarmed knots of men, fixing the great stones in place, drawing back the thick beams that would hurl the projectiles. From every side came others, dragging more of these balistas, assembling a battery against the monster that menaced their city. . . ."

no more way of predetermining than mice in some man-made trap. Furthermore, this shaft also ran downward. And although its pitch was less, and it did not therefore drop as quickly toward that level wherein lay the openings of escape into the outer valley, it did fall at right angles to the corridor through which we had come. We knew that to retrace our steps would but take us back to the forges and thence to the hall of Cones, and the certain peril waiting there for us.

We stepped into the opened way. For a little distance it ran straight, and then turned and sloped gently upward. A little distance more we climbed. And suddenly, not a hundred yards from us, a flood of soft radiance, filled with pearly glimmerings and rosy shadows, gushed out into it.

It was as though a door had opened into some world of luminescence. From it a lambent torrent poured and billowed down upon us. In its wake came music—if music it could be called, the mighty harmonics, the sonorous chords, the crystalline themes and the linked chaplets of notes that were like spiralings of tiny golden star bells.

Toward source of light and sound we moved, nor could we have halted nor withdrawn had we so willed. The radiance drew us to it, as the sun draws the water drop, and irresistibly the sweet, unearthly music called to us. Closer we came—to a narrow alcove from which the sound and light poured. We crept into it—and went no further.

We peered into a vast and columnless vault, a limitless temple of light. High up in it—strewn manifold, danced and shone soft orbs like tender suns. No pale gilt luminaries of frozen rays were these. Effulgent, jubilant, they flamed—orbs red as the wine of rubies the Djinns of Al Shiraz press from enchanted vineyards, twin orbs rosy white as breasts of pampered Babylonian maids, orbs of pulsing opalescences, and orbs of the murmuring green of bursting buds of spring. Crocused orbs, and orbs of royal coral. Suns that throbbed with singing rays of wedded rose and pearl, of amorous sapphires and topazes. Orbs born of cool virginal dawns and of imperial sunsets. And orbs that were the fruit of mating rainbows of fire.

They danced, these countless aureoles. They swung and threaded in radiant choral patterns, in linked harmonies of light.

And as they danced, their gay rays caressed and bathed myriads of the Metal Folk beneath them. Under those rays the jewel fires of disk and star and cross leaped and pulsed, and danced to the same bright rhythm.

We sought the source of the music—a tremendous thing of shimmering crystal pipes, like some colossal organ. Out of the radiance around it great flames gathered, shook into sight with streamings and pennonings, in bannerets and bandrols, leaped upon the crystal pipes and merged within them.

And as the pipes drank them the flames changed into sound. Throbbing bass viols of roaring vernal winds, diapasons of waterfall and torrents—these had been flames of emerald. Trumpetings of desire that had been great streamers of scarlet. Rose flames that dissolved into echoes of fulfilment. Diamond burgeonings that melted into silver symphonies, like mist-entangled Pleiades transmuted into melodies.

To these chameleon harmonies the strange suns danced.

And now I realized with a clutch of awe, with a sense of profanation, the secret of this chamber.

Within every pulsing rose of irised fire that was the heart of a disk, from every rubrous, clipped rose of a cross, and within every rayed purple petaling of a star there nestled a tiny disk, a tiny cross, a tiny star, luminous and symboled even as those that cradled them.

The metal babes budding like crystals from hearts of radiance beneath the play of jocund orbs. Incredible blossomings of crystal and of metal whose lullabies and cradle songs were singing symphonies of flame.

It was the birth chamber of the Horde!

The womb of the City!

The walls of the niche sparkled out, the glittering eye points regarding us with a most disquieting suggestion of sentinels who, slumbering, had been caught unaware, and who awakening challenged us menacingly. The niche closed—so swiftly that we barely had time to spring over its threshold into the corridor.

The corridor was awake, and threateningly alive. There was none of the twinkling, playful malice in the points now. They glared. Their power darted out, gripped us, and thrust us violently onward. Up it swept us, and on. Far away a square of light appeared, grew quickly larger. Framed in it was the amethystine burning of the great ring girdling the encircling cliffs.

I turned my head. Behind us the corridor was closing.

Now the opening was so close that through it I could see the vast panorama of the valley. The wall behind us touched us, and pushed us on. We thrust ourselves against it, despairingly. As well might flies have tried to press back a moving mountain.

Resistlessly, inexorably, we were thrust forward. Now we cowered within a yard-deep niche. Now we trembled upon a foot-wide ledge.

Shuddering, gasping, we glared down the sheer drop of the City's wall.

Its smooth and glimmering scarp fell thousands of feet straight to the valley floor. And there were no merciful mists to hide what was awaiting us. In that brief, agonized glance every detail of the Pit was disclosed with an abnormal clarity.

We tottered on the brink. The ledge melted under our feet.

Down we plunged, locked in each other's arms, hurtling to shattering death far below!

CHAPTER XXIII

THE TREACHERY OF YURUK

WAS it true that Time is within ourselves—that like Space, its twin, it is only a self-created illusion of the human mind? There are hours that flash by on humming birds' wings, there are seconds that shuffle on, shod in leaden shoes.

Was it true that when death faces us the consciousness finds power through its will-to-live to conquer the illusion—to prolong Time? That, recoiling from extinction we re-create, in a fractional moment, whole years gone past, years yet to come—striving to lengthen our existence, stretching out our apperception beyond the phantom boundries, overdrawing upon a Barmecide deposit of minutes, staking fresh claims upon a mirage?

How else explain the seeming slowness with which we were falling—the seeming leisure with which the wall drifted up past us?

And was this our punishment—a sentence meted out for profaning with our eyes a forbidding place? A penalty for touching with our gaze the Ark of the Metal Tribes—their Holy of Holies—the budding place of the Metal Babes?

The valley was swinging—swinging in slow broad curves, was oscillating dizzily. Slowly the wall slipped upward.

Realization swept over me and left me mazed, only half believing. This was no illusion. After that first swift plunge our fall had been checked. It was we who were swinging—not the valley!

Deliberately, in arcs, like pendulums, we were swinging across the City's scarp. Three feet out from it. And as we swung, we were slowly sinking.

The countless eyes of the watching wall were twinkling, regarding us with an impish mockery. And it was the grip of the living wall that held us, that rocked us from side to side as though giving greater breadths of it a chance to behold us, and that was dropping us gently, carefully, to the valley floor, now a scant two thousand feet below.

A storm of rage, of intensest resentment swept over me; any gratitude I should have felt for escape was submerged in angry humiliation.

Why, if we had sinned, had not execution been done—decently, with respect for us as thinking things? Why, if we had not sinned, had we been thrust so cruelly out to apparent annihilation? Had it all been a jest?

Why dangle us thus—like frightened puppies swung by thoughtless children down the facade of a skyscraper? Was this another jest? Or were we to be lured with false hope of safety only to be more cruelly slain at the end? What relish for all this could exist in this monstrous mass—a mass to which we were as pebbles to a mountain?

Blindly wrathful, I broke Drake's clasp and shook my fists at the twinkling wall, and strove to kick and smite it like an angry child. I cursed it, and dared it to hurl me down to death.

My passion passed and left me trembling. I felt Drake's hand touch mine in encouragement.

"Steady?" he said. "Steady, old boy! It's no use. Thank God we're out of it. Steady! Look down."

Hot with shame for my outburst, weak from its violence, I obeyed. The valley floor was now no more than a thousand feet away. Thronging about where we must at last touch, clustered and seething, was a multitude of the Metal Folk. They seemed to be looking up at us, watching and waiting for us.

"Reception Committee!" muttered Drake grimly.

I glanced away, over the valley. It was luminously clear, yet the sky was overcast, no stars showing. The light was no stronger than that of the moon at full, but it held a quality unfamiliar to me. It cast no shadows. Though soft, it was piercing, revealing all it bathed with the distinctness of bright sunshine. The illumination came, I thought, from the encircling veils falling from the band of amethyst.

And, as I peered, out of the veils and from far away a violet spark appeared. With meteor speed it flew toward us. It landed close to the base of the City and perhaps half a mile away with a flashing of blue incandescence. I knew it for one of the Flying Things, the Mark Makers—one of the incredible messengers.

At its fall the turmoil of the crowding throng awaiting us increases. There came, too, an abrupt change in our own motion. The long arcs lessened, and we were dropped more swiftly.

NORHALA APPEARS

FAR away, in the direction from which the Flying Thing had flown, I sensed another movement, something coming that carried with it subtle suggestion of unlikeness to all the other incessant, linked movement over the pit.

"Norhala!" gasped Drake.

It was Norhala. Robed in her silken amber swathings, hair streaming, she was racing toward the City like some lovely witch, riding upon the back of a steed of huge cubes.

Nearer she raced. More direct became our fall. Now we were dropping as though at the end of an unreeling plummet cord. The floor of the valley was no more than two hundred feet below.

"Norhala!" we shouted; and again and again—"Norhala!"

Before our cries could have reached her, the cubes swerved and came to a halt beneath us. About Norhala surged and slithered and rubbed the Horde—grotesquely catlike. She paid no heed, staring up at us as we fell. In my heart foreboding grew. We were lifted softly out from the wall and were set with no perceptible shock beside her.

"Norhala—" I began and stopped. For this was no Norhala whom we had known. Gone was all calm, banished every trace of unearthly tranquility. It was Norhala awakened at last. Over the blazing eyes the brows were knit in a rigid, golden bar; the delicate nostrils were pinched, the mouth once sweet and red was white and merciless.

What was it that had awakened her—what in awakening had changed the inpouring human consciousness into this flood of fury? A stronger foreboding gripped me.

"Norhala!" My voice was shaking. "Those we left—"

"They are gone! They were—taken!"

(*Continued on page* 83)

DIRIGIBLES

By LT. COM. C. E. ROSENDAHL

(*Continued from page* 15)

aircraft which float in the air much as a seagoing vessel does in water. We have: free balloons, which possess no motive power and drift with the wind, the pilot having only up and down control; the kite or captive balloon which floats aloft and is made fast to the earth by a wire cable; then come the dirigible balloons which are of three classes—non-rigid, semi-rigid and rigid.

The non-rigid airship is one whose gas bag contains no internal structure and owes its shape solely to the outward pressure of the gas contained within it. The semi-rigid has a partial internal structure which it relies upon together with the internal gas pressure to maintain its shape. The rigid airship is one whose form is maintained entirely by a rigid skeleton structure. There are a number of non-rigids in this country—our Navy now operates the J-3 and the J-4 for training purposes and our Army has several similar ships called the TC class. Non-rigid airships are of necessity small but can cruise at 55 or more miles per hour for about 12 to 24 hours. They are useful for convoy work, coastal patrol, anti-submarine work, photography and mapping and a number of other purposes.

Semi-rigid airships have a somewhat greater range and greater carrying capacity than the non-rigid and form the intermediate step to the rigid airship. The Navy has no semi-rigids at the present time but the Army operates one, the RS-1, from Scott Field, Illinois. The Italians favor the semi-rigid and it was a ship of this type, the Norge, which carried the Amundsen-Ellsworth-Nobile Expedition over the North Pole in 1926. The rigid airship of which the Los Angeles is an example, has a much greater cruising radius and carrying ability than the other two classes.

WHAT THE DIRIGIBLE HAS DONE

IN order that you may better understand the usefulness of the rigid airship, let me point out a few of its outstanding flights: (a) Small commercial rigid airships operated in Germany both before and after the war and carried 37,000 passengers without accident or mishap. Most of this was even before the war, as the post-war commercial ships had to be delivered to the Allies after only brief German operation. The proof of this commercial venture was that the ships practically always carried capacity loads.

(b) The German L-59 in November, 1917, took off from her base in Bulgaria, carrying a cargo of fourteen tons of medical supplies and small arms' ammunition to the besieged German East African Colonies. Just as the destination was about reached, a radio message was received by the airship stating that the German Colony had surrendered. She therefore returned to her base without landing. Although she had been in the air for almost 100 hours and had traveled about 4,500 miles with her four-teen-ton cargo, upon landing she still had sufficient fuel for an additional forty-eight hours' flight.

(c) The round trip of the British R-34 between England and the United States in July, 1919, was a noteworthy achievement, as that type and size vessel was then already obsolete.

(d) In October, 1924, our American built Shenandoah, modeled after the German 1916 war type but not completed until 1923, cruised across the continent, up the Pacific Coast and returned to Lakehurst, having covered 9,000 miles in many kinds of weather, basing entirely on mooring masts for over 19 days.

(e) The Zeppelin Dixmude while operated by the French stayed aloft for 118 hours or nearly five days, making the world's record for aircraft.

(f) The Los Angeles, then designated as the ZR-3, on her delivery flight from Germany covered 5,060 miles in eighty-one hours, spanning the actual ocean expanse in sixty-one hours, her average speed being over 62 miles per hour.

(g) Space does not permit me to recount to you here the varied wartime uses to which airships were put, but they were many and important.

(h) It is significant to note that the only successful westbound flights across the Atlantic have been made by airships.

COMFORTS OF AIRSHIP TRAVEL

WHEN it comes to the comforts which airships can provide you may be surprised. In airship travel you ride in a sheltered structure, there is no noise, no vibration, no dirt, no smoke, and the motion, when there is any, is a mild gradual pitch. I have never seen any seasickness in an airship. There are ample comforts for sitting, sleeping, reading, writing, card playing, walking about and exercising and the new airships contemplate even ball rooms. But, of most importance, the airship provides an electric kitchen which can furnish as satisfactory a menu as can be desired. Perhaps airships will never provide swimming pools as huge steamers do, but when you are crossing the Atlantic in two days instead of six you can probably dispense with your daily swim for that period. Fogs, muddy or snow-covered fields present no insurmountable difficulties for airships, and airship flight at night and in darkness is generally even easier than in the daytime.

Airships are not yet wholly perfected instruments but they are capable of many improvements as they become larger—"bigger and better" is a correct slogan for airships up to at least four times the size of the Los Angeles. And what is more important, the efficiency of the airship or the amount of its useful load compared to its "dead" load increases with larger ships. With this increase it becomes possible to add structural strength, more speed and greater performance—all factors of great importance. All this is possible in the light of present principles of design and construction and with the materials now available; the future may and probably does hold new variations and strong lighter materials which will add to increased airship efficiency. We shall even see airplanes carried on airships attachable and detachable in flight, just as a steamer carries smaller power boats.

1928 TO BE AN AIRSHIP YEAR

AND these are some of the reasons I look for 1928 to be an airship year. In England nearing completion are two huge commercial airships of 5,000,000 cubic feet capacity—each twice as large as the Los Angeles and each capable of carrying one hundred passengers in comfort for 4,000 miles. Commander Burney is in the United States today arranging for a probable visit of the first of these two ships to the United States this summer. The second of these ships will be finished in September. Great Britain has built these two large airships to unite her Empire more closely and accordingly has laid out a route from England to India via Egypt; servicing stations and terminal facilities are nearly complete and mooring masts are to be built in Canada as well. By airship from England to Canada will take two and one half days, whereas steamers now require six days; from England to Egypt will require two and one-half days by airship as opposed to six days by steamer; from England to Singapore will require eight days by airship whereas twenty-four days are required by steamer—making a 16 day saving possible by airship in this case.

At this very moment in Friedrichshafen, Germany, the birthplace of the Los Angeles, the airship LZ-127 is being rushed to completion and her maiden voyage across the Atlantic to the United States is expected to be made early this summer. This ship, one and one half times the size of the Los Angeles, built largely by popular subscriptions by the German people, embodies many novel and wonderful features of comfort and operation. This ship will probably be operated under a subsidy from the Spanish Government for a commercial run between Spain and the Argentine.

MOORING OF AIRSHIPS

By joint agreement, our Navy is charged with the development of rigid airships in the United States. The problems of both military and commercial airships have, so far, coincided to a large extent. As our contribution to airship progress, we have conducted many experiments that are about to produce their results within the next six months or so. The greatest problems of airship operation in the past have been those due to undeveloped methods and equipment for handling airships on the ground—in other words, terminal facilities for airships have been inadequate. It is remarkable indeed that airships handled only by man power on the ground, have been able to accomplish as much as they have. However, we are never content to do with man power what we can develop mechanical power to do, and this substitution of machines for the men now used on the ground is the problem we in the United States shall have solved in the near future. We expect soon to make the airship just as available as steamers now are; the airship will not have to be berthed in a shed regularly but will moor outside between flights and go into a hangar only for "dry-docking." Many other interesting and essential problems of operation have been worked out and we shall begin employing them very soon. So it is really but a few months off when we shall see airships become enormously more available and useful.

And what about new construction in the United States? At present our only large airship is the Los Angeles. The last Congress authorized as a part of the five year aircraft building program, two large naval rigid airships of six million cubic feet gas capacity—larger than even the new British ships about to be completed. Unfortunately their construction has not yet been begun—we hope and expect it will be in the immediate future. These ships will embody many novel features of great importance.

It is easy perhaps for you to realize the commercial possibilities of aircraft and particularly of airships. In order to present clearly and briefly what the Naval functions of airships are, I can do no better than to quote from a Congressional report which was rendered only last year. After an exhaustive investigation the report reads partly as follows:

OFFICIAL RECOGNITION OF AIRSHIPS

"The Committee finds that airships of adequate size hold unquestionable possibilities as adjuncts to the Fleet. Large airships are peculiarly naval as their sphere of greatest usefulness lies over the water; they are essentially long-distance, weight carrying machines, having long radii of action, ability to keep in the air for long periods, superior habitability, the ability to operate at night successfully without the necessity for elaborate lighted airways, and wide range of speed variation to the extent of being able to stop all engines and still remain aloft.

"Their principal naval mission will be

scouting and reconnaissance, augmented by such uses as anti-submarine operations, convoy work, carrying airplanes, transportation of and communication with detached units, and under certain conditions, bombing.

"In the case of the large airship of proved type of construction, built so that interior parts are accessible for repair during flight; filled with noninflammable helium gas; equipped with machine guns for defense or limited offense; and carrying two or more airplanes for self-protection, vulnerability will be reduced to a point where it will not militate against the airship playing an influential role in military operations.

"So decided are the possibilities of lighter-than-air craft, it is felt that we cannot afford to do otherwise than to follow up its present advantage and determine the utility and limitations of rigid airships when employed in active operations with our other naval forces; we have all the necessary facilities and are prepared to go ahead vigorously with the further development of this type of craft. The Committee has found that rigid airship development in this country lags far behind airplane development. The expenditures on airships have been only about 2% of the total expenditures for aviation. It is believed that the construction of the two rigid airships included in the bill will go far toward building up in this country an airship industry which, when it is established on a sound basis, will be in a position to carry forward the commercial development of airships.

"The Committee feels that the least that should be done in this field is to provide for two rigid airships of approximately 6,000,000 cubic feet volume each, to be used as adjuncts to the fleet."

AIRSHIPS NOT TO SUPPLANT STEAMSHIPS

I HAVE no present vision of the sky being darkened by multitudes of airplanes and airships. Nor do I believe we shall ever see steamships rotting alongside their docks nor railroads falling to pieces because of competition from aircraft. Furthermore, all aircraft are still merely instruments of transportation and cannot completely replace any major branch of the armed forces—they cannot do the work of battleships and of infantry. However, I do believe that aircraft will become indispensable additional means of transportation for both commercial and military purposes. Aircraft have considerably complicated modern warfare and will remain important auxiliaries as far as we can now see.

It may not be pleasing to our pride to see huge commercial airships flying to and from the United States under foreign flags years before American ships are in the air. Even last year the National Advisory Committee for Aeronautics was forced to report briefly that the world leadership in the design and construction of rigid airships has passed from the United States to Europe. Our great engineering and scientific resources are unexcelled in the world; our monopoly of the world's supply of the entirely safe helium gas alone gives us a world wide advantage in airships.

It is my opinion that huge American-built airships as well as airplanes will prove to be of indispensable commercial value and an auxiliary of high naval value that will add strength and prestige to our American Navy and the American Nation.

Radio Wrinkles Wanted!

The Radio Editor, Mr. Paul E. Welker, wants to hear from you, if you have a good idea or wrinkle. Make a pencil or pen and ink sketch of the contrivance, write 50 words or so of description, and mail to the Radio Editor, c/o this magazine.

The Metal Emperor

By A. MERRITT

(*Continued from page 78*)

"Taken! By whom?" I gasped. "Taken by what—these?" I swept my hands out toward the Horde milling around us.

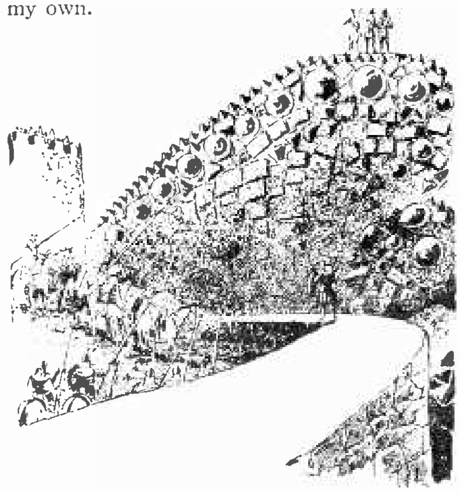
"No! These are mine! These are they who obey me!" The golden voice now shrilled with her passion. "Taken by—men!"

Drake had read my face although he could not understand our words.

"Ruth—" he groaned.

"Taken," I told him. "Both Ruth and Ventnor. Taken by the armored men—the men of Cherkis!"

"Cherkis!" She had caught the word. "Yes—Cherkis! And now he and all his men—and all his women—and every living thing he rules shall pay! And fear not—you two. For I, Norhala, will bring back my own.



"There was a blare of trumpets. Upon the parapet leaped a man clad all in gleaming red armor. From head to feet the close-linked scales covered him. Within a hood shaped somewhat like the tight-fitting head coverings of the Crusaders, a cruel face stared at us. In the fierce black eyes no trace of fear.

The man in scarlet threw up a hand.

"'Who are you?' he shouted. 'Who are you three that come driving down upon Ruszark through the rocks? We have no quarrel with you?'

"'I seek a maid and a man,' cried Norhala. 'A maid and a man your thieves took from me. Bring them forth!' . . . ."

"Woe, woe to you, Cherkis, and to all of yours! For I, Norhala, am awake, and I, Norhala, remember! Woe to you, Cherkis, woe—for now all ends for you!

"Not by the gods of my mother who turned their strength against her do I promise this. I, Norhala, have no need of them—I, Norhala, who have strength greater than theirs. And would I could crush those gods as I shall crush you, Cherkis—and every living thing of yours. Yes—and every unliving thing as well!"

No longer halting was Norhala's speech. It poured from the ruthless lips, flamingly.

"We go," she cried. "And something of vengeance I have saved for you—as is your right."

She tossed her arms high, and stamped upon the back of the cubes that held us. They quivered and sped away. Swiftly dwindled the City's bulk, fast faded its glimmering, watchful face. Above us, crouching against the blast of our going, streamed like a silken banner Norhala's tresses, gemmed with the witch lights and threaded with the flashing strands of beaded jewel fire.

Now we were far out in the Pit. The cubes slowed. Norhala threw high her head. From her throat pealed a trumpet call—golden, summoning, imperious. Thrice it rang forth—and all the Pit seemed to halt and listen.

Followed upon its ending, a chanting as goldenly sonorous. Wild, peremptory, triumphant—it was a mustering shouting to adventurous stars, buglings to buccaneering winds, cadenced beckonings to restless ranks of viking waves, signaling to all the corsairs and picaroons of the elemental.

A cosmic call to loot!

Under that lawless roulade the blocks upon which we rode quivered, and I felt a thousand needle-pointed, roving arrows prick me, urging me on to some jubilant, reckless orgy of destruction.

Obeying that summoning there swirled to us cube and globe and pyramid by the score. By the hundreds. They swept into our wake and followed, lifting up behind us, like an ever rising sea.

Higher and higher arose that metal wave—mounting, ever mounting as other score upon score leaped upon it, rushed up it and swelled its crest. And soon it was so great that it hung over us and shadowed us.

The cubes we rode swerved in their course, and raced with ever increasing speed toward the spangled curtains. Still Norhala's golden chant lured. Higher and ever higher reached the following wave. Now we were rising upon a steep slope, and now the amethystine, gleaming ring was almost over head.

Norhala's song ceased. One breathless, soundless moment and we had pierced the veils. A globule of sapphire shone afar, the elfin bubble of her home. We neared it.

I saw three ponies, with high and empty saddles turquoise-studded, lift their heads from their roadway browsing. For a breath they stood, stiff with terror, then whimpering, raced away.

We were at Norhala's door. We were lifted down. Drake and I sprang to enter.

"Wait!" Norhala's white hands caught us. "There is peril there—without me. You must—follow."

We stared at her. Upon her face was no diminishing of rage, no weakening of determination. The star-flecked eyes were not upon us, they looked over and beyond—coldly, calculatingly.

"Not enough," I heard her whisper. "Not enough—for that which I will do."

We turned, following her gaze. A hundred feet on high, stretching nearly across the gorge, an incredible curtain was flung. Over all its folds was movement—arms of spinning globes that thrust forth like paws, and down upon which leaped pyramid upon pyramid, stiffening, as they clung, like bristling spikes of hair; great bars of clicking cubes that threw themselves out from it like arms, flexed themselves, and drew back into the mass. The curtain was in a ferment. It palpitated with eagerness. It throbbed with desire.

"Not enough!" murmured Norhala.

Her lips parted. From them came another trumpeting—tyrannic and arrogant. The curtain writhed. Out from it spurted thin cascades of cubes. They swarmed up into tall pillars that shook and swayed.

With blinding flash upon flash the sapphire incandescences struck forth at their feet. A score of flaming columned shapes leaped up and curved in meteor flight. Streaming with violet fires they shot back to the valley of the City.

"Hai!" shouted Norhala as they flew. "Hai!"

Up darted her arms. The mighty curtain of the Metal Things pulsed and throbbed, its units interweaving—block and globe and pyramid of which it was woven each seeming to strain at leash.

"Come!" cried Norhala, and led the way into her house. I stumbled over a brown-faced, leather-cuirassed body that lay half over, legs barring the threshold.

We were within the chamber of the pool. About it lay a fair dozen of the armored men. Ruth's defense, I thought with grim delight, had been most excellent. Those who had taken her and Ventnor had not done so without paying toll.

A flashing drew my eyes away. Close to the pool wherein we had first seen the white miracle of Norhala's body, two immense purple stars blazed. Between them, like a suppliant cast from black iron, was Yuruk. Poised upon their nether tips the two stars guarded him. Head touching his knees, eyes hidden within his folded arms, the black eunuch crouched.

"Goddess!" he whimpered. "Goddess! Mercy!"

"I saved him," she turned to us, "for you to slay. It was he who brought those who took the maid who was mine, and the helpless one that she loved. Now you shall slay him."

Drake's hand twitched down to his pistol. He leveled the gun at the black eunuch. Yuruk saw it, and shrieked and cowered. Norhala laughed.

"He dies before the stroke falls," she said. "He dies doubly therefore—and that is well."

Drake slowly lowered the automatic, and turned to me.

"I can't," he said. "I can't do it. I want to kill him—and I can't."

"Master!" The eunuch writhed toward us. "What I did was for love of the Goddess. I thought if the maid and the blasted one were gone, that you would follow. Then I would be alone with the Goddess once more. Cherkis will not slay them—and Cherkis will welcome you, and give the maid and the blasted one back to you for the arts that you can teach him. Mercy, Masters, I meant no harm—bid the Goddess be merciful!"

"Slay him," said Norhala. "Slay him—one or both of you. It is your right."

"Norhala," I answered, "we cannot slay him so. When we kill, we kill in fair fight. The maid we love has gone. It will not bring her back if we destroy him. We would punish him—yes. But kill him we cannot. And we would be after the maid and her brother quickly."

She looked at us, perplexity shading the anger.

"As you will," she said at last. "But Yuruk has disobeyed *me*. That of mine, which I committed to his care, he has given to my enemies."

She pointed to the dead.

"Yuruk, gather up these carrion and pile them together."

The eunuch arose, and stole out fearfully from between the two stars. He slithered to body after body, dragging them to the center of the chamber, forming of them a heap. One of the Persians was not dead. His eyes opened as Yuruk seized him.

"Water!" he begged. "Give me drink. I burn!"

I felt pity, and lifted my canteen and walked toward him.

"You of the beard," said Norhala coldly, "he shall have no water. Drink he shall have, and soon—drink of fire!"

The soldier's fevered eyes rolled toward her, and read aright the ruthless face.

"Sorceress!" he spat at her. "Cursed spawn of Ahriman!"

The talons of Yuruk stretched around his throat.

"Son of unclean dogs!" whined the eunuch. "You dare blaspheme the Goddess!"

He snapped the soldier's neck as though it had been a rotten twig. At the callous cruelty I stood for an instant, petrified; heard Drake swear wildly, saw his pistol flash up.

Norhala struck down his arm.

"Your chance has passed," she said. "And not for that shall you slay him."

Yuruk threw the body upon the others. The pile was complete.

"Mount!" commanded Norhala, and pointed. He cast himself at her feet. She looked at one of the stars. Something of command passed from her, something it understood plainly. The star slipped forward—there was an almost imperceptible movement of its side points. The twitching form of the black leaped from the floor and was thrown like a bag upon the mound of the dead.

Then out of the violet ovals beneath the upper tips of the stars spurted streams of blue flame. They fell upon Yuruk and splashed upon the heap of the slain. In the mound was a dreadful movement. The bodies stiffened. They seemed to try to rise, and to push away—dead nerves and muscles responding to the blasting energy passing through them.

Out of the stars rained bolt upon bolt. In the chamber was the sound of thunder, crackling like broken glass. The bodies flamed and crumbled.

Where there had been a heap of slain capped by the black eunuch, there was but a little whirling cloud of sad gray dust. Caught by a passing draft, it eddied, slipped over the floor and vanished through the doorway. The blasting stars stood motionless, contemplating us. Motionless stood Norhala, her wrath no whit abated.

"Listen," she spoke abruptly. "You two who love the maid. What you have seen is nothing to that which you shall see—it is but as a wisp of mist to the storm-cloud!"

"Norhala"—I found speech—"when was it that the maid was captured?"

"They came long before dusk," she said. "By the night before, Yuruk had gone to Ruszark, the city of Cherkis. And long before dawn they were on their way hither. The black dog told me."

"But Yuruk was with us here at dawn of yesterday," I gasped.

"A night has passed since then," she said, "and lo! another night is almost gone."

Stunned, I considered this. If it were true—and not for an instant did I doubt her word—then not for a few hours had we lain at the foot of the living wall in the hall of the cones, but for the balance of that day and that night, and another day and part of still another night.

"What does she say?" Drake stared anxiously into my white face.

I told him.

"Yes." Norhala spoke again. "The dusk before the last dusk I returned to my house. The maid was there and sorrowing. She told me you had gone into the valley, and prayed me to help you and to bring you back. I comforted her, and something—of the peace—I gave her. But not all, for she fought against it. A little we played together, and I left her sleeping. I sought, and found you also sleeping. I knew no harm would come to you, and I went my ways—and forgot you. Then came I here again to find Yuruk and these the maid had slain."

Her eyes flashed.

"I honor the maid for the battle that she did," she said, "though how she slew so many strong men I know not. All my heart goes out to her. And therefore when I bring her back she shall no more be plaything to Norhala, but sister. And with you—it shall be as she wills. But woe to those who have taken her!"

From without came a rising storm of thin wailings, insistent and eager. She paused, listening.

"And I have an older vengeance than this to take," she went on. "Long have I forgotten—and shame I feel that I had forgot. So long have I forgotten all hatreds, all lusts, all cruelty—among—those—" She thrust a hand forth toward the hidden valley. "Forgot—dwelling in the great harmonies. Save for you, and what has befallen, I would never have stirred from them, I think. Now, awakened, I take my vengeance. After it is done"—she paused—"after it is over I shall go back again. For this awakening has in it nothing that I love. It is a fierce and slaying fire. I shall go back—"

The shadow of far dreaming softened the angry brilliancy of her eyes.

"Listen, you two!" The shadow of dream fled. "Those that I am about to slay are evil—evil are they all, men and women. Long have they been so—yes, for cycles of suns. And their children grow like them—or, if they be gentle and with love for peace, they are slain, or die of heartbreak. All this my mother told me long ago. So no more children shall come from them to suffer, or to grow evil."

Again she paused.

"My father ruled Ruszark," she said at last. "Rustum he was named, of the seed of Rustum the Hero, even as was my mother. They were gentle and good, and it was their ancestors who built Ruszark when, fleeing from the might of Iskander, they were sealed in the hidden valley by the falling mountain. Then there sprang from one of the families of the nobles, and kin to mine, Cherkis! Evil, evil was he, and as he grew he lusted for rule. On a night of terror he fell upon those who loved my father and slew. Barely had my father time to fly from the city with my mother, still but a bride, and a handful of those loyal to him. They found, by chance, the way to this place, hiding in the cleft which is its portal. They came, and they were taken by—those who are now my people. Then my mother, who was very beautiful, was lifted before him who rules here, and she found favor in his sight, and he had built for her this house, which is now mine.

"And in time I was born—but not in this house. Nay—in a secret place of light where too, are born my people."

A secret place of light! Was it that vast vault of mystery, of dancing orbs, of flames transmuted into music into which we had peered? And was this the explanation of her strangenesses? Had she sucked in there with her mother's milk the enigmatic life of the Metal Horde? been transformed into half-human changeling? Become true kin to them? What else could explain—

"My mother showed me Ruszark," her voice checked my thoughts. "Once, when I was little, she and my father bore me through the forest and through the hidden way. I looked upon Ruszark—a great city, and a caldron of cruelty and of evil.

"Not like me were my father and mother. They longed for their kind and sought them. There came a time when my father, driven by this longing, ventured forth to Ruszark, seeking friends to help him regain that place—for these obeyed not him as they obey me. So he could not have marched—as I shall—upon Ruszark.

"Cherkis caught him. And Cherkis waited, for he knew not where to seek my mother nor where they had lain hid.

"Between this city and here the mountains are great, unscalable, and the way through them is cunningly hidden. Though they tortured him, my father would not tell them how to find that way. And after a while my mother stole forth with those who still remained of hers. They left me here with Yuruk. And Cherkis caught my mother!"

"My father was flayed alive, and crucified," she whispered. "They nailed his skin to Ruszark's gates. And when Cherkis had had his will with my mother, he threw her to his soldiers for their sport!

"All of those who went with them, save one, he tortured and slew. That one escaped and told me—me who was not yet a budding maid. He called on me to bring vengeance

—and he died. A year passed . . . and I am not like my mother and father . . . and I forgot . . . dwelling here in the tranquilities, barred from and having no thought for men and their ways.

"Aie, aie!" she wailed: "Woe to me that I could forget! But now I shall take my vengeance—I, Norhala, will stamp them flat—Cherkis and his city of Ruszark and everything it holds! I, Norhala, and my servants shall stamp them into the rock of their valley so that none shall know that they have been!"

She threw out white arms.

The Disc had not slain her mother, then—or any of hers? Why had Yuruk told that tale of her mother's mother, and why had he lied to me of their fate? Of course! He had lied to play upon our terrors. To frighten us away.

The wailings were rising in a sustained crescendo. One of the slaying stars slipped over the chamber floor, folded its points, and glided out of the door.

"Come!" commanded Norhala, and led the way. The second star closed and followed us. We stepped over the threshold—

For one breathless moment we paused. In front of us reared a monster—a colossal, headless Sphinx. Like fore legs and paws, a ridge of pointed cubes and globes thrust against each side of the canyon walls. Between them for two hundred feet on high stretched the body, a shifting, weaving mass of the Metal Things. They formed into gigantic cuirasses, giant bucklers, shields and corselets of living mail. From them as they moved came the wailings. Like a headless Sphynx they crouched—and as we waited, they surged forward.

"Hai!" shouted Norhala, "Hai! my companies!"

Out shot a long and slender trunk of the cubes and spinning globes. It nuzzled us, caught us up as an elephant would its mahout and swept us to its crest. I tottered, dizzily, was held fast, and stood beside Norhala upon a little, level, twinkling eyed platform. At her other side swayed Drake.

Through all the monstrous shape throbbed an eager, impatient pulse. Like some huge and grotesque beast, the back of the clustered Things ran for half a mile behind, tapering to a dragon tail that coiled and twisted a full mile toward the Pit. From this back uprose and fell immense, fan-shaped ruffs, thickets of spikes, whipping knouts of bristling tentacles, fanged crests. They thrust and waved, whipped and fell constantly. And constantly the great tail lashed and snapped—fantastically alive.

"Hai!" shouted Norhala once more. From her throat came again the golden chanting—now a relentless song of slaughter.

Up reared the monstrous bulk. Into it ran the dragon tail. Into it poured the fanged and bristling back.

Up, up we were thrust—three hundred feet, four hundred, five hundred. Over the blue globe of Norhala's house the shape bent a gigantic leg. Spiderlike, out from each side of it, thrust half a score of others.

Overhead the dawn began to break. We rushed straight to the line of cliffs behind which lay the city of the armored men—and Ruth and Ventnor.

CHAPTER XXIV

RUSZARK

SMOOTHLY moved the colossal steed; we rode upon it as easily as though cradled. The columned legs raised themselves, bending from a thousand joints. The pedestals of the feet, massive as foundations for sixteen-inch guns, fell with machinelike precision, stamping gigantically. Under their tread the trees snapped, and were crushed like straw. From far below came the sound of their crashing. The thick forest checked our progress less than tall grass would that of a man.

Our trail was marked by deep, black pits in the forest's green, clean cut and huge as the mark upon the poppied valley. The footprints of the Thing that carried us.

The wind streamed and whistled. A *lammergeier* swooped down on wide funereal wings. It peered at us, and soared away toward the cliffs.

"There will be no carrion there for you when I am through, black eater of the dead!" whispered Norhala.

Steadily grew the dawn light. From Norhala's lips came again the chanting. And now that paean and the reckless pulse of the monster we rode, began to creep through my own veins, and through Drake's too, I knew. A jubilant pulse streamed up, throbbing through us. The pulse—sang!

Closer and closer came the cliffs. Down, and crashing down, fell the trees, the noise of their fall accompanying the chant of Norhala, like wild harp chords. Now the cliffs loomed overhead. The dawn had passed. It was full day.

Cutting through the towering granite scarps was a rift. Black shadows clustered in it, thickly. Straight toward that cliff we sped. The little platform on which we stood began swiftly to lower. Down we sank and down—a hundred feet, two hundred. Now we were not more than two score yards above the tree tops.

Out shot a neck from that which bore us, a tremendous serpent, crested with the pyramids, its immense head coroneted with them. For hundreds of feet it stretched ahead of us, and for twice as far behind a monstrous, lizard-shaped body writhed.

We rode now upon a glittering blue metal dragon, spiked and knobbed and scaled. The weird steed of Norhala, flattening and thrusting out to pierce the rift.

The rift enclosed us. Lower we dropped. That upon which we rode became a metal torrent roaring through the chasm. A deeper blackness enclosed us—a tunneling. Through that we flowed. We darted out of it into a widening that was filled with wan light drifting down through a pinnacle-fanged mouth miles on high. The cleft shrunk. A thousand feet ahead was a crack, a narrowing so small that barely could a man pass through it.

The metal dragon halted.

Norhala's chanting changed, and became again the arrogant clarioning. Close below us the huge neck split. The part that had broken off formed into a colossal pillar out of which, instantly, scores of arms thrust forth. Over these arms great globes raced. After these flew other scores of huge pyramids. The manifold arms grew rigid. Quiet for a moment, a metal Briareus, it stood.

Then at the tips of the arms the globes began to spin—faster, faster. Upon them the pyramids opened into a host of blazing blue stars. The cleft leaped out in a flood of violet light.

Now for another instant the stars which had been motionless, poised upon the whirling spheres and joined their spinning. Cyclopean pin wheels, they turned, and then, again as one, they ceased. More brilliant now was their light and dazzling—as though in their whirling they had gathered greater force.

From the stars came hurricanes of lightnings. A cataract of electric flame poured into the crack and splashed and guttered down the granite walls.

The face of the precipice smoked and split. It was whirled away in clouds of dust. The crack widened. Lightnings these were—and more than lightnings. Lightnings keyed up to an invincible, annihilating weapon that could rend and split and crumble to atoms the living granite.

Steadily the cleft expanded. As its walls melted, the Blasting Thing advanced, spurting its flaming torrents. Behind it we crept. The dust of the shattered rocks swirled up toward us like angry ghosts. Before they reached us they were blown away by strong winds streaming from beneath us.

On we went, blinded and deafened. Interminably, it seemed, poured forth the hurricanes of blue fire. Interminably the thunder bellowed.

There came a louder clamor—chaotic, dulling the thunders. The sides of the cleft quivered and bent outward. With the roar of falling worlds they split and crashed down. Bright daylight poured in upon us, a flood of light toward which the billows of dust rushed, seeking escape.

And the Blasting Thing shook—as though with laughter!

The stars closed. Back ran globe and pyramid. They slid toward us, and joined the body from which they had broken away. Through all that re-united mass ran a wave of jubilation.

We glided forward out of the cleft. There was a burst of sunlight, strangely yellow after that incessant violent volleying.

I felt a shifting movement. Up and up we were thrust. I looked behind me. In the face of a sky-climbing wall of rock, smoked a wide rift. The billowing dust clouds streamed out of it, pursuing, threatening. The cleft precipices quivered with agony.

Higher we rose and higher.

"Look!" whispered Drake.

Less than five miles away was the place of the armored men—Ruszark, the City of Cherkis.

And it was like some ancient city come to life out of long dead centuries, a page from conquering Persia's time crumbled book. Built around and upon a low mount, it stood within a valley little smaller than the Pit. The plain was level, as though once it had been the floor of some primeval lake. The hill on which the city stood was its only elevation. I caught the glinting of a narrow stream beyond it, meandering. The valley was ringed with precipitous cliffs falling sheer to its floor. We advanced.

The city was almost square, bulwarked by double walls of hewn stone. The first ramparts were raised a hundred feet. They were turreted and parapeted and pierced with gates. A quarter of a mile behind them the inner walls uprose.

The city covered about twenty square miles. It ran upward in broad terraces. It was very fair, decked with blossoming gardens and green groves. Among the clustering granite houses, red and yellow roofed, tall spires towered. Upon the mount's top was a broad, flat plaza on which were great buildings, marble white and golden roofed, temples I thought, or palaces—or both.

And running to Ruszark, out of the steads that surrounded it, were scores of little figures. Here and there among them I glimpsed horsemen, arms and armor glittering. All were racing to the gates and to the shelter of the battlements.

Nearer we drew.

From Ruszark's walls came a faint sound of gongs, of drums, of shrill pipings. Upon the walls hosts were gathering, hosts of swarming little figures whose bodies glistened. From above them came gleamings—the light striking upon helms, spears and javelin tips.

"Ruszark!" breathed Norhala, eyes wide and red lips smiling. "Lo—I am before your gates! Lo—I, Norhala, am here—and was there ever joy like this!"

Her flaming hair whirled and snapped. From all her sweet body came white-hot furious force, a withering perfume of destruction. She pressed against me, and I trembled at the contact.

(*Continued on page* 92)

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Write for your Money-making Opportunities

The Metal Emperor

(*Continued from page 90*)

Again the monster shook beneath us. Faster we moved. Louder grew the clangor of the drums, the gongs, the pipes.

Now we were close upon the heels of the last fleeing stragglers. We slackened in our stride. We waited until they were close to the gates. I heard the brazen clanging of their valves. Those shut out beat upon them. They dragged themselves close to the base of the battlements, and cowered there, or crept, seeking some hole in which to hide.

With a slow lowering of its height, the Thing we rode advanced. Now its form was that of a spindle upon whose bulging center we three stood.

A hundred feet from the outer wall we halted. We looked down upon it, not more than fifty feet above its broad top. From that vantage-point I could see regiments of soldiers crouching behind the parapets, companies of archers with great bows poised, arrows at their cheeks, hundreds of leather-jerkined men with stands of javelins at their right hands, scores of spearsmen and men with long, thonged slings.

Set at intervals behind the parapets were squat, powerful engines of wood and metal, and beside them heaps of huge, rounded boulders. Catapults around which swarmed knots of men fixing the great stones in place, drawing back the thick beam, that would hurl the projectiles. From every side came others, dragging more of these ballistas, assembling a battery against the monster that menaced their city.

Between outer wall and inner battlements galloped squadrons of mounted men. Upon this inner wall the soldiers clustered as thickly as on that between us and it, and prepared as actively for its defense.

The city seethed. From it arose a humming, a buzzing, as of some immense angry hive.

I visualized the spectacle we must present to those who looked upon us—this huge incredible Shape of metal, alive with quick-silver shiftings, this, as it must have seemed to them, hellish mechanism of war captained by a sorceress and her two familiars in form of men. There came to me dreadful visions of such a monster looking down upon the peace reared battlements of New York—the panic rush of thousands away from it—

There was a blare of trumpets. Upon the parapet leaped a man clad all in gleaming red armor. From head to feet the close linked scales covered him. Within a hood shaped somewhat like the tight-fitting head coverings of the Crusaders, a cruel face stared at us. In the fierce black eyes no trace of fear.

The man in scarlet threw up a hand.

"Who are you?" he shouted. "Who are you three that come driving down upon Ruszark through the rocks? We have no quarrel with you?"

"I seek a maid and a man," cried Norhala. "A maid and a man your thieves took from me. Bring them forth!"

"Seek elsewhere for them then," he shouted. "Turn now and seek elsewhere. Go quickly, lest I loose our might upon you and you go forever!"

"Little man whose words are so big!" laughed Norhala. "Fly who thunders! What are you called, little man?"

Her raillery bit deep.

"I am Kulun," shouted the man in scarlet armor. "Kulun, the son of Cherkis, and captain of his hosts. Kulun—who will cast

your skin under my mares in stall for them to trample, and thrust your red flayed body upon a pole in the grain fields to frighten away the crows! Does that answer you?"

Her laughter ceased, and her eyes dwelt upon him.

"The son of Cherkis!" I heard her murmur: "He has a son! A son—"

"Kulun," she cried. "I am Norhala—daughter of another Norhala and of Rustum, whom Cherkis tortured and slew. Now go, you spawn of unclean toads—go and tell your father that I, Norhala, am at his gates! And bring back with you the maid and man! Go, I say!"

(*To be continued*)

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Drawing Table and Utility Cabinet Are Easy to Build

By EDWIN M. LOVE

(*Continued from page 39*)

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