...ay

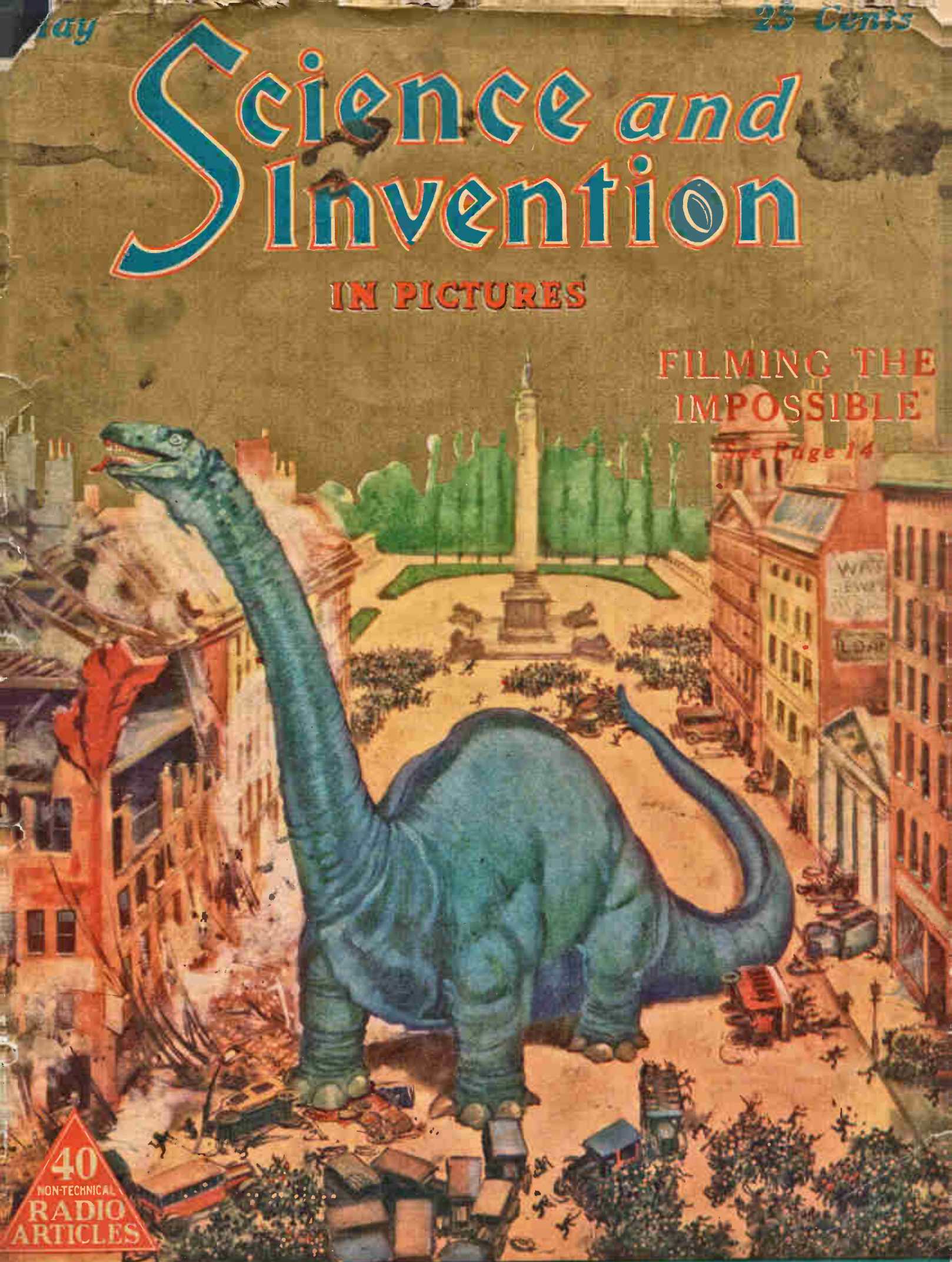
25 Cents

Science and Invention

IN PICTURES

FILMING THE IMPOSSIBLE

See Page 14



40 NON-TECHNICAL RADIO ARTICLES

EXPERIMENTER PUBLISHING COMPANY, NEW YORK, PUBLISHERS OF
RADIO NEWS - SCIENCE & INVENTION - THE EXPERIMENTER - MOTOR CAMPER & TOURIS...

Unholz and Farina, once common laborers, now have their own electrical company.

G. Melrose now makes $400 a month because S. & H. and Lincoln Tech. trained him right.

G. Fields jumped from $35 a month to superintendent of a big electrical plant with 2 big salary increases to date.

Only 20 Weeks

Then You'll Be Ready for These Big ELECTRICAL JOBS

Just 20 weeks. Think of it. And yet in this short time you now can receive the amazing training of the S. & H. Engineering Company and Lincoln Institute of Technology and be ready to step into big jobs like Unholz and Farina, or G. Melrose, or G. Fields and hundreds of others. And yet this remarkable course takes only 30 minutes a day. No matter what your experience or education, this is an amazing opportunity for you.

S. & H. Fits You for Jobs Like These

Jobs like these above can be yours, so thorough is this training. After many years' study and experimental work there has been developed this remarkable way of teaching electricity right in your own home. This shop type home training is an exclusive copyrighted feature. You can get it nowhere else. And remember! You receive a diploma actually certified and endorsed by the Lincoln Institute of Technology. This is something you receive nowhere else. You not only get theoretical knowledge of electrical principles that is taught in technical universities, but you get the practice that a man gets only from doing practical work. This makes this amazing training the quickest and yet the simplest training in electricity ever devised.

And Electricity needs you. Right now hundreds of big pay jobs want men. But you must be trained right. The experts of this great institution know exactly what you need to fit you for these jobs. And you get it right in your own home, so simple and easy to grasp is this amazing training. You can soon be equipped to demand and get the high salaries this profession pays. All you need do is to take the first step.

Send for Big Book FREE

If you want to be an electrical expert send the coupon at once. All who send immediately will receive an amazing free offer of a complete outfit of electrical apparatus, instruments and appliances for experimental and practical home shop work. Also our big catalog gives you full information about this amazing rapid and easy course. Learn what electricity holds for you. Find out what the S. & H. Training will do for you. Also about our big free Employment Bureau. But do not delay. Mail the coupon now.

S. & H. ENGINEERING CO.

In Affiliation With Lincoln "Tech"

1422 W. Monroe Street

Chicago, Ill.

Dept. E-2

Chief Engineer,
S. & H. Engineering Co.,
122 W. Monroe St., Dept. E-2,
Chicago, Ill.

Please send me catalog and full information about the remarkable S. & H. Course, your Free Outfit, your Employment Bureau, etc. This information is free and does not obligate me in any way whatsoever.

Name .....

Address .....

City ..... State .....

Vol. XIII.
Whole No. 145

Science and Invention

FORMERLY
ELECTRICAL EXPERIMENTER

May, 1925
No. 1

Member Audit Bureau of Circulations

EDITORIAL & GENERAL OFFICES: 53 Park Place, New York City

Published by Experimenter Publishing Company, Inc.
(H. Gernsback, Pres.; S. Gernsback, Treas.; R. W. DeMott, Sec'y).

Publishers of SCIENCE & INVENTION, RADIO NEWS, THE EXPERIMENTER and MOTOR CAMPER & TOURIST.

IN OUR NEXT ISSUE

Do You Know How to Preserve Cut Flowers?

If so, and your method is a simple and consistent one, you will stand a good chance to win a prize in the contest which will be announced in detail in our next issue. Prizes will be awarded for various good methods of preserving cut flowers.

* * *

How Much Light Will a Dollar Buy?

Do you know that for every dollar which you pay your lighting company for gas or electricity, you only receive a very small fraction of its value in light? Pictures in our next issue will show just what this percentage is and how it may soon be raised.

* * *

Do You Know How Newsprint Paper Is Made?

A profusely illustrated article will lead the reader through the process of the manufacture of newsprint paper from the raw materials to the finished product, ready to receive impressions which will carry the news of the world to its readers.

* * *

Are You Handy With Wood-Working Tools?

Our next issue will contain a complete constructional article showing all the details of how to make a folding "breakfast nook" of substantial, yet decorative design.

* * *

Apple and Cherry Trees One Foot High!

The Japanese have long been noted for their quaint miniature gardens. One of our writers in the next issue will show you how results comparable to those obtained by these well-known agriculturists may be had in your own garden.

The above are just a few of the treats in store for our readers in the next issue.

Contents for May

POPULAR ARTICLES

PRIZE CONTESTS

AUTOMOBILES

ELECTRICITY

RADIO ARTICLES

CONSTRUCTOR ARTICLES

CHEMISTRY ARTICLES

ASTRONOMY ARTICLES

HOW TO SUBSCRIBE FOR "SCIENCE AND INVENTION." Send your name, address and remittance to Experimenter Publishing Co., 53 Park Place, New York City. Checks and money orders should be made payable to Experimenter Publishing Co., Inc. Mention the name of the magazine you are ordering inasmuch as we also publish RADIO NEWS, THE EXPERIMENTER and MOTOR CAMPER & TOURIST. 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 for a renewal, delivery of the magazine is stopped.
CHANGE OF ADDRESS: Notify us as far in advance as possible, giving your old address as well as the new one to which future magazines are to go. It takes several weeks to make an address change on our records.

SCIENCE AND INVENTION is published on the 10th of each month. There are 12 numbers per year. Subscription price is $2.50 a year in U. S. and possessions. Canada and foreign countries $3.00 a year. U. S. coin as well as U. S. stamps accepted (no foreign coin or stamps). Single copies, 25 cents each. A sample copy will be sent gratis on request. All communications and contributions to this journal should be addressed to Editor, SCIENCE AND INVENTION, 53 Park Place, New York City, N. Y. Unaccepted contributions cannot be returned unless full postage has been included. ALL accepted contributions are paid for on publication.
SCIENCE AND INVENTION, Monthly. Application as second class matter made at New York, N. Y. with additional entry at Long Island City, N. Y. Post Office, under act of Congress of March 3, 1879, formerly entered at Jamaica, N. Y. Entered on Sept. 15, 1924, at Post Office, San Francisco, Cal. Title Registered at the Patent Office. SCIENCE AND INVENTION is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris. Member of the Audit Bureau of Circulations.

New York City
General Advertising Dept.
53 Park Place

Western Advertising Representatives
Finucan & McClure
720 Cass St., Chicago, Ill

Pacific Coast Advertising Representatives
A. J. Norris Hill Co.
Hearst Bldg., San Francisco, Calif.

Kansas City Advertising Representatives
George F. Dillon
Republic Building, Kansas City, Mo.

SCIENCE and INVENTION READERS' BUREAU

Time and Postage Saver

IN every issue of SCIENCE and INVENTION you undoubtedly see numerous articles advertised about which you would like to have further information.

To sit down and write an individual letter to each of these respective concerns, regarding the article on which you desire information, would be quite a task.

As a special service to our readers, we will write the letters for you, thus saving your time and money.

Just write the names of the products about which you want information, and to avoid error the addresses of the manufacturers, on the coupon below and mail it to us.

If the advertiser requires any money or stamps to be sent to pay the mailing charges on his catalogue or descriptive literature, please be sure to enclose the correct amount with the coupon.

We will transmit to the various advertisers your request for information on their products.

This service will appear regularly every month on this same page in SCIENCE and INVENTION.

If there is any Manufacturer not advertising in this month's issue of SCIENCE and INVENTION from whom you would like to receive literature, write his name, address and the product in the special section of the coupon below.

TEAR ALONG THIS LINE

READERS' SERVICE BUREAU, S & I 5-25

Experimenter Publishing Co., Inc., 53 Park Place, New York, N. Y.

Please advise the firms listed below that I would like to receive detailed information on their product as advertised in the ..... issue of SCIENCE and INVENTION.

☞THIS FORM SHOULD NOT BE USED FOR TECHNICAL QUESTIONS

NAME	ADDRESS (Street—City—State)	List here specific article on which you wish literature.	If Catalogue of complete line is wanted, check in this column.

☞THIS FORM SHOULD NOT BE USED FOR TECHNICAL QUESTIONS

If you desire information from a manufacturer whose advertisement does not appear in this month's issue, use this space.

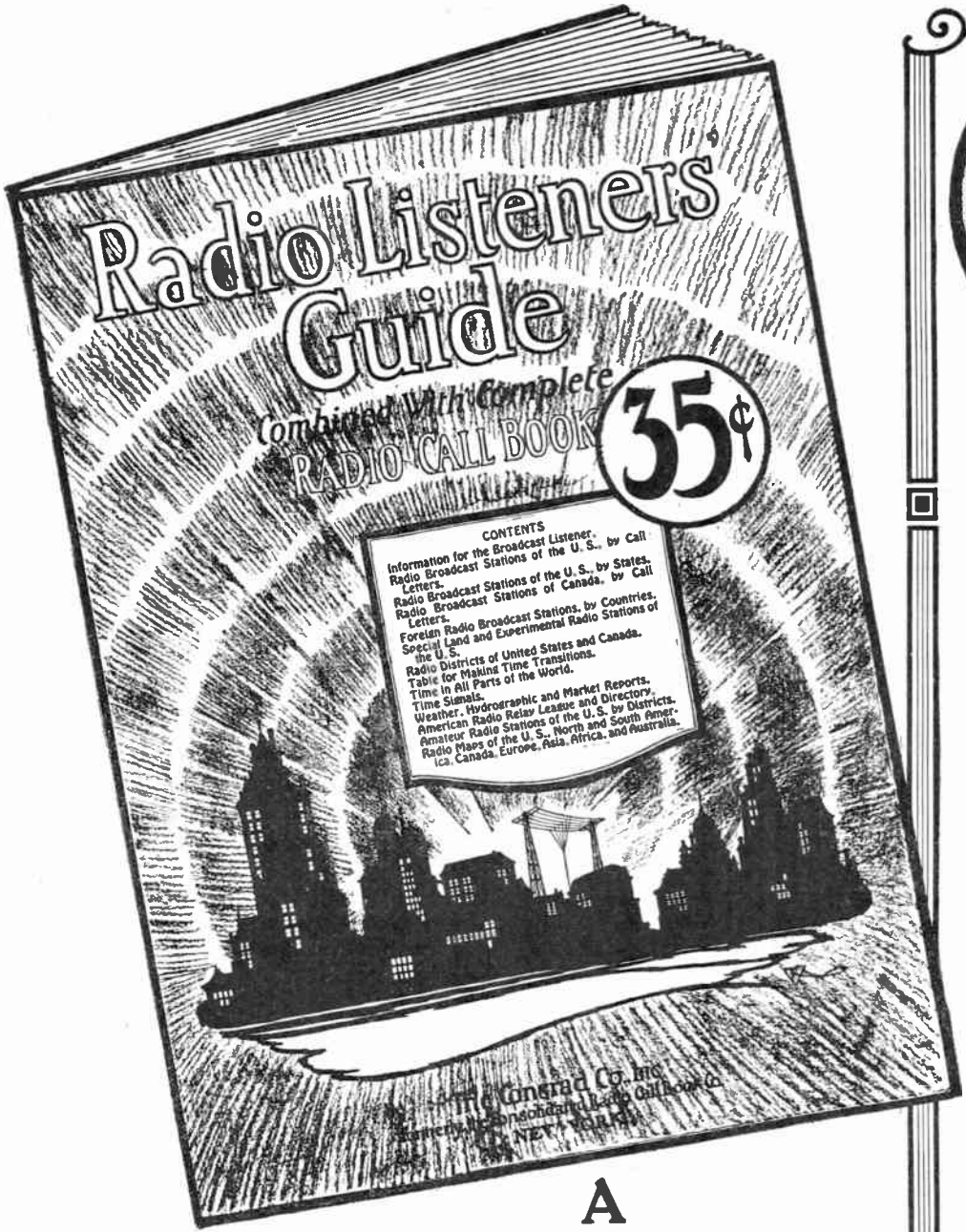
NAME	ADDRESS	

Your own name here.....

If you are a dealer check here. ☐

Address.....

City..... State .....



A New Service

Consrad has developed a special service for every user of the New Consrad "Radio Listeners' Guide and Call Book" that is designed to enable you to keep your station call record up to the minute, in line with all changes in stations and any new stations that are assigned call letters from month to month.

It consists of monthly, detailed supplement sheets carrying all information in regard to the call letters of new stations and changes of old ones. By means of this service, you can keep a practical, complete record of broadcast stations at all times.

There is a special coupon in every copy of the "Radio Listeners' Guide and Call Book" offering the purchaser the opportunity of subscribing to this six months service for the low price of 50c.

IF YOUR DEALER CANNOT SUPPLY YOU USE THIS COUPON

The Consrad Co., Inc., 233 Fulton St., New York, N. Y.

Gentlemen: I am unable to obtain a copy of the "Radio Listeners' Guide and Call Book" in my town. I am enclosing 35c, for which kindly send me a copy direct.

Name .....

Address .....

City .....

State .....

S.&I.-5

35¢

Radio's finest and most complete Call Book

There has never been any radio book for the amateur, the engineer or the regular radio broadcast listener exactly like this great Consrad edition.

Here is a book for *everybody*, covering all the information any listener needs to most thoroughly enjoy a radio program. It tells how to use and operate a radio set to the best advantage. It tells where, by whom, and on what wave length every radio broadcast station of the United States is operated, etc.

Altogether there are 114 pages filled to the brim with practical data. There is not a page of advertising—all text material for the user.

This is the one radio book that should be at the side of every radio receiving set in operation.

Table of Contents

114 Large Pages of Real, Practical Information—No Advertising

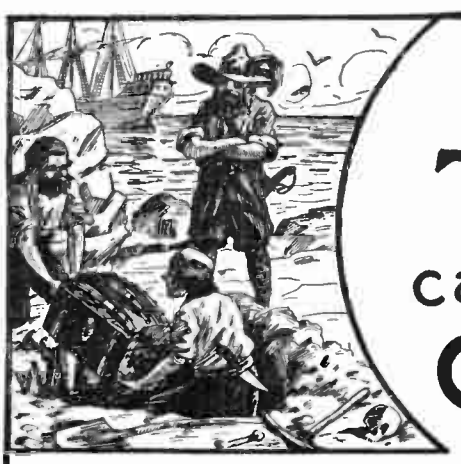
Size 9 by 12 Inches.

Bound with Beautiful Stiff Two-Color Cover.

Published Twice a Year

The Consrad Co., Inc.
233 Fulton Street
New York, N. Y.

Consrad



BURIED TREASURE can still be found in CHEMISTRY

Good Chemists Command High Salaries

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

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

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

What Some of Our Students Say of This Course:

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

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

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

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

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

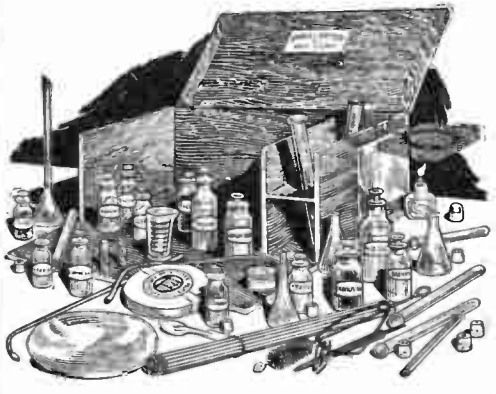
I shall always recommend your school to my friends and let them know how simple your lessons are.—C. J. AMDAHL.

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

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

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

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



Experimental Equipment Furnished to Every Student

We give to every student without additional charge this chemical equipment, including forty-nine pieces of laboratory apparatus and supplies, and forty different chemicals and reagents. These comprise the apparatus and chemicals used for the experimental work of the course. The fitted heavy wooden box serves not only as a case for the outfit but also as a useful laboratory accessory for performing countless experiments.

Now Is the Time to Study Chemistry

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

You Can Learn at Home

To qualify for this remarkable calling requires elaborate specialized training. Formerly it was necessary to attend a university for several years to acquire that training, but thanks to our highly perfected and thorough system of instruction, you can now stay at home, keep your position, and let us educate you in Chemistry during your spare time. Even with only common schooling you can take our course and equip yourself for immediate practical work in a chemical laboratory. Dr. Sloane gives every one of his students the same careful, personal supervision that made him celebrated throughout his long career as a college professor. Your instruction from the very beginning is made interesting and practical, and we supply you with apparatus and chemicals for performing the fascinating analyses and experimental work that plays such a large part in our method of teaching, and you are awarded the Institute's official diploma after you have satisfactorily completed the course.

Easy Monthly Payments

You don't have to have even the small price of the course to start. You can pay for it in small monthly amounts—so small that you won't feel them. The cost of our course is very low, and includes everything, even the chemistry outfit—there are no extras to buy with our course. Our plan of monthly payments places a chemical education within the reach of everyone. Write us and let us explain our plan in full—give us the opportunity of showing you how you can qualify for a highly trained technical position without even giving up your present employment.

Special 30 Day Offer

Besides furnishing the student with his Experimental Equipment, we are making an additional special offer for a short while only. You owe it to yourself to find out about it. Write today for full information and free book "Opportunities for Chemists." Send the coupon right now while it is fresh in your mind. Or just write your name and address on a postal and mail it to us. But whatever you do, act today before this offer is withdrawn.

DON'T WAIT—MAIL COUPON NOW!

CHEMICAL INSTITUTE OF NEW YORK, Inc.

Home Extension Division 5
66-S—WEST BROADWAY NEW YORK CITY

CHEMICAL INSTITUTE OF NEW YORK
Home Extension Division 5
66-S—West Broadway
New York City

Please send me at once, without any obligation on my part, your free Book "Opportunities for Chemists," and full particulars about the Experimental Equipment given to every student. Also please tell me about your plan of payment and your special 30 day offer.

NAME .....

ADDRESS .....

CITY..... STATE.....

S.I., May, '25

Master Electricity By Actual Practice

The only way you can become an expert is by doing the very work under competent instructors, which you will be called upon to do later on. In other words, *learn by doing.* That is the method of the New York Electrical School.

Five minutes of actual practice properly directed is worth more to a man than years and years of book study. Indeed, Actual Practice is the only training of value, and graduates of New York Electrical School have proved themselves to be the only men that are fully qualified to satisfy EVERY demand of the Electrical Profession.

The Only Institution of the Kind in America

At this "Learn by Doing" School a man acquires the art of Electrical Drafting; the best business methods and experience in Electrical Contracting, together with the skill to install, operate and maintain all systems for producing, transmitting and using electricity. A school for Old and Young. Individual instruction.

Over 9,000 Graduates are Successful Men in the Electrical World

No previous knowledge of electricity, mechanics or mathematics is necessary to take this electrical course. You can begin the course now and by steady application prepare yourself in a short time. You will be taught by practical electrical experts with actual apparatus, under actual conditions.

The N. Y. E. S. gives a special Automobile Ignition Course as an advanced training for Auto Mechanics, Garage Men and Car Owners. The course covers completely all Systems of Ignition, Starters, Lighting and other electrical equipment on automobiles, motor boats, airplanes, etc.

Let us explain our complete courses to you in person. If you can't call, send now for 64-page book—it's FREE to you.

New York Electrical School
29 W. 17th St., New York, N. Y.

Please send FREE and without obligation to me your 64-page book.

..... NAME

..... STREET

.....CITY .....STATE

New York Electrical School

29 West 17th Street, New York

Volume XIII
Whole No. 145

Science and Invention

May, 1925
No. 1

H. GERNSBACK, EDITOR AND PUBLISHER
H. WINFIELD SECOR, ASSOCIATE EDITOR
T. O'CONOR SLOANE, Ph.D., ASSOCIATE EDITOR
Editorial and General Offices, - - - 53 Park Place, New York

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

Time

By HUGO GERNSBACK

BENJAMIN FRANKLIN once wrote an interesting little story about a certain species of fly called ephemera, which lives only one single day. The conversation was between a "youngster" fly and an old "grandfather" fly who was almost a full day old. Franklin, in this story, tried to bring out that time, like most other things, is only relative. To the fly living one day, that one day is, of course, a full lifetime, the same as are 70 years for the human being who lives that long. If there were human beings who lived 1,000 or 10,000 years, their viewpoint upon life and its surroundings would be relative to our present viewpoint.

I BELIEVE THAT:

many a fact today will probably be a delusion in the future.

The writer has mentioned in his former writings that time itself is meaningless and exists only in man's imagination. It is imaginary, just the same as is the line of the equator running around the center of the earth is purely imaginary. Time in free space and throughout the universe does not exist, it being solely a yardstick invented by man to compute elapsed periods between certain events. Therefore, when it is mentioned that the last dinosaur roamed upon this earth 150,000 or more years ago, such a statement is often greeted with incredulity, even among the well educated. Inasmuch as our capacity to conceive enormous periods which have elapsed is none too good, such long stretches cannot be grasped by the human mind, for the simple reason that man himself lives only 60 or 70 years and this unconsciously becomes his yardstick. Such a term as a million or a hundred million years, therefore, becomes meaningless to us.

I BELIEVE THAT:

nothing in this changeable world has stability — everything is in flux—nothing lasts.

Although time itself does not exist, the effect of a lapse between greatly extended periods makes itself felt sharply throughout the universe. For instance, no one will deny that all the human races are physically pretty nearly alike. Thus a Chinaman or an Australian aborigine, or an Eskimo, are all fundamentally one. While the head formation may be slightly different, as a whole the races spring from the same origin. To be sure, the color of their skin is different, and it is here that the elapsed time makes itself felt. The white or Caucasian type, living in northern climates for, perhaps, 100,000 years, had its skin bleached white, whereas the negroid type of Africa, exposed for the same length of time to a torrid sun, gradually became brown, then dark brown, then black. If we were to transfer the white race to Africa today, under similar conditions, the white man would have turned black at the end of 100,000 years elapsed time. If anyone doubts this, let him look at a white explorer who has lived in the tropics for several years. Even during such a short time he has turned brown.

Generally, changes throughout Nature are so slow that it takes tremendous expanses of elapsed time before notable changes occur. This is true, not only of the earth's fauna, but of everything else as well. Whether it is a species of tree, or the contour of a continent, the changes wrought in man's lifetime are insignificant, but they become very notable after great stretches of time.

I BELIEVE THAT:

there can be only one happiness—the happiness of achievement.

The age of the earth has been variously estimated as running into the hundreds of millions of years, a term that becomes at once meaningless to our imagination. Still, even such an enormous stretch is comparatively insignificant when it comes to the universe in general. The one thing that is all abundant in the universe is that very non-existing, meaningless thing—time itself. Where it takes the planetary system hundreds of millions of years to form, other similar star systems have been in formation not for millions, not for billions, of years, but over such tremendous stretches that the expression, "a billion years," shrinks into insignificance and becomes less in comparison than a grain of sand on the beach. You can reach as far backwards to the ages whence we have come as you can reach into the future to where we are going. Behind and before us is a bottomless pit of time-space, incomprehensible to the human mind, chiefly because our minds are not accustomed to such vast dimensions.

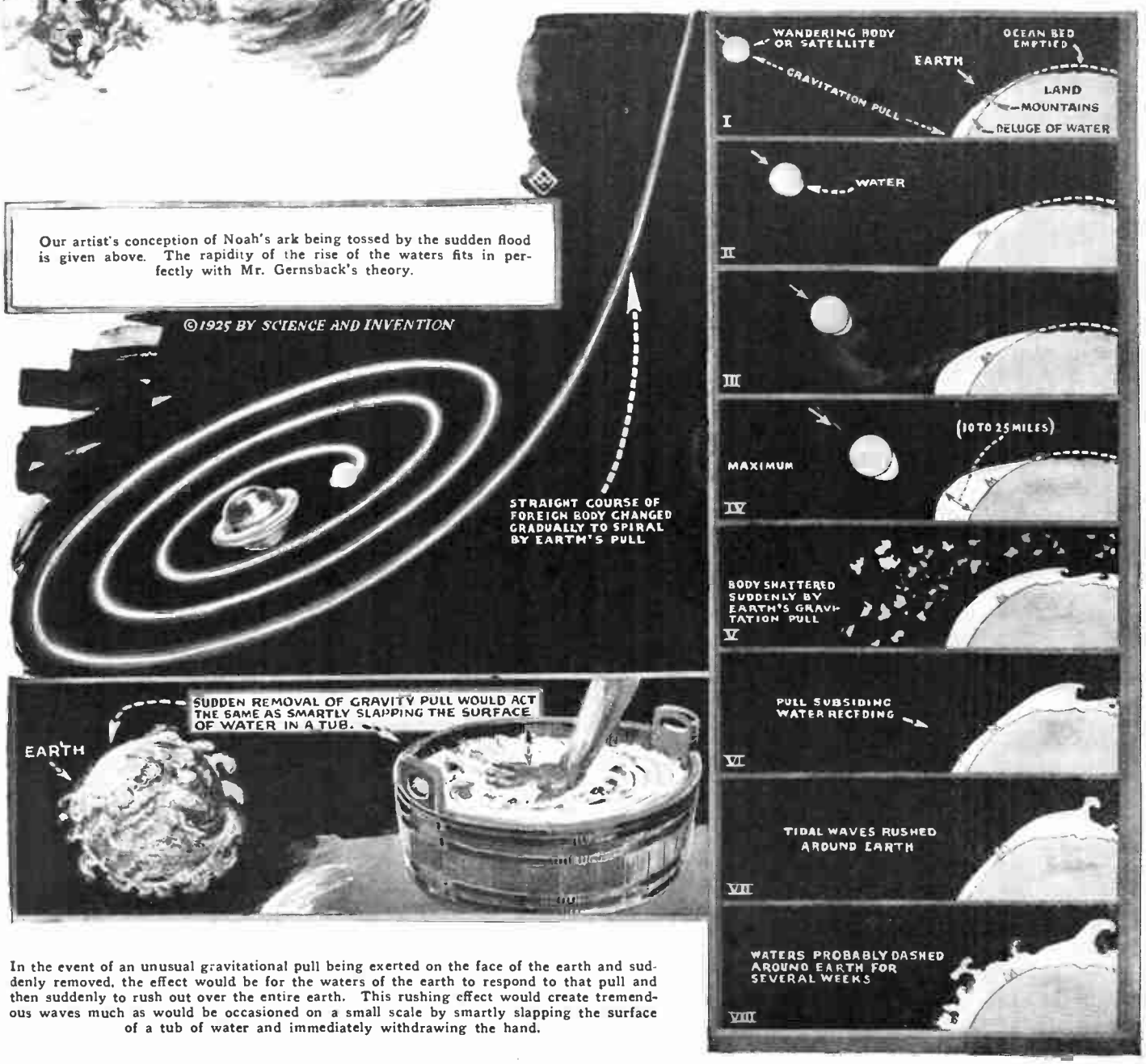
Even our sun, so comparatively close to us, has a span of life that can be calculated as running well into the trillions of years, a span impossible to grasp. And the greater the span of a star's life, naturally the slower is its growth. From the first state of star-dust until the star becomes a faintly luminous nebula covers a stretch of hundreds of millions of years; until the nebula becomes luminous and begins to contract covers a similar period, and for the contracting star to become a flaming blue-white mass of gases a longer period is needed. From then on the star's life declines, its color gradually changing until it finally turns a dark red, and after billions of years the star gives out no more light.

—H. GERNSBACK.

What Caused Noachian Flood?

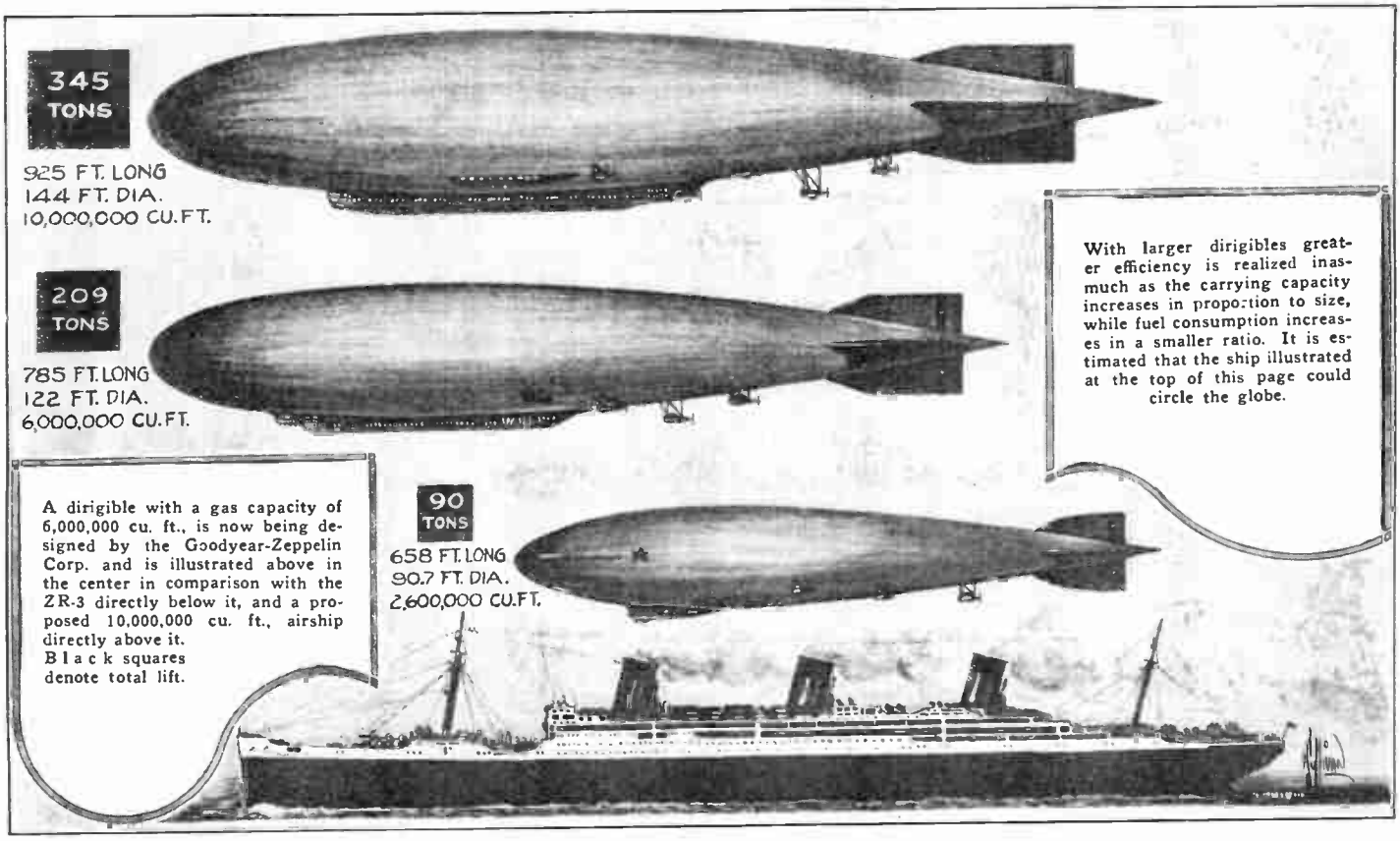
FROM time immemorial there have arisen countless discussions as to what caused the so-called Noachian flood of Biblical fame. A recent theory of a German engineer, Herr Horgiger, illustrated by Scriven Bolton in "The Illustrated London News" and described by Max Bailer in "Illustrirte Zeitung," recalls to mind the article which appeared in the October, 1920, issue of this magazine, detailing a theory advanced by Mr. H. Gernsback which explained just how the flood could have occurred and also gave many reasons why we can believe that such a flood did actually occur during the existence of human beings on this earth. So much interest has been aroused on this subject that we feel that it is quite timely to present to our readers many facts connected with this historical episode. Mr. Gernsback's theory which, by the way, is substantiated by Mrs. Isabel M. Lewis, our astronomical writer, deals with the advent of a wanderer from space in the shape of a foreign body such as a meteor. This body, according to a new theory, may have been traveling in a straight course as illustrated below until it became influenced by the gravitation of the earth. It would then have started to trace a spiral course as shown, whereupon its own gravitational attraction would have caused great tides to rise on the surface of the earth and would have caused all the waters to collect in a tremendous belt. As the gravitational attraction became stronger, this body might have broken up, whereupon its attraction would have been removed and the collected waters on the earth would have rushed out over the surface in a tremendous wave. Thus the great flood may have been caused, not by tremendous rain storms or by the melting of masses of glacial ice, as some scientists have supposed, but by the presence of some celestial body which either shattered and so disappeared or went on its travels through space.

Our artist's conception of Noah's ark being tossed by the sudden flood is given above. The rapidity of the rise of the waters fits in perfectly with Mr. Gernsback's theory.



In the event of an unusual gravitational pull being exerted on the face of the earth and suddenly removed, the effect would be for the waters of the earth to respond to that pull and then suddenly to rush out over the entire earth. This rushing effect would create tremendous waves much as would be occasioned on a small scale by smartly slapping the surface of a tub of water and immediately withdrawing the hand.

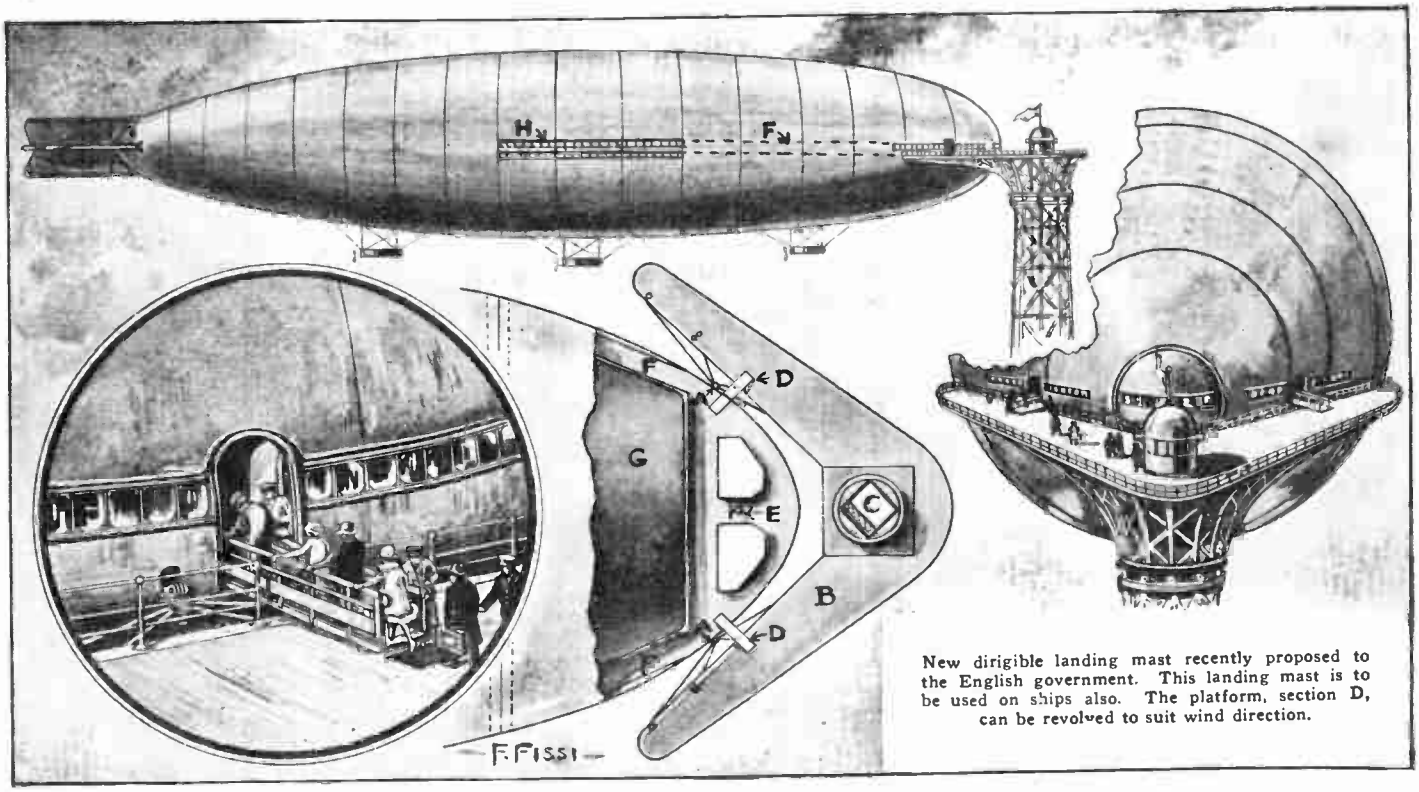
Round-the-World Dirigible



With larger dirigibles greater efficiency is realized inasmuch as the carrying capacity increases in proportion to size, while fuel consumption increases in a smaller ratio. It is estimated that the ship illustrated at the top of this page could circle the globe.

A dirigible with a gas capacity of 6,000,000 cu. ft., is now being designed by the Goodyear-Zeppelin Corp. and is illustrated above in the center in comparison with the ZR-3 directly below it, and a proposed 10,000,000 cu. ft., airship directly above it. Black squares denote total lift.

England To New Zealand by Air



New dirigible landing mast recently proposed to the English government. This landing mast is to be used on ships also. The platform, section D, can be revolved to suit wind direction.

In this new type of airship, the passenger and freight carrying gondolas are eliminated and only the engine carrying compartments are suspended below the gas bag. The passenger and freight compartments are located in the center at H. The ship can swing up and down on cable pivots A. The pilot house is located in the foremost part of the nose of the ship and is indicated by E in the center illustration above.

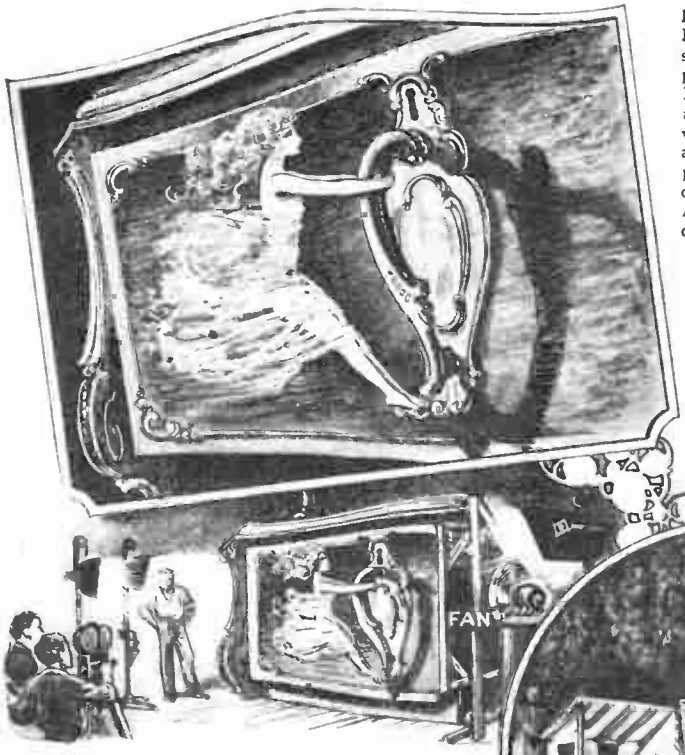
The passengers for this new dirigible ascend in an elevator through the center of the mast as at C in the center drawing. They then proceed along the wings of the mast to the gang planks D, and through the passageways F to the compartment H. Specially designed cast-off devices are indicated by A and controlled from the pilot house E. The gas bags are indicated by G, and have a capacity of 5.000.000 cubic feet.

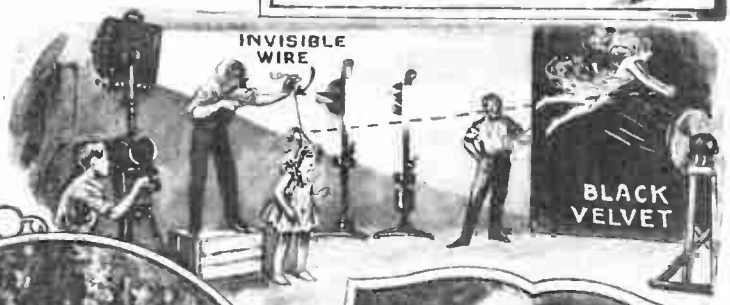
Filming "Peter Pan"

How Fairyland Effects in the Motion Picture Were Produced

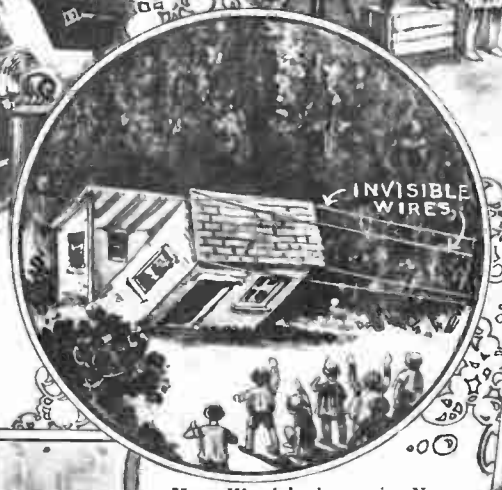
By EDWIN SCHALLERT

In the play of "Peter Pan" one of the scenes shows Tinker, the fairy, pulling Wendy's hair, In a combination of short and long shots Wendy was close to the camera and the fairy was suspended by wires in front of a black velvet curtain. An assistant pulled Wendy's hair with a fine wire.

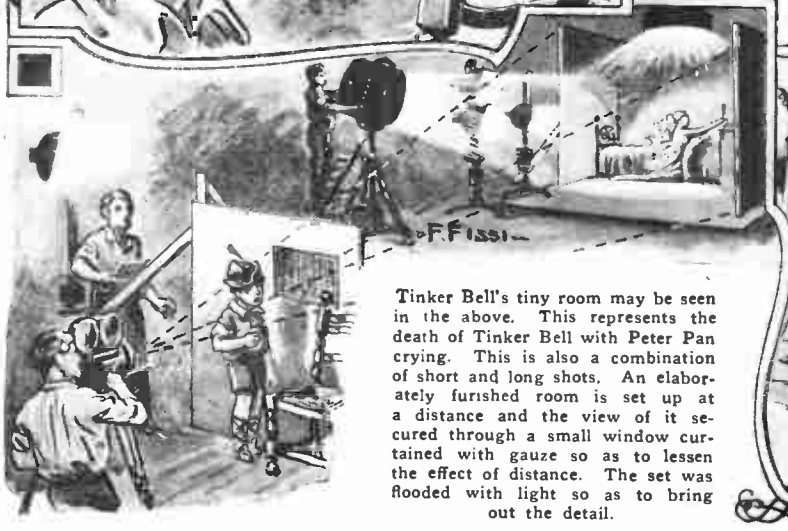




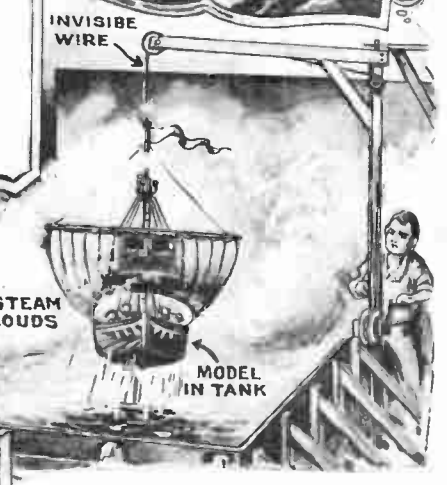
Tinker Bell as she appears on a dresser drawer handle or pull in the movie, is shown in the upper photo. This scene was taken on a duplicate large sized dresser drawer built in the studio. Electric fans blew the draperies of the actress to increase the fantastic appearance.



How Wendy's house in Never Never Land was built by magic. Peter Pan provides this domicile for his companions, the children from the real world. Children of Never Never Land bring various materials and place them in piles on the ground. They then form together, and the house is finished. Actually, invisible wires tore the house down, the camera being turned in reverse.



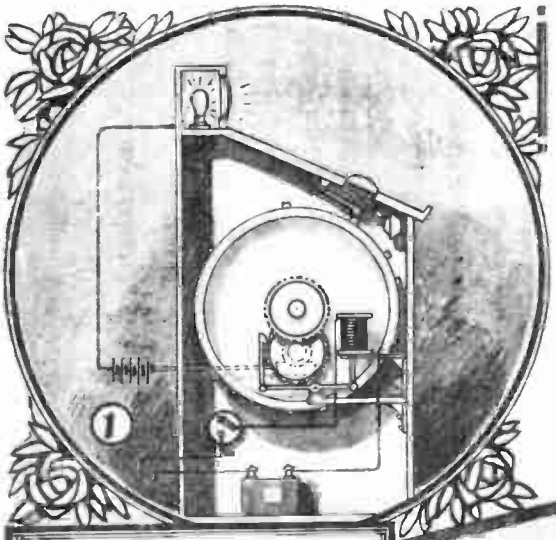
Tinker Bell's tiny room may be seen in the above. This represents the death of Tinker Bell with Peter Pan crying. This is also a combination of short and long shots. An elaborately furnished room is set up at a distance and the view of it secured through a small window curtained with gauze so as to lessen the effect of distance. The set was flooded with light so as to bring out the detail.



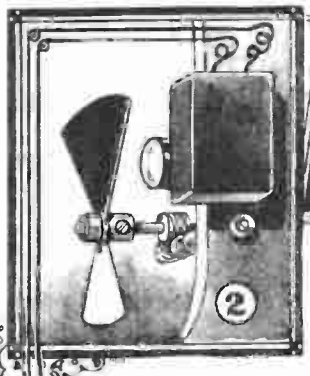
The pirate ship views were taken on location in the Pacific Ocean. After the children defeat the pirates, the ship becomes a magical affair under Peter Pan's sway and flies through the air. In securing this latter scene, a duplicate miniature ship was attached to wires from a crane-like support and placed in a tank in the studio. As it is lifted, clouds of steam are blown in its direction, giving the effect of a ship apparently floating among clouds.

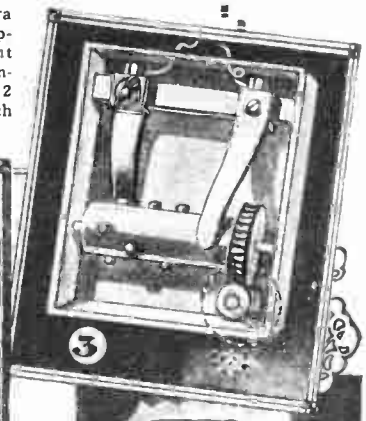
Electrical Orchestra Director

By A. P. PECK

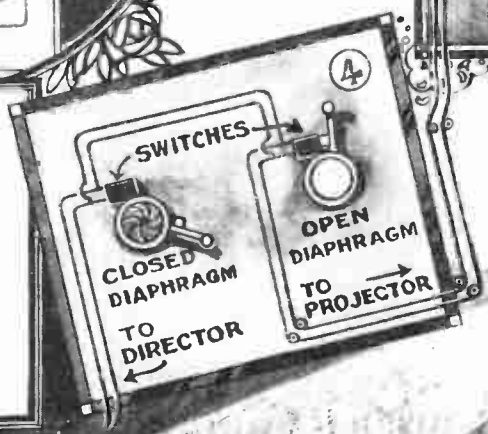


The operating mechanism of this new aid to orchestra directors is illustrated at the left in Fig. 1. This apparatus is located in the orchestra pit directly in front of the leader as shown in Fig. 6 below. Electrical impulses controlled by the device illustrated in Figs. 2 and 3 at the right, energize the solenoid shown which operates a ratchet pawl through a series of levers and so turns a large drum. On this drum the list of cues as shown in Fig. 7 are fastened, and intermittently shown through the small window in the sloping top of the desk.





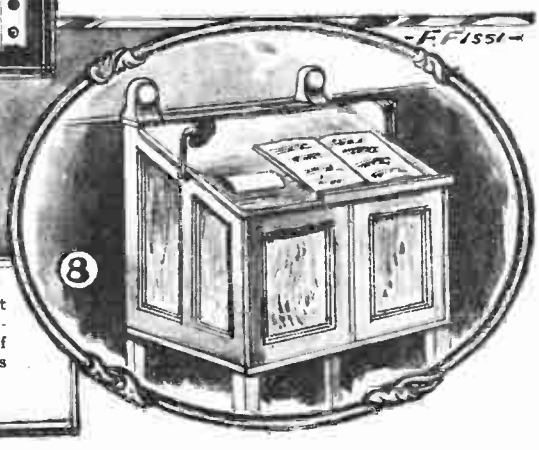
During the entire showing of a film there is a dim light inside the desk illustrated above. Just before a cue is to be given to the director, a light flashes in front of him and a brighter light illuminates the drum. The conductor is thus warned of a change in the music so that he can give the necessary signals to the musicians. In this way the leader is never caught unawares by a sudden change in the character of the picture being shown.



The electrical director is controlled by one or the other of the projection machines. The switches controlled by the diaphragms as in Figs. 4 and 5 change the circuits.

A NEW electrical device designed to aid the conductor of an orchestra and so effect a perfect musical score with a motion picture has recently been designed by S. W. Lawton and is in use in the Colony Theatre, New York City. Essentially this device consists of a musical score written on a paper strip which is to be placed on a cylindrical drum. Electrical mechanism controlled from the motion picture projector turns this drum slowly so that the cue written on the paper strip is presented to the director at exactly the correct time for him to change the type of music being played. In this way the director need not continually watch the screen to the detriment of the music, but can concentrate his entire attention on the actual playing of the orchestra. A series of contacts on a drum which is geared to the shutter on the projecting machine. Figs. 2 and 3, open and close the circuit, and the power in turn energizes the solenoid which slowly rotates the drum in the cabinet in front of the director.

Above in Fig. 7 is shown a section of the cue sheet used. Once such a sheet is compiled for a certain production, many copies can be made and used wherever that picture is shown. The contacts on the edges close a lamp circuit.



The cabinet which is located in the orchestra pit directly in front of the conductor is shown at the right in Fig. 8. Lamps continually illuminate his music, two signal lamps are placed in front of him as warnings and at the side of the music is a magnifying glass through which the cue sheet is viewed.

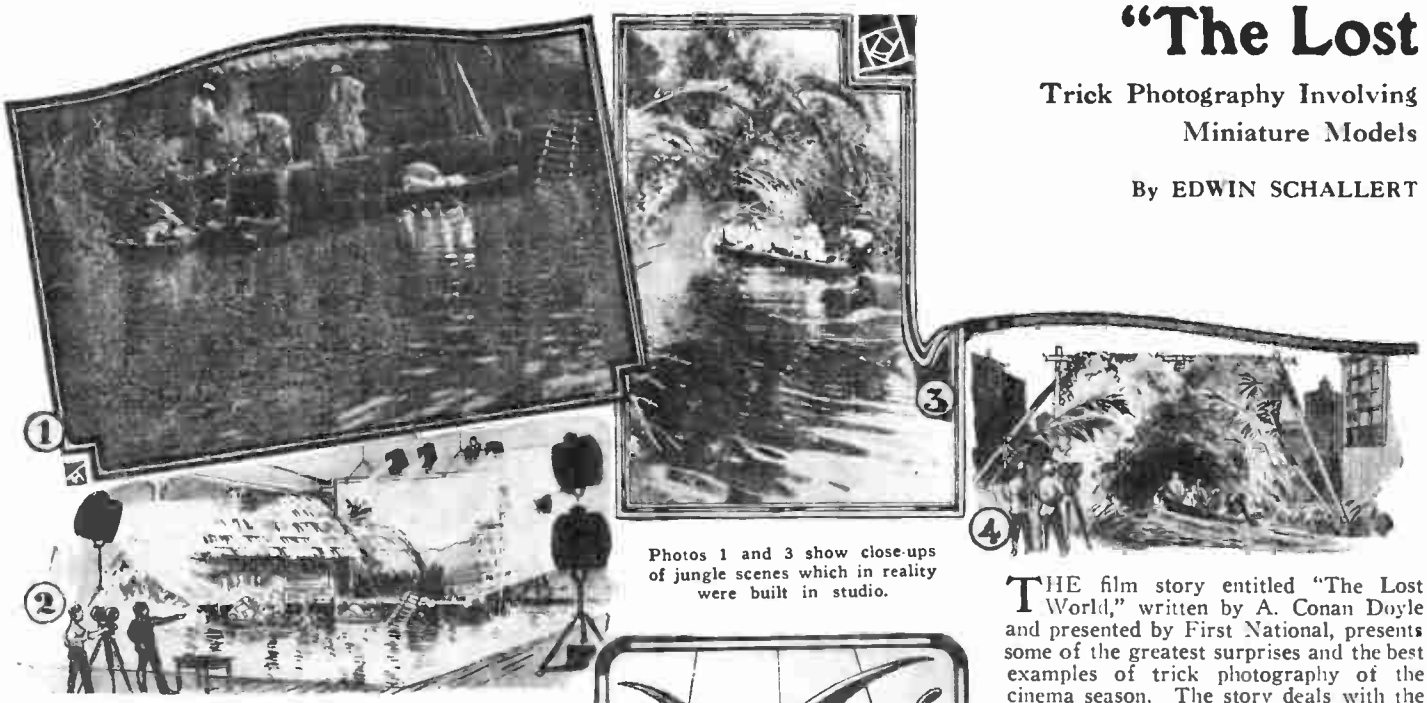
Where motion pictures are destined to have long runs, the Lawton Electrical Orchestra Director will be of great value to the leader of the musicians as, with its aid, he can direct quickly and accurately.

With this device, sad, soft music will always be played when necessary and not when some lively scene is being shown, as often happens when the director has to follow the picture for his cues.

"The Lost

Trick Photography Involving Miniature Models

By EDWIN SCHALLERT



Photos 1 and 3 show close-ups of jungle scenes which in reality were built in studio.

Drawings 2 and 4 above illustrate the methods by which the photos 1 and 3 were taken. A large studio tank was built in which tropical plants and houses were placed.

THE film story entitled "The Lost World," written by A. Conan Doyle and presented by First National, presents some of the greatest surprises and the best examples of trick photography of the cinema season. The story deals with the discovery of a land at the headwaters of the Amazon River in South America inhabited by gigantic prehistoric animals. The methods used in taking these photographs with miniature models of the animals are illustrated on this and the two succeeding pages.

In the photographing of the various scenes in this picture, two main miniature settings were required. One of these was the ground below the plateau pictured in various illustrations on these pages, and the other was the ground on the top of the plateau. Of course, there were minor miniature sets as well, such as the one depicting the street scene in London. In these miniature scenes the animals used were made up of a rubber-like composition veined throughout with wires. The result was that the models were extremely pliable yet would stay in whatever position they were placed. In all of the action photos the strip of film was taken two frames at a time with what is known as a stop motion camera. With this device one turn of the crank exposes one frame of film. Between the exposure of each two frames, the models were moved to their next position by hand.

Above: The prehistoric animal ambling down the city street was taken with the stop motion camera mentioned at the right. When the falling building effect was produced, the miniature set was pulled apart by wires.

Fig. 7 above gives an idea of the relative sizes of the miniature models of prehistoric animals used in this film.

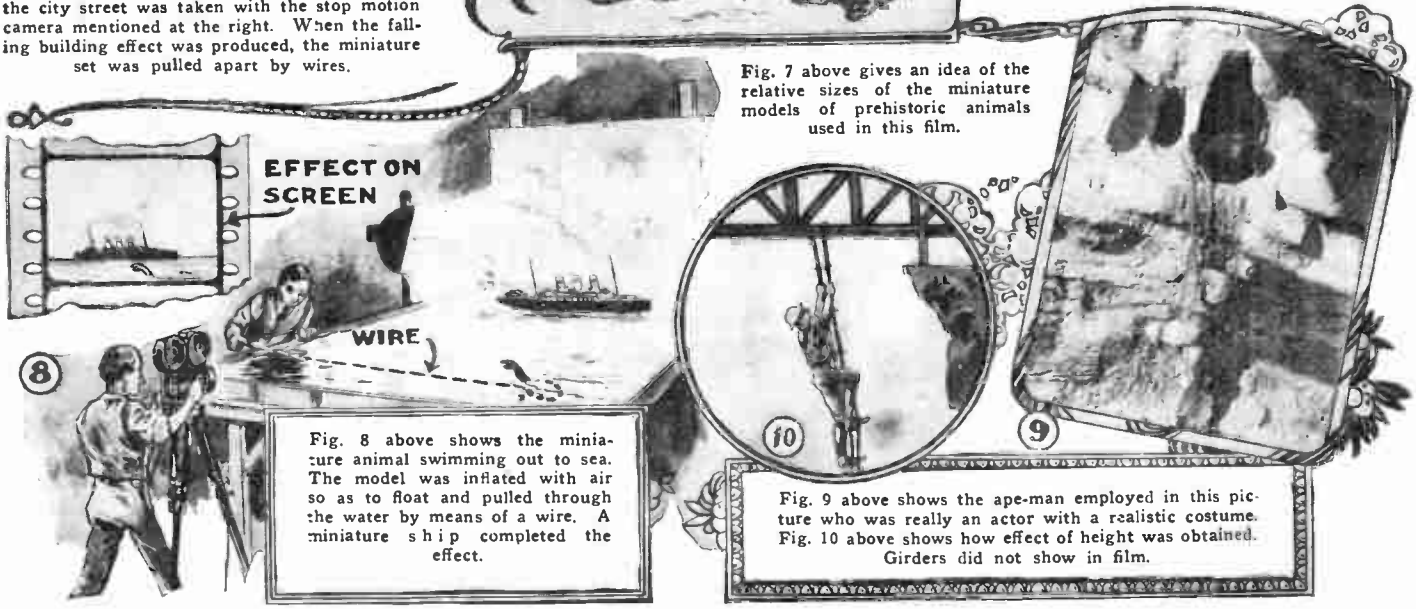


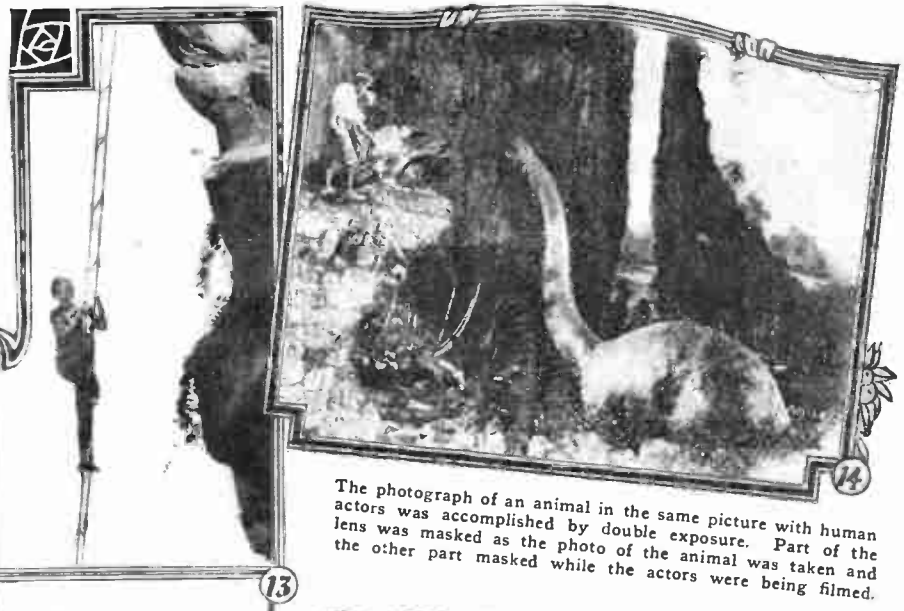
Fig. 8 above shows the miniature animal swimming out to sea. The model was inflated with air so as to float and pulled through the water by means of a wire. A miniature ship completed the effect.

Fig. 9 above shows the ape-man employed in this picture who was really an actor with a realistic costume. Fig. 10 above shows how effect of height was obtained. Girders did not show in film.

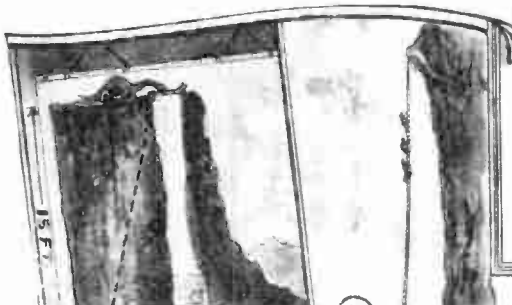
World"

Complicated Hand Moved Explained in Detail.

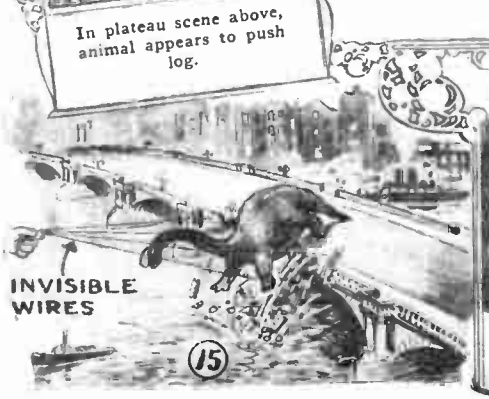
and J. K. BURLEIGH



The photograph of an animal in the same picture with human actors was accomplished by double exposure. Part of the lens was masked as the photo of the animal was taken and the other part masked while the actors were being filmed.



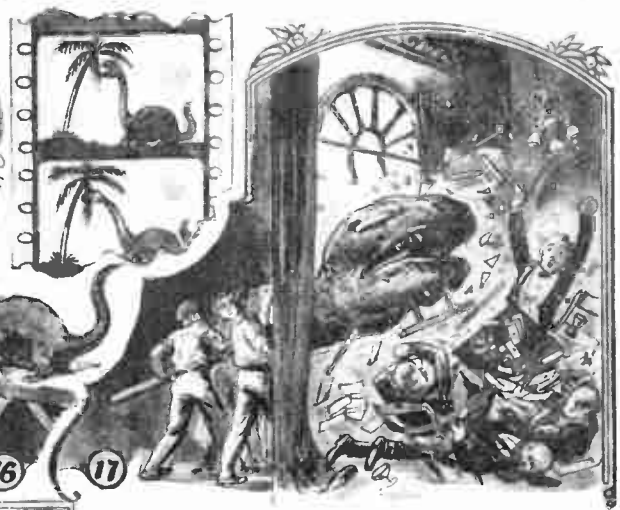
In Fig. 11 log is removed with wire. In Fig. 12, miniature figures seem to climb rope ladder. Close-ups are taken as in Fig. 10.



In plateau scene above, animal appears to push log.

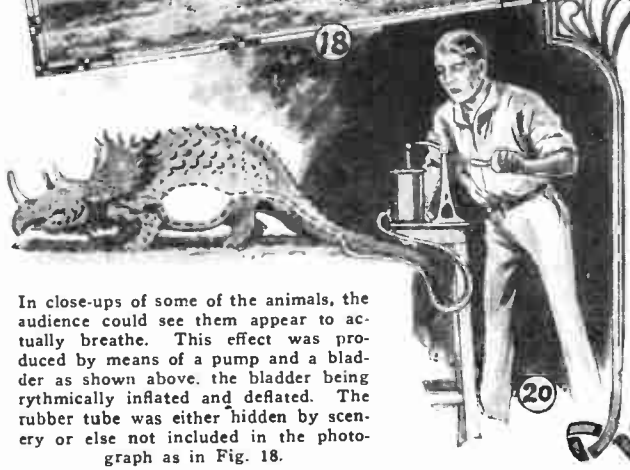
The miniature model manipulated by hand ambled along the bridge and suddenly decided to head back for South America. He crashed through the side of the miniature bridge, being pulled by invisible wires as above.

Using the stop motion camera, the animal models were placed in position by hand as illustrated above in Fig. 16. Even the motions of eating were taken two frames at a time, the mouth being opened or closed between each two frames. The effect of saliva in the mouth was produced by shellac and the blood in the fight scenes was a thick dark liquid.

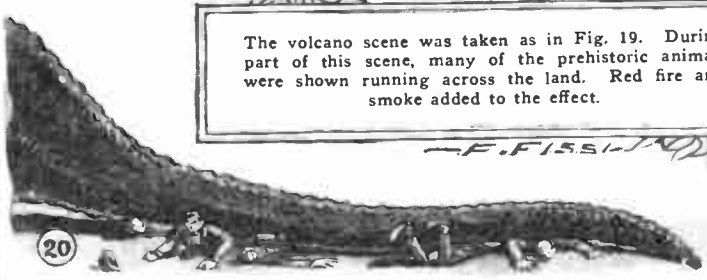


While in London, the beast thrust its head into a clubroom. The interior scene was taken as above, a full sized model of the head being used.

The volcano scene was taken as in Fig. 19. During part of this scene, many of the prehistoric animals were shown running across the land. Red fire and smoke added to the effect.



In close-ups of some of the animals, the audience could see them appear to actually breathe. This effect was produced by means of a pump and a bladder as shown above. the bladder being rythmically inflated and deflated. The rubber tube was either hidden by scenery or else not included in the photograph as in Fig. 18.

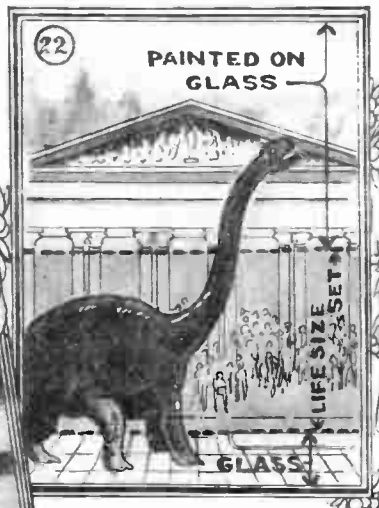


In the London scene, the tail of the animal knocked down several people. A full sized tail of canvas was made for this scene and caused to switch around, producing the desired effect.

"The Lost World"

(*Continued from page 15*)

21



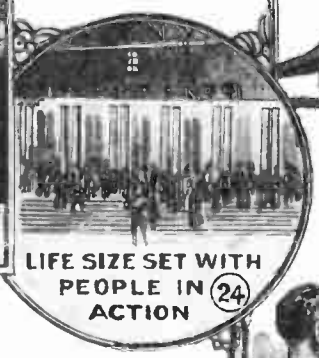
Above: The complete assembly of painted, life-size and animal sets.

26

Fig. 26 above is one of the most gripping scenes in the whole photoplay. Depending on the principle of perspective, the miniature model and scenery were placed in the foreground and the actors in the background.

Above: A photograph produced by a combination of Figs. 23, 24 and 25.

25



Above: One of the miniature animal models.

27

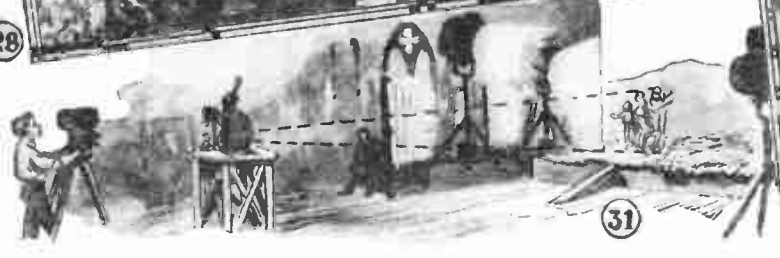
To produce the photo in Fig. 21, a miniature scene was painted on glass as in Fig. 23, a full size set made as in Fig. 24 and a model as in Fig. 25 were used. They were all arranged as shown in Fig. 22, the full sized set in the background.

29

In the scene above, a complete miniature set moderately lighted occupied the foreground, while the actors strongly lighted were in the background. In the result, both sets appeared to be equally distant from the camera.

28

30



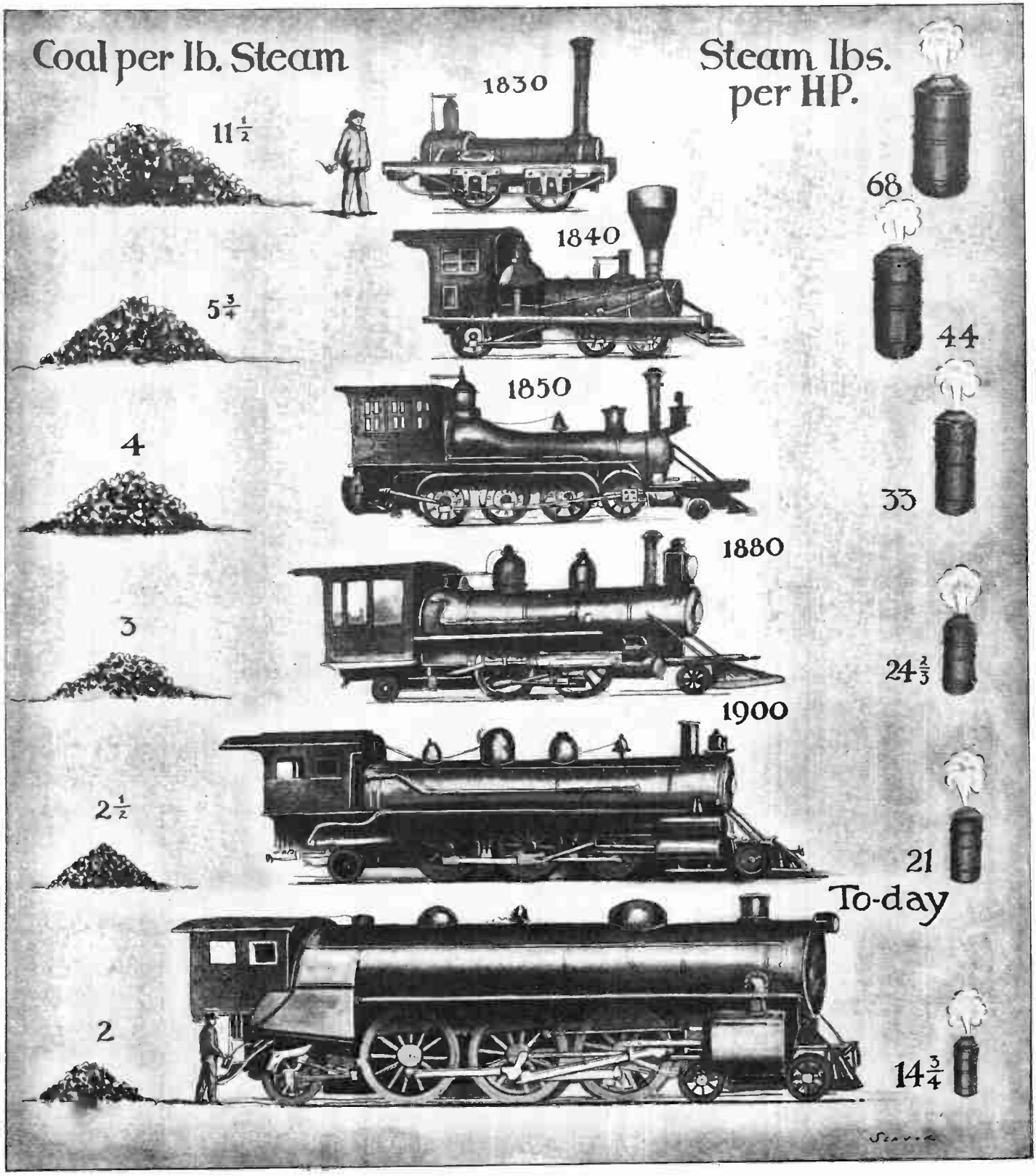
31

32

In the photograph shown in Fig. 28, where the two prehistoric animals are engaged in mortal combat, the same principle of perspective described above was brought into play as in Fig. 31. Figs. 29 and 30 detail this part of the filming. The extreme background was a painted scene, while the foliage in the foreground consisted of miniatures.

Above in Fig. 32 is illustrated another scene wherein the models and human figures appear on the same picture. A complete description of how these animal models were made and photographed appeared in the August, 1922, issue of this magazine.

Locomotive Evolution



RECENT attention has been focussed so strongly on the great forward strides in the development of internal combustion engines, aviation, radio and other interesting fields that the average person is apt to completely disregard one mechanical adjunct to our everyday life, the locomotive. Truly it does seem that even though we rely on these leviathans of the rails, we pay all too little attention to the development of this device and only those directly in contact with the railroad industry realize what great improvements have been made in the design and construction of locomotives since 1830. Our illustrations above show the great forward steps which have been taken, dividing these steps into periods as indicated by the various dates. In the early days of railroad travel, using a locomotive such as illustrated at the top of this page, 11½ pounds of coal were necessary to develop 1 pound of steam, and 68 pounds of steam had to be generated in order to obtain 1 horse-power of actual energy. In a short period of 10 years, these figures were reduced greatly as indicated and from that time on down to the present day we have slowly but surely perfected locomotives to a point where in the up-to-date engine only 2 pounds of coal are required per pound of steam, while only 14¾ pounds of steam per hour develop 1 horse-power. And yet even these giants are doomed to eventual oblivion by the turbine and Diesel locomotives, although it will be some years before our present day locomotives are entirely displaced for more efficient and powerful prime movers. — Dr. Stelzer, University of Vienna.

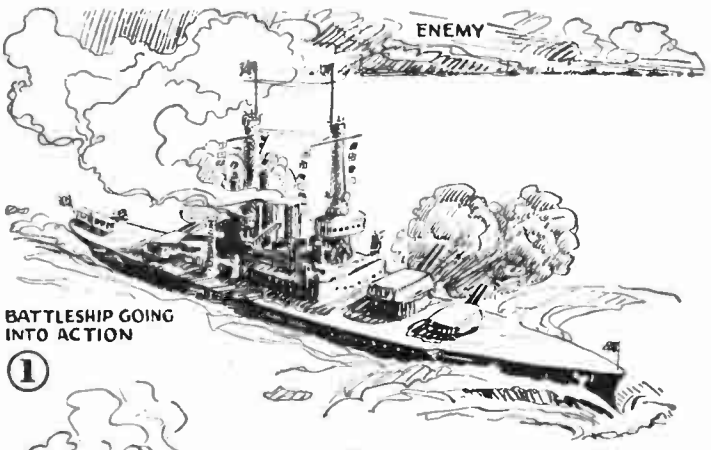
Navy Challenges

By H. WINFIELD

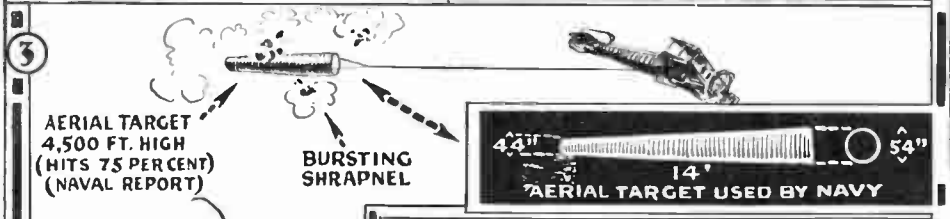
Tests Under War Conditions of Aerial Bombers Guns When

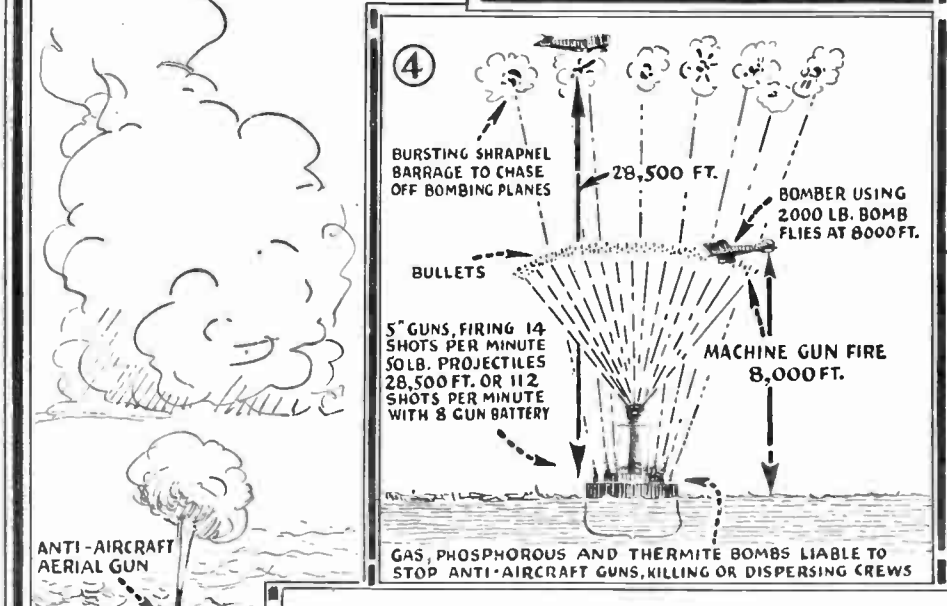
THE author's article in the April issue of this magazine entitled, "Can We Fight War Gas Attacks" has aroused much serious comment on the subject of the United States' sadly weakened air force. Considering this and the fact that Brig. General Mitchell and the United States Navy have recently presented numerous important facts, the results of tests, to the public, the author felt that the time was ripe to give to the readers of this magazine certain important points connected with the defense of our country.

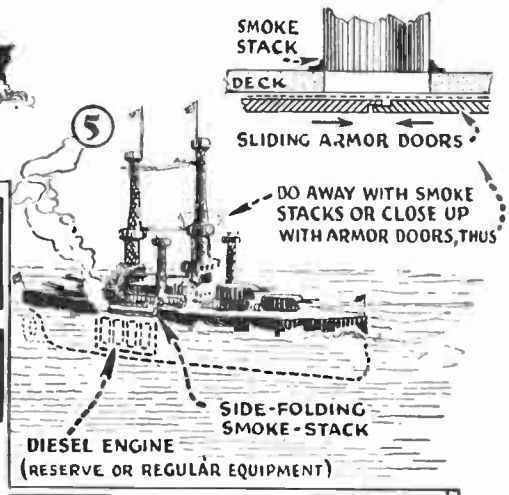
Our illustrations on this and the opposite page show the points where the United States Navy is weak under actual battle conditions and where the air force triumphs. Furthermore, there are times when aerial fighters cannot fulfill their missions and sometimes under these conditions the battleships are able to carry on most effectively. For instance, at the right, Figs. 1 and 2 show a fully equipped battleship going into action and the same ship after having been pounded by the airplanes and ships of the enemy. In Fig. 2, the masts, smokestack and entire super-structure have been shot away. The actual fighting elements of the ship, however, have not been much impaired and the ship is just as much in action as if it had never been touched by shot or shell.



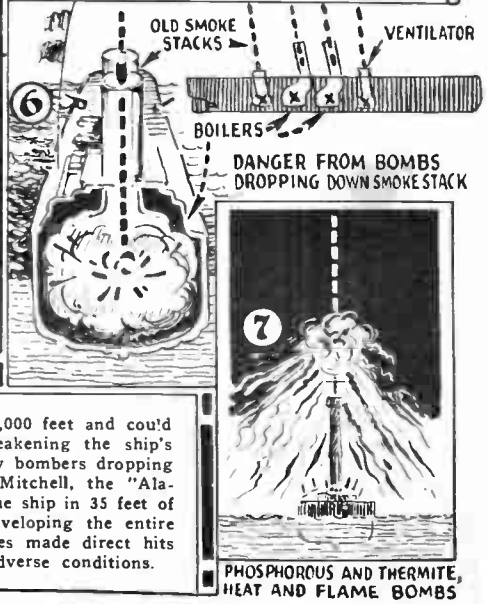
A recent naval report shows that an aerial target trailed behind a plane as in Fig. 3 below was hit by at least one or more shell fragments in 75 per cent. of the target practices. The aerial target is illustrated in detail below.







An aerial bomber flying low and with good luck could occasionally place a bomb in the smoke stack of a battleship with the result that the boilers and propelling mechanism would be completely destroyed. This is illustrated below and a suggestion for remedying the situation given above. With stacks closed, Diesel engines could be used.



Above: Aerial bombers would be safe from machine gun fire above 8,000 feet and could drop gas- or explosive-bombs, partially disabling the crew and weakening the ship's fighting efficiency. The battleship could then be demolished at will by bombers dropping explosive charges. During tests on the "Alabama" under General Mitchell, the "Alabama" was attacked by airplanes. The first 2,000-pound bomb sank the ship in 35 feet of water. Other planes dropped phosphorous and thermite bombs, enveloping the entire super-structure in sheets of flame and heat. In this case, the planes made direct hits in darkness and demonstrated their remarkable efficiency under adverse conditions.

Aerial Bombers

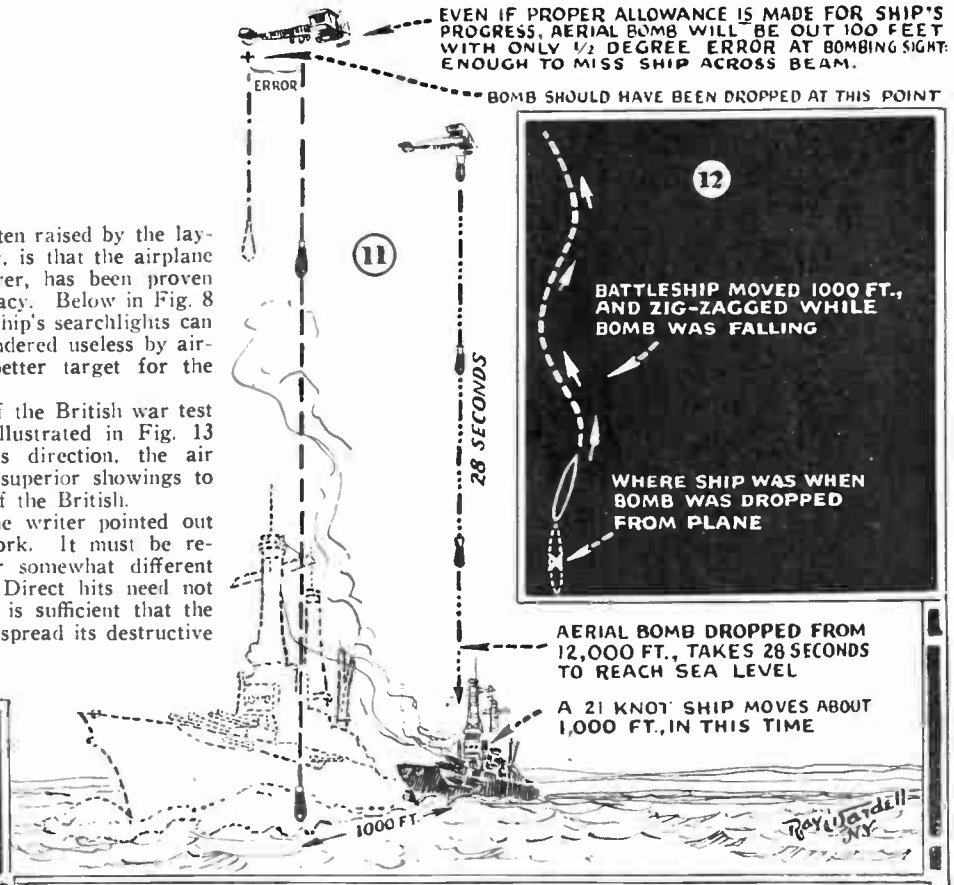
SECOR, E. E.

Show Strong and Weak Points and Anti-Aircraft Compared

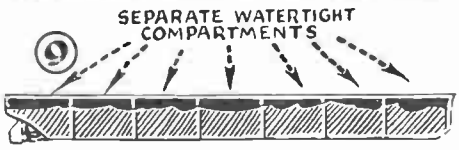
ONE great objection to aircraft fighting often raised by the layman and even by those who should know, is that the airplane pilot is at a loss in darkness. This, however, has been proven by General Mitchell and his staff to be a fallacy. Below in Fig. 8 is shown a battle in darkness. Although the ship's searchlights can occasionally pick out a plane, they may be rendered useless by airplane flares and only serve to provide a better target for the bomber.

Some anti-aircraft agitators cite the case of the British war test on the scrapped battleship "Agamemnon," illustrated in Fig. 13 below. However, under General Mitchell's direction, the air forces of the United States have made far superior showings to this in test conditions more rigid than those of the British.

In the article dealing with gas attacks, the writer pointed out the great efficiency of airplanes for this work. It must be remembered that here the planes work under somewhat different conditions than when attacking battleships. Direct hits need not be made when bombing a city with gas. It is sufficient that the bomb burst somewhere near the objective and spread its destructive vapors.

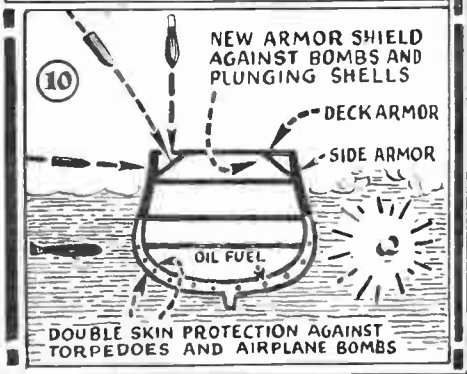


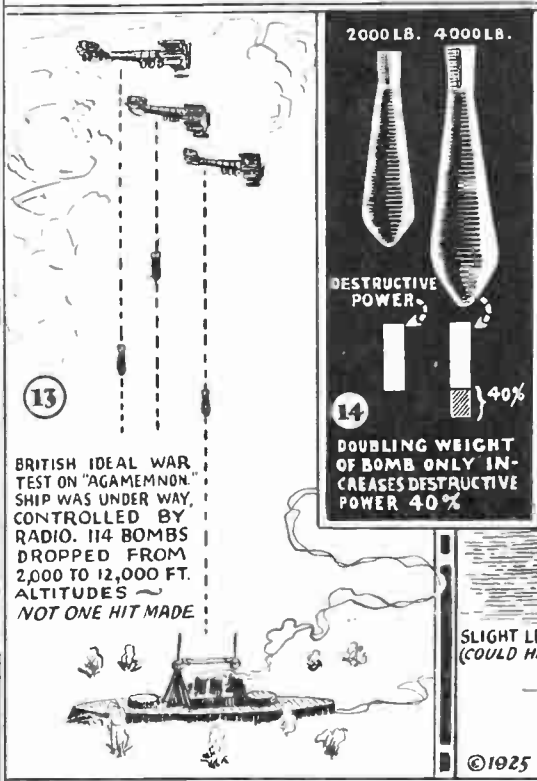
An aerial bomber has to gauge the position of a ship when attacking it within one-half degree error as above in Fig. 11. Furthermore, a battleship will move about 1,000 feet while a bomb is falling and can zigzag as in Fig. 12 above.

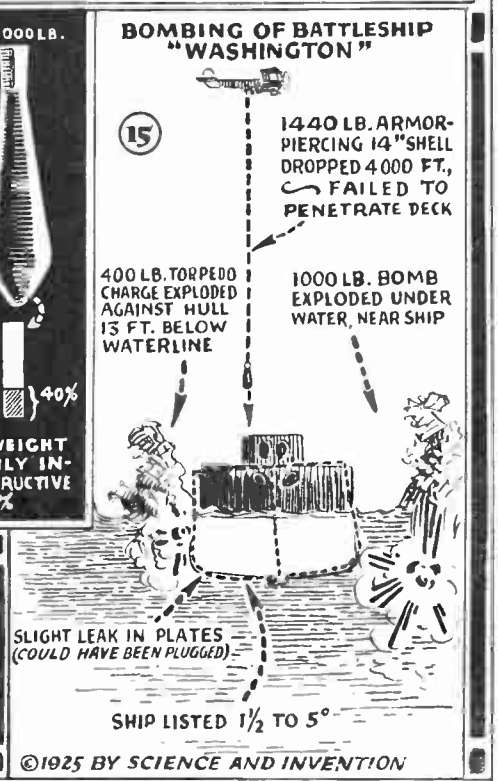


HOW SHIP HULL IS DIVIDED BY BULKHEAD WALLS TO PREVENT FLOODING AND SINKING

Battleships are protected from sinking by separate water-tight compartments as shown in Fig. 9 above, although a direct hit by an explosive bomb or shell will often cripple the ship. New types of armor as shown below in Fig. 10 are also of great assistance in protection against all types of projectiles. Deck armor and side armor repel aerial bombs, gun shells and torpedoes.







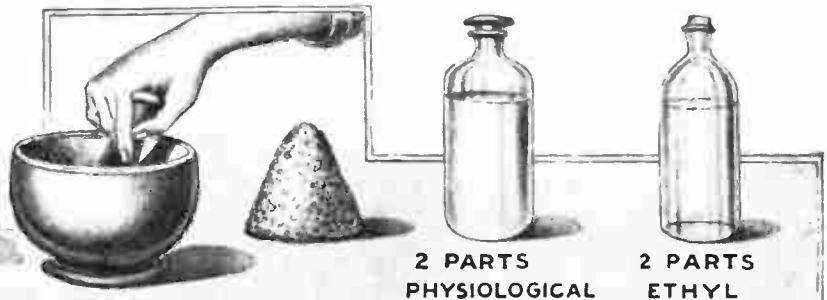
The chief of the Army Air Service recently proposed that the size of aerial bombs be doubled in order to greatly increase their effectiveness, but the destructive power would only be increased 40 per cent, as shown in Fig. 14. In aerial tests conducted against the battleship "Washington," the results were obtained which are illustrated in Fig. 15. The deck armor resisted a 1,440-pound armor-piercing shell (no powder used) dropped from an altitude of 4,000 ft. Leaks were developed by charges exploded against the hull and a 1,000-pound bomb exploded under water near the ship caused a list of 1½° to 5°. The "Washington" several days later was sunk by gun-fire. A recent report intimates she sank from effects of aerial explosions.

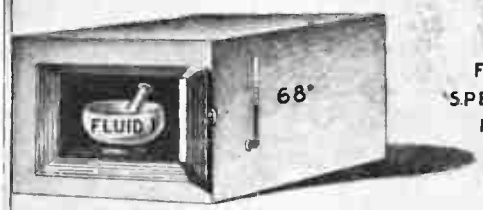
Predicting the Sex of the Unborn

By JOSEPH H. KRAUS

Staff Medical Expert

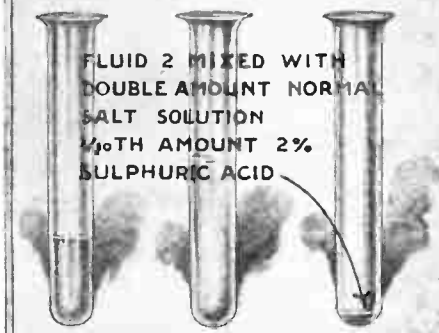
On this page is shown the complete process for predicting the sex of the unborn child as developed by Dr. Isaac Fried, M.D., formerly of the pathological department of the Jewish Maternity Hospital in New York. This test is effective from the fifth month of development until birth and in more than twelve hundred cases recorded by Dr. Fried, he claims there has been no error. The basis of the test is founded on the theory of Steenstrup, zoologist of Copenhagen, who considers that sex is everywhere implanted in the body and each cell of the organism is sexually characterized. The test aims to detect differences between male and female characters in the blood of the prospective mother.

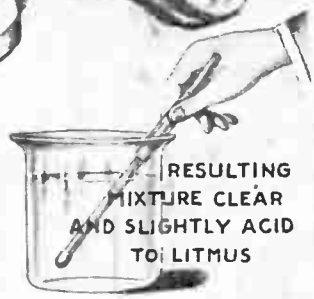


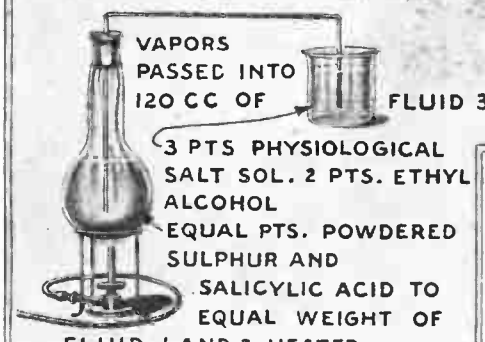


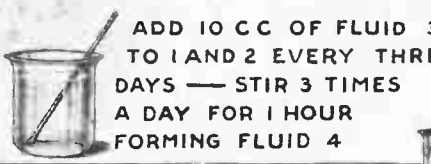
KEEP AT 68° C FOR 72 HRS. AND GRIND 3 TIMES PER DAY

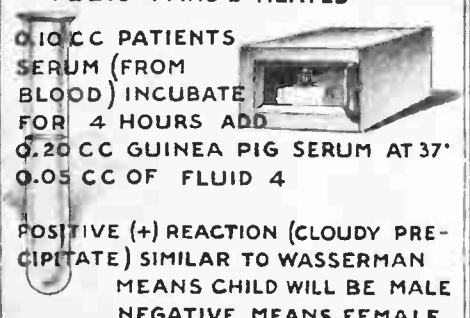
EXAMINED - MUST BE ACTIVE AT END OF 20 HOURS REFRIGERATION. KEPT IN REFRIGERATOR FOR 72 HRS.







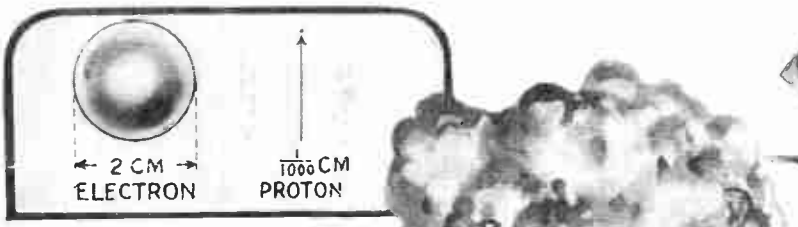




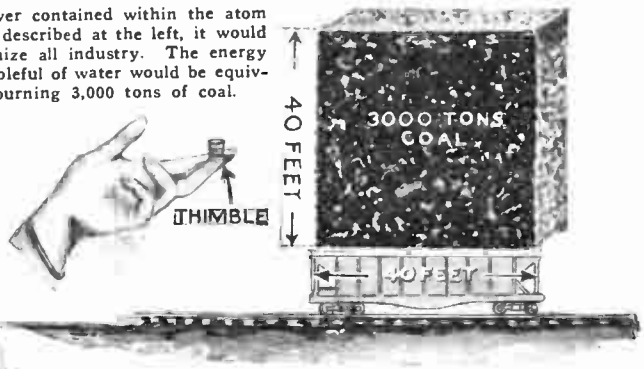
THE test for determining the nature of the sex of the unborn child is similar to the Wassermann reaction. About thirty cubic centimeters of the blood of the mother is taken. The male gonads and prostate are obtained within 3 or 4 hours after death for making the required reagents. In setting up the test 0.10 cc. of patient's serum is added to 0.20 cc. of Guinea pig serum (the complement) and 0.05 antigen. This is incubated for 4 hours at thirty-seven degrees Centigrade and then 0.50 cc. sheep cells 4% and 2 units of amboceptor are added and the entire mixture is incubated for 30 minutes. A positive reaction indicates the presence of a male child, negative reaction suggests a female. In case of twins, one male and the other a female, the reaction will again be positive. If both are female the reaction will be negative and if both are male will be positive.

The Mystery of Atomic Energy

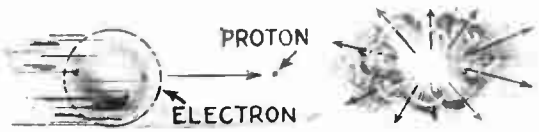
Below are pictured the constituents of an atom; the electron and the proton whose combinations in varying numbers make up all matter. The proton weighs 1,840 times as much as its inflated companion. If these two could be made to unite, neutralizing their charges, energy might be released, which energy would then give atomic power.



If the enormous power contained within the atom could be released as described at the left, it would completely revolutionize all industry. The energy released from a thimbleful of water would be equivalent to that of burning 3,000 tons of coal.



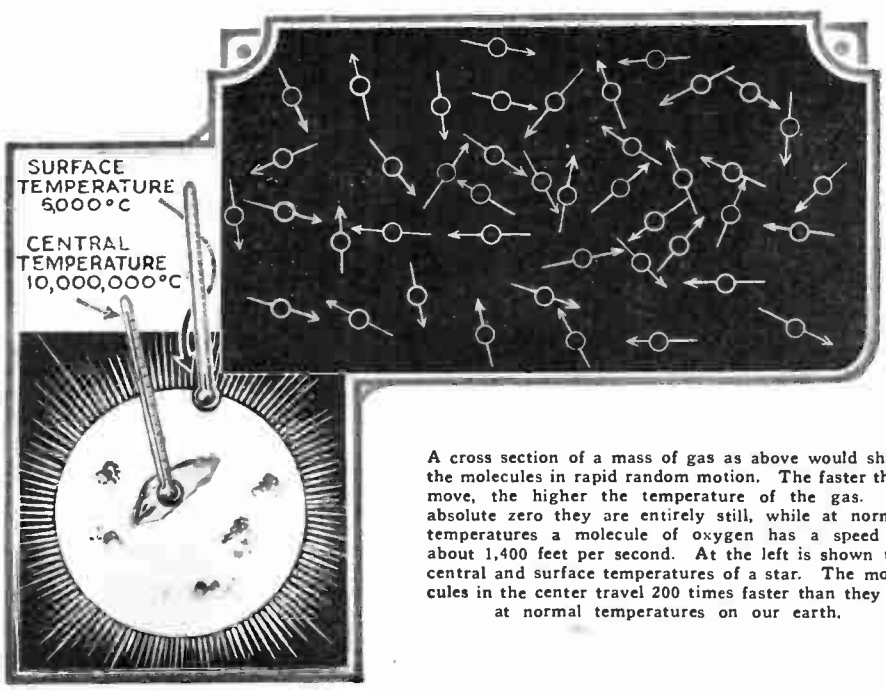
Just what the results of releasing the tremendous forces of the atom would be is hard to realize. With our present day machinery, there is a great possibility that this gigantic force could not be controlled. The loosing of atomic energy would produce a temperature of over one million degrees Centigrade. Such a rise in temperature would undoubtedly raise other neighboring atoms to the point of explosion and the process would continue, resulting in a rapid annihilation of the earth. In the center of stars, where the temperature reaches ten million degrees Centigrade, protons and electrons collide at a speed two hundred times greater than they do at our normal temperatures. Thus complete destruction is realized and the heat of the stars maintained.



Above: The two highest temperatures yet reached. The heat produced from an electrically exploded wire has never been exceeded on this earth.

ONE of the greatest dreams of chemists throughout the ages has been free power in general and more specifically, power from the atoms. Will that day come when we will no longer have to rely upon uncertain and rapidly diminishing coal and oil supplies for heat, light and energy? Radioactivity hints at an unlimited source of power within the nucleus of the atom itself. Astronomers tell us that the huge energy output of the sun and stars could be maintained only if in some way matter is being transformed into energy within the bodies themselves. Few scientists doubt the reality of such a phenomenon, although they are at a loss as to the method of duplicating this process or controlling the atoms in their laboratories.

All of the above mentioned facts, the illustrations on this page and their accompanying captions must be taken into consideration and the facts contained therein carefully weighed against each other before we can answer the following question. O: what value would be the discovery of a process for releasing the tremendous forces contained within the atom? Would not such a process mean immediate destruction to our entire world? Such would seem to be the case unless suitable machinery, capable of handling the gigantic forces thus released, was first designed. And how can such machinery be made unless we have something definite to work upon? Gasoline engines were designed after the explosive force of gasoline was discovered. From that day up to the present the engines have been constantly improved. Will not such a process have to be gone through in the utilization of atomic force? Such a tremendous step forward in science furnishes ample food for thought.—Donald H. Menzel, Ph.D.

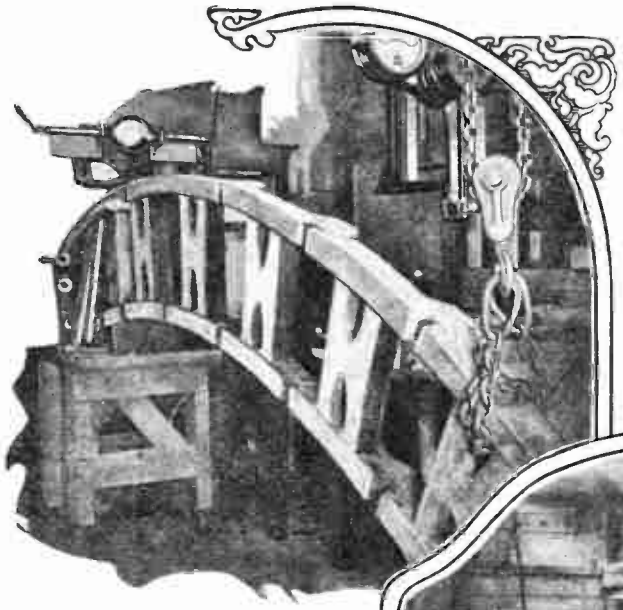


A cross section of a mass of gas as above would show the molecules in rapid random motion. The faster they move, the higher the temperature of the gas. At absolute zero they are entirely still, while at normal temperatures a molecule of oxygen has a speed of about 1,400 feet per second. At the left is shown the central and surface temperatures of a star. The molecules in the center travel 200 times faster than they do at normal temperatures on our earth.

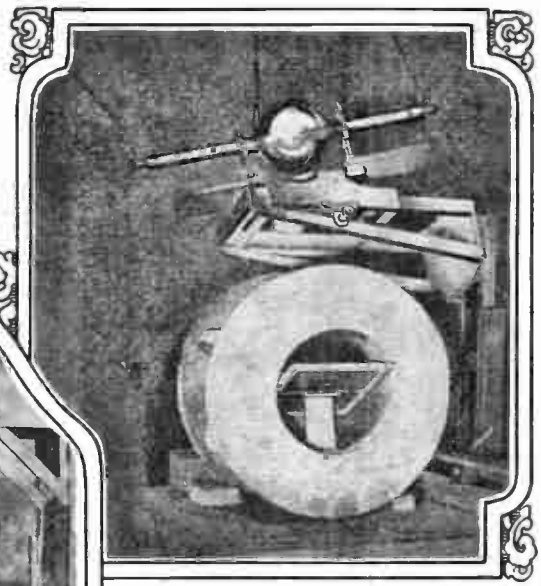
X-Raying Big Guns

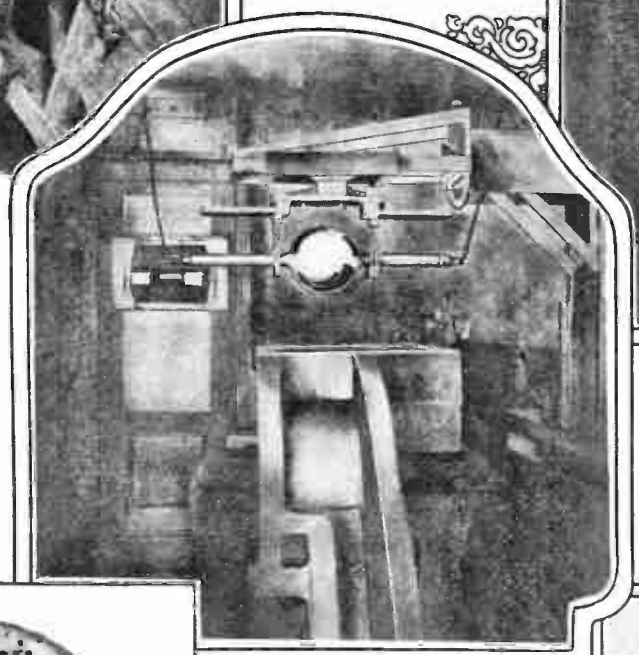
By S. R. WINTERS

With the use of improved X-ray tubes and accessories thereto, it is now possible to detect flaws in the castings for big guns and their mountings, which otherwise would be invisible even under the most stringent inspection. X-ray tubes placed on one side of a casting and photographic plates on the other side reveal defects in the interior of the casting that could be found by no other means short of drilling.



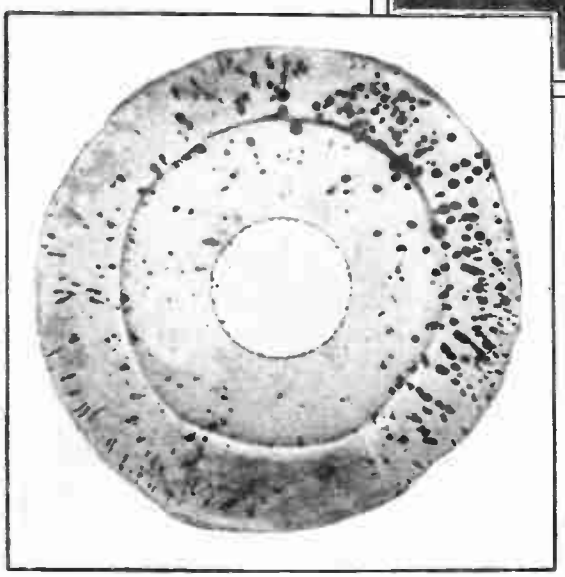
In the photograph at the left, a spacer-ring casting for a 16-inch coast defense gun is being arranged for X-ray examination. This segment is 15 feet long and weighs 2,300 pounds.



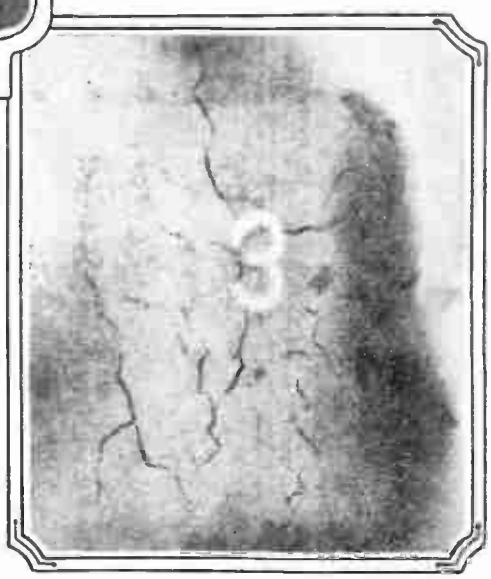


In the illustration at the right, a floor-frame steel casting for a coast defense gun is shown arranged in the government laboratory with an X-ray tube in position for taking radiographs which will decide whether or not the casting will go through the rest of the usual process and finally be incorporated as an integral part of one of our monster units of armament. Notice the specially adjustable X-ray tube support which enables the tube to be used in any desired position.

One of the steel trunnions in rough casting form is shown ready to "have its picture taken." A specially adjustable frame is used for holding the X-ray film in a light-tight frame and in any desired or necessary position. Obviously the work need not be done in a darkened room.



At the left is shown an X-ray photograph of a circular section of gun barrel indicating hard spots and other flaws in the steel which could never be detected without the use of the X-ray. The illustration at the right is an enlarged X-ray view wherein cracks are visible that might render the use of a gun made from this casting positively dangerous. None of the cracks shown were visible on the outside of the gun barrel, although some of them showed on the inside surface, where the inspector could not see them. Many of the cracks were not visible on either surface and were only brought to light when the X-ray photo was taken.



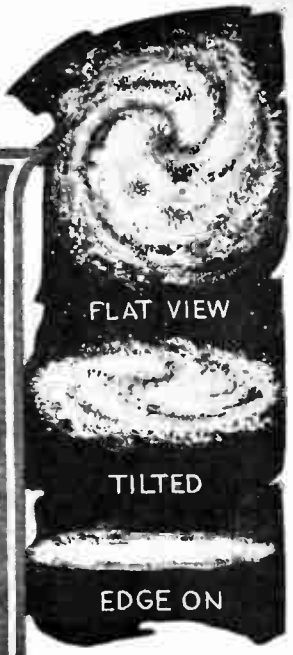
THE installation of a 280,000-volt X-ray equipment in the Watertown Arsenal of the Ordnance Department of the United State Army marks a great step forward in the production of war material which will give satisfactory and safe operation under field conditions. The main apparatus is illustrated above and some of the photos are reproduced. The results of this work are obviously very valuable.

THE use of X-rays to detect flaws in big gun castings will, of course, effect a great saving as large castings will not be carefully machined until they have passed the penetrating inspection of a series of X-ray photographs. Furthermore, ordnance equipment will not be sent out on the field for actual use only to burst or become useless under trial or service due to undetected flaws in the steel.

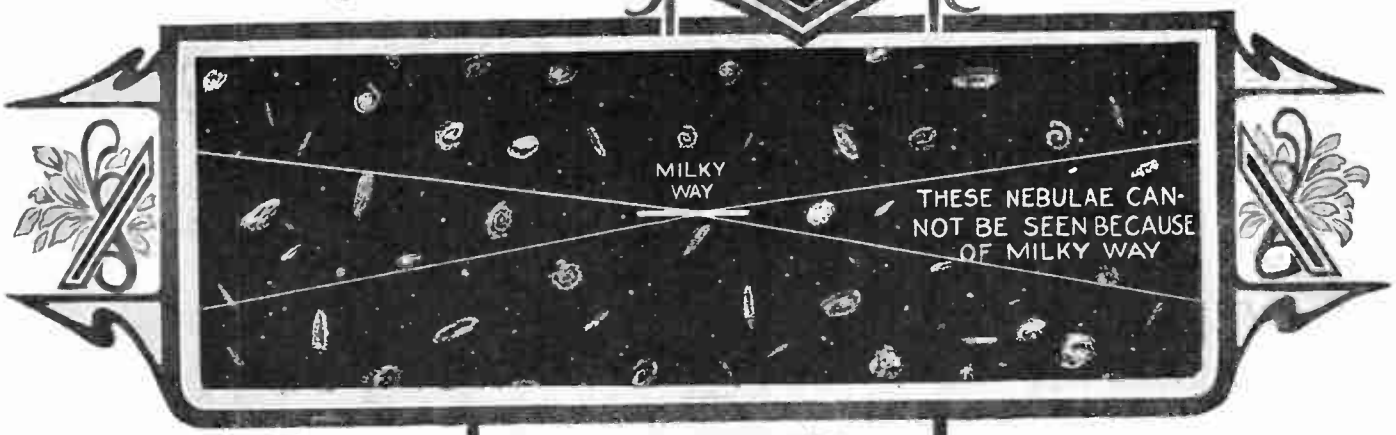
What Are Spiral Nebulae?

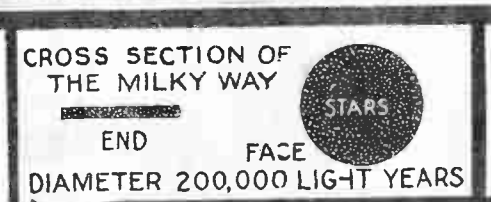
By CHARLES T. DAHAMA, Ph.D.

Spiral nebulae well known to astronomers are objects comparable to pyrotechnic pinwheels in action. Only two of them are visible to the naked eye as faint patches of light. Large telescopes, however, give a closer study of them, and an estimate of their number which is placed well up in the hundreds of thousands. The photo at the right is one taken through a large telescope. The two circles near the central part of the nebula enclose two new stars which have flashed up in that position. Although they are mere specks in the photograph, we know them to be stars about a million times as bright as our sun.



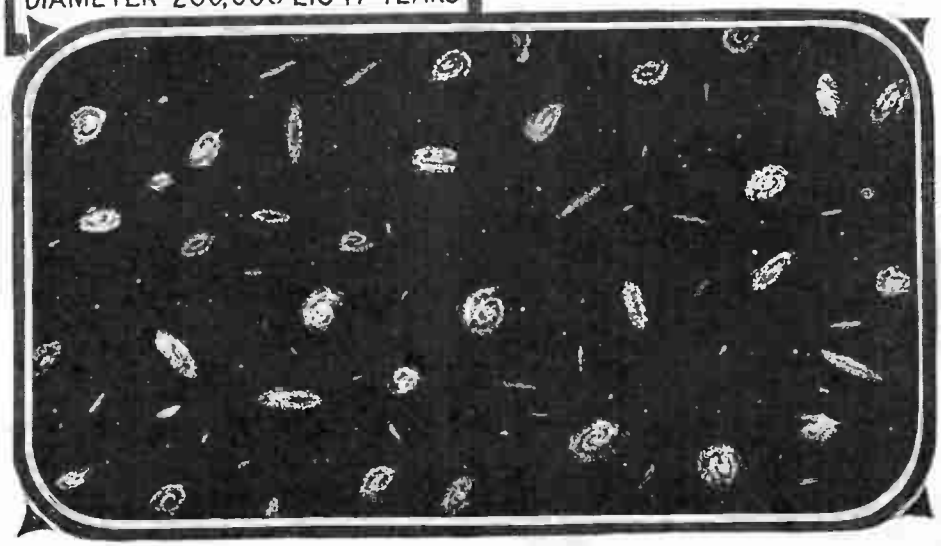
The difference in the apparent shape of various nebulae is due to the angle from which they are viewed. This is clearly illustrated in the above diagram.



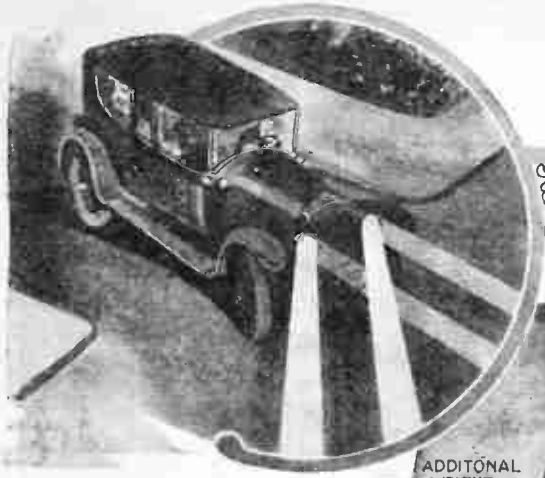


METHODS of measurement have indicated that the size of various nebulae is enormous. However, we still do not know exactly what is the form and composition of the brilliant central portion. Dr. Hubble reports that the one hundred-inch Mt. Wilson telescope has resolved the edges of the nebula of Andromeda into countless stars. This result should appeal greatly to the imagination as each new discovery of the astronomers belittles man still more as our universe expands with our understanding. The Milky Way, but one of the thousands of universes which fill space, is indicated in the central illustration. Space is here represented as filled with countless numbers of nebulae, many of which cannot be seen by telescopes because they are obscured by the Milky Way. Another view of space is shown at the right. Here the Milky Way is illustrated as a spiral nebula in the center, but it is by no means certain that it is a true spiral. It is true that we believe that our Galaxy is about the largest object existing, but it is beyond our powers of comprehension even to appreciate the size of the smaller spiral nebulae, at whose distance our own sun would be invisible even to the most powerful telescopes.

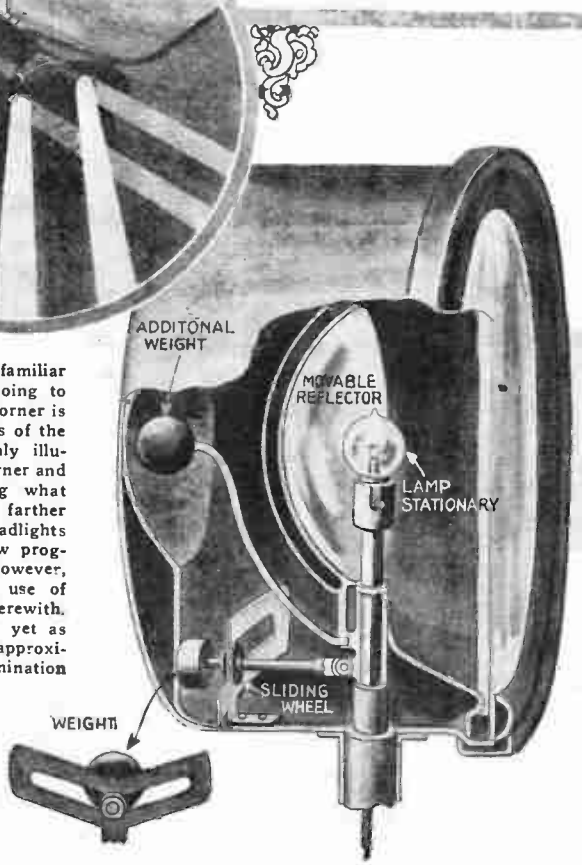
We are left with a mental picture of a universe not filled with stars, but with spiral nebulae, whose composition we are not sure of, at inconceivable distances from us and from each other.

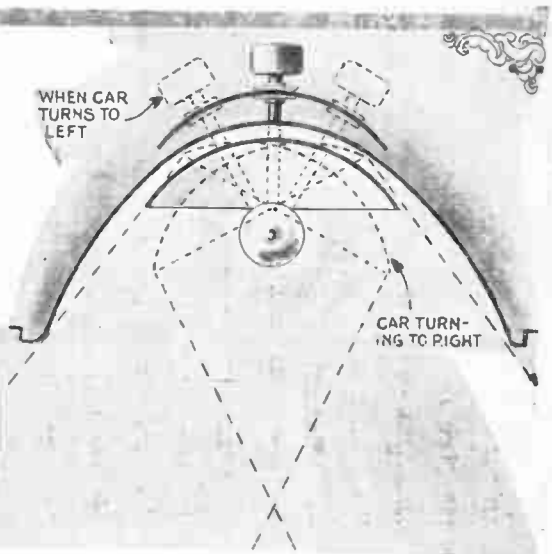


Movable Headlights



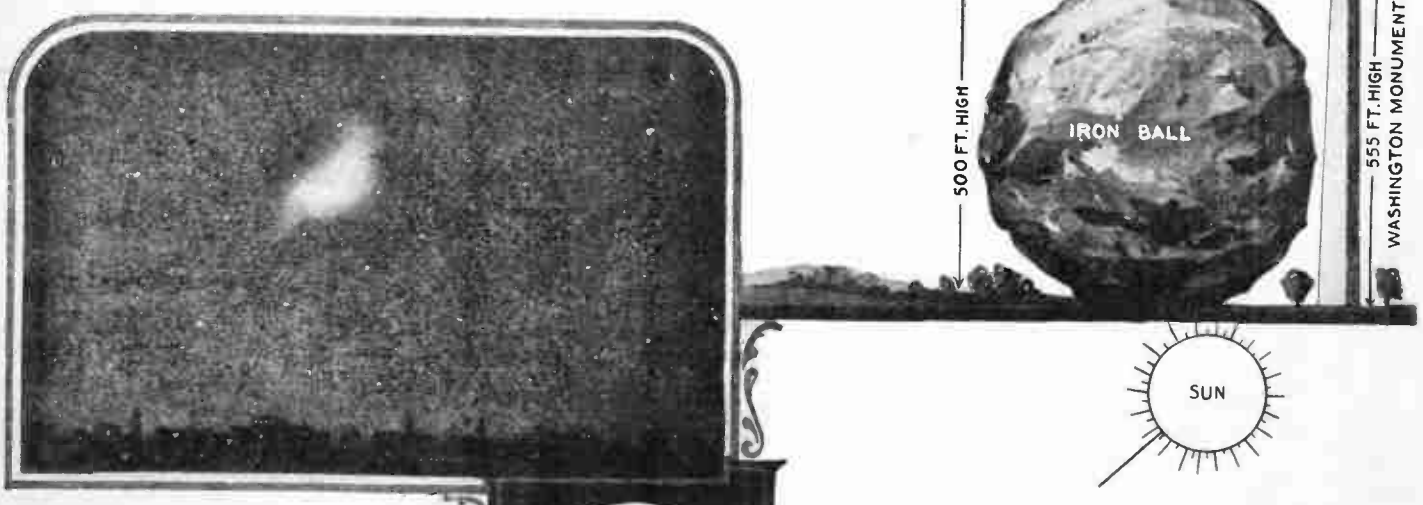
When traveling on dark and unfamiliar roads, the problem of what is going to be encountered just around the corner is often a serious one for the nerves of the driver. Ordinary headlights only illuminate a small portion of the corner and prevent the driver from seeing what condition the road is in a little farther on. The use of stationary headlights often necessitates extremely slow progress in order to insure safety. However, this problem is solved by the use of headlights such as illustrated herewith. They are entirely self-contained, yet as a car starts to turn a corner, approximately two-thirds of the illumination shifts so as to light the road around the corner, whereas one-third pursues the course of ordinary headlights.

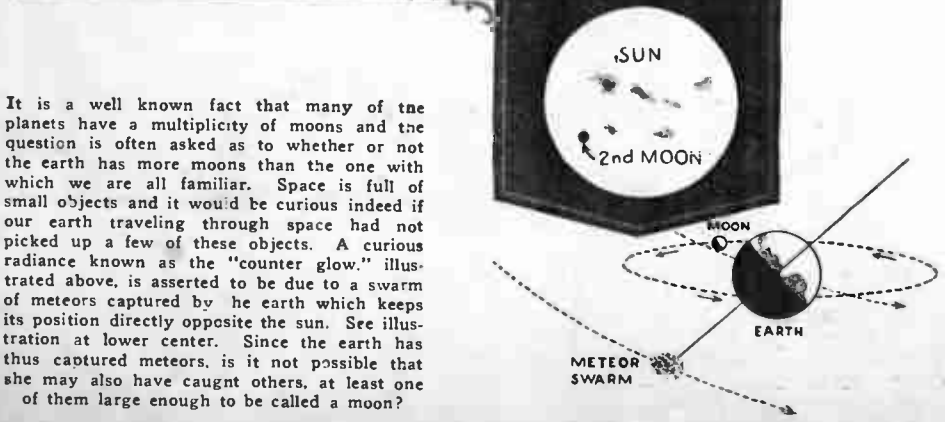




THE headlights illustrated herewith contain a movable reflector which is swung to the right or left as the car turns by the inertia of the weights illustrated and which serves to direct the beams of the headlights around the corner. The stationary part of the reflector provides partial light straight ahead. Since the sliding wheel as at the left operates along an inclined path, the movable reflector immediately returns to its central position by gravity as soon as the rotary action of the car ceases, as when the front wheels are straightened out. This device has been proved to be absolutely dependable and positive in operation.—H. W. S.

Has the Earth Two Moons?



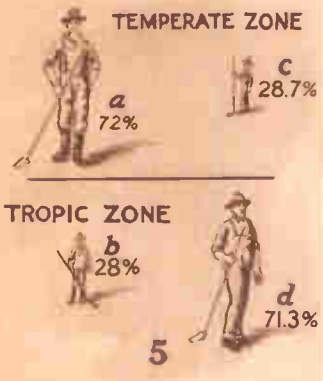


It is a well known fact that many of the planets have a multiplicity of moons and the question is often asked as to whether or not the earth has more moons than the one with which we are all familiar. Space is full of small objects and it would be curious indeed if our earth traveling through space had not picked up a few of these objects. A curious radiance known as the "counter glow," illustrated above, is asserted to be due to a swarm of meteors captured by the earth which keeps its position directly opposite the sun. See illustration at lower center. Since the earth has thus captured meteors, is it not possible that she may also have caught others, at least one of them large enough to be called a moon?

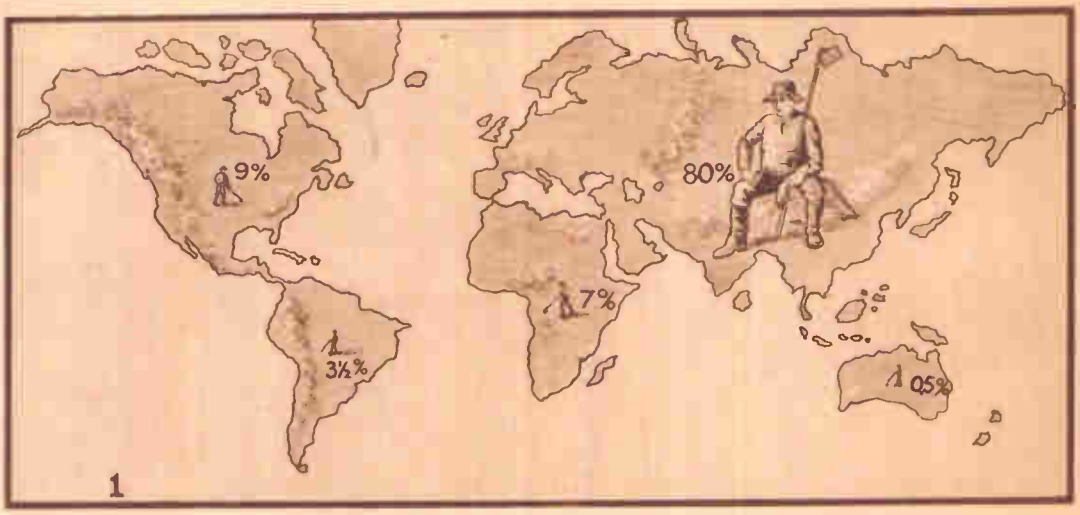
Recent unauthorized dispatches have stated that a "moon" exists about 2,500 miles from the earth's surface. Such a meteor, if entirely of iron and weighing 15 million tons, as the dispatches have stated, would be 500 feet in diameter. See illustration above. Such a phenomenon is impossible. A few elementary calculations prove conclusively that no second moon of the size indicated can exist. Such an object would be quickly detected in its passage across the sun, its comparative size being indicated in the illustration at the left. Furthermore, such a moon when full would be about two and one-half times as bright as Venus at her brightest and could never have been missed by astronomers in past decades. Even an object only ten feet in diameter and 2,500 miles from the earth would soon be detected.—By Don Home.

Is the World Facing Famine?

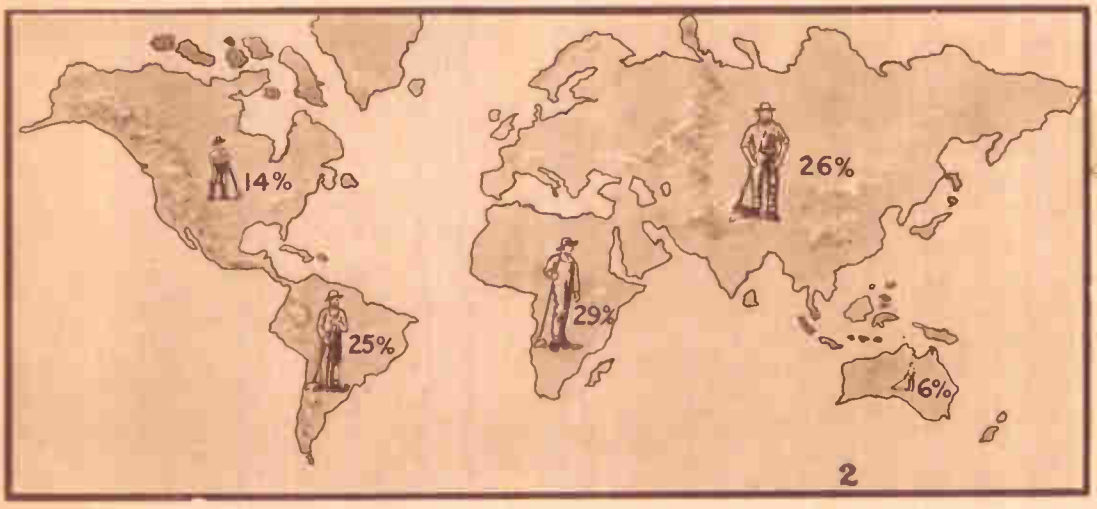
By PROFS. STELZER and VICTOR HOEFERT



Today 72% of the world's population is concentrated in the temperate zones and only 28% in the tropics as indicated above at A and B, whereas according to relative fertility the tropics should support 71.3% and the temperate zone 28.7%, C and D above.



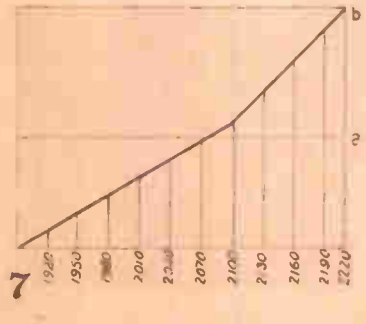
The distribution of the world's population by percentage is shown graphically above. With this population increasing at a rate of nine million persons per year, it is estimated that in three hundred years the entire earth will hardly be able to feed its inhabitants, according to the standards of living today.



If the population of this world were distributed over the surface today in accordance with the fertility of the land the result would be a distribution such as illustrated in Fig. 2 above. Compare this with Fig. 1.

If, with the present day population, the surface of the earth were divided evenly among the people, each person could claim a lot 176 feet square, while in 300 years, considering the present rate of increase, each person will have to be content with only fifty by forty-nine feet. Even with scientific farming the food problem will become serious.

The temperate zones are fast reaching a saturation point in population and it is estimated that in 150 years they will have to send superfluous inhabitants to the tropics or import practically all foods therefrom.



The gradual increase in population is shown by graph above. A indicates the saturation point of the temperate zones, and B of the world.

One source of food supply that has not as yet been carefully developed is the land of the tropical aborigine when left to his own resources. Illustrations 3 and 4 above show the production of the savage when left to himself, as compared with the quantity of food produced by the same land when under white domination and scientific farming.

The Living Death

By JOHN MARTIN LEAHY

Then suddenly, as Captain Livingstone had done, we stepped, one after another, out of the fog as through a curtain, and there were the Gardens of Paradise!

CHAPTER XXV

EIGHTH INSTALLMENT

THE HEAD

AH-CONE-CAWN-GA! Much speculation was elicited by that word—or words. What had the Antarctican tried to tell us? *Ah-cone-cawn-ga!* What did it mean? Was it a thing, a place, a human being, or what was it? Well, wondering about it could never give us the answer; nevertheless we kept wondering and wondering.

"There is one thing that I can't help regarding as significant," I told them. "I can't say, though, that it makes the thing any clearer. In fact, it makes it more mysterious than ever."

"I think," Darwin Frontenac observed, "I know what you mean. The last time he spoke that word (or words) he pointed towards the harpy: you think, Bond, that *Ah-cone-cawn-ga has something* to do with *that* up there?"

"It seems to me that the suggestion is not altogether a fanciful one."

"Same here, McQuestion," concurred Nunatak. "What did he point towards that awful figger for?"

But Darwin Frontenac shook his head in marked dissent.

"There is, of course, no use guessing what he meant to tell us; but we can regard it as almost certain, it seems to me, that, whatever it was, it had no connection at all with that harpy. Why, he had never even set eyes on that thing!"

"Just the same he might have known when he saw it. This may not be the only one."

"I don't believe," Frontenac answered, "that the poor devil even knew what he was pointing at, that he saw the monster at all—even when he was looking at it."

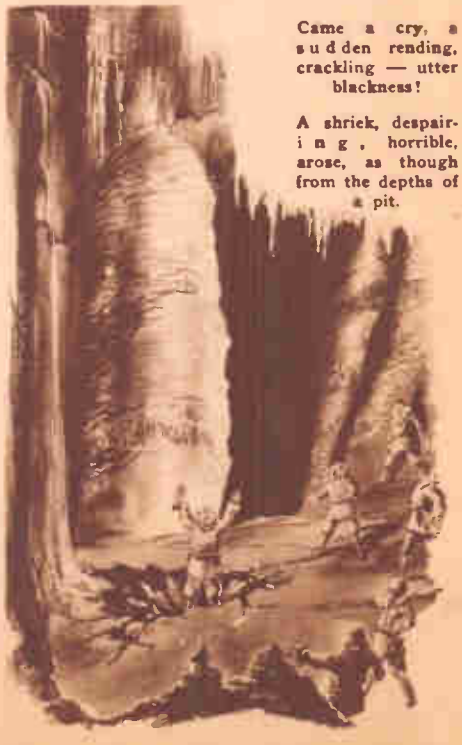
I admitted that this might have been the case—which, however, was by no means tantamount to saying that I believed it had indeed been so.

In this mysterious business, only one thing was incontrovertible, and this was that the man had come from the Gardens of Paradise. It was possible, probable perhaps, that he had not come from that part seen by Captain Livingstone; but that the man had come to this awful spot from some part of that wonderful valley was so clear that no man of us, for one moment, entertained the slightest doubt on that point.

Here, then, was another route into Paradise. No thermometer here in these underground ways dancing a minus jig, doing the can-can, or taking a snooze at 30° or 40° below. No glaring white here to blind you; no pressure-waves or pressure-ridges to cross or go around; no terrible sastrugi; no crevasses hundreds of feet in depth and treacherously concealed by a film drawn from edge to edge.

These thoughts, however, did not throw me into a transport of joy. The fact is the more I considered the possibility thus so suddenly presented, the greater became my uneasiness.

The absence of the things mentioned above (and others) was, of course, simply wonderful by way of contrast; but, on the other hand, my imagination (and I do not think that I am in any sense a very imaginative man) had not the least difficulty in picturing things in this subterranean place that would positively make me long to hug a sastrugus, and shed tears of joy at the very thought of a crevasse.



Came a cry, a sudden rending, crackling — utter blackness!

A shriek, despairing, horrible, arose, as though from the depths of a pit.

SYNOPSIS.

Captain Livingstone, an Antarctic explorer, communicates with Darwin Frontenac, a famous scientist who has conducted research work involving methods of inducing hibernations in mammals. To Frontenac and Bond McQuestion, a reporter, the Captain recounts a weird tale of discoveries in the Antarctic. He tells how a land of palm trees and luxurious flowers was found far south of the Antarctic circle and how during part of their exploration trip, several of the members of the party were killed by an invisible "Thing." During further explorations, a cave was discovered and in the ice coated floor they found encased the body of a beautiful girl. The Captain formed the opinion that this girl was not dead, but was in a state of suspended animation. Proceeding further into the cave the explorers discovered a sealed stone doorway guarded by a tremendous carved figure of a harpie. On the way back the only remaining member of the party, with the exception of the Captain, fell into a crevasse, followed by his sled carrying on it photographic records of the trip.

The story so interests Frontenac and McQuestion that they decide to accompany the Captain on a return trip. They take with them 102 dogs which are artificially "killed" by Frontenac and placed in a refrigerator on board ship. After they become encased in the ice as far south as they can go, the Captain, while walking over the surface of the ice is suddenly attacked by a killer whale that breaks through the ice and kills him.

Just before establishing their depot on land, the dogs are reanimated with no disastrous effects from their long "hibernation."

After the long Antarctic night, spent in preparations, the party finally sets out for the cave. They find it and the beautiful girl encased in the floor as told by the Captain. Using twine as a return guide, the party proceeds into the cavern and finds the stone doorway. At this time a noise is heard and suddenly there staggers out of the darkness a horribly emaciated man, naked except for a loin cloth, carrying at his side a skin sack of water. He collapses, then somewhat revives and points at the figure of the harpie carved above the doorway, muttering the word "Ah-cone-cawn-ga." With that he again collapses and dies.

To endeavor to get into the Gardens of Paradise by this subterranean route! Suppose we should find this wonderful idea regarded with favor by Darwin Frontenac? Well, I certainly hoped that we shouldn't.

We photographed ourselves, the door, the monster on guard above it and the dead man, whom we at last carried off and lay in a vault in the cavern wall. We had removed the water-bag and his belt. There was a beautiful sheath attached to the belt; the weapon, however, had been lost. So we laid him down there in that tomb chamber which Nature herself had hollowed out of the crinoidal limestone rock—a tomb noble enough for any earthly potentate; and there we left him—the mummified body or the white bones to startle, perhaps, some future explorer and touch his proud, brave heart with the sad lesson of mortality's glittering dreams and the fearful end that awaits it.

I believe I have forgotten to mention that, at this point where the door is situated, the great gallery makes a sharp turn to the right. It was from this direction that the Antarctican had come to us. This reminds me, too, by the way, that Nunatak expressed the belief that he actually had heard a voice that time at the entrance we others, however, were of the opinion that the musher had certainly been deceived.

We now quitted the spot, moving in that direction whence the Antarctican had come. Twenty minutes or so elapsed, and then Addison announced that all the string was reeled off the spool. This meant that, since quitting the door, we had advanced half a mile.

There had been no noteworthy change in the form of the cavern. On we went, leaving marks to guide us in our return. We could not dream of trusting to our footprints, for half of the time there weren't any; there were long distances where not the faintest impression remained on the hard floor to mark our passage across it.

Another twenty minutes passed, and then there was a change. We had seen but few stalactitic or stalagmitic formations, and these only small ones; but now we suddenly entered a grotto, the beauties and marvels of which were such as to surpass any description that I could ever pen—or, indeed, any other man.

In all directions, stalactites were hanging, some of them as slender and symmetrical as the masts of a noble ship. In many places stalactite had met stalagmite, forming pillars—some of them thirty feet in diameter—of a beauty that the human hand never has fashioned. There was a group of columns that gave forth a musical sound when struck sharply by the hand, and upon these, after some practice, Frontenac actually succeeding in playing *Yankee Doodle*. The wonders of the place had, apparently, not suffered the slightest change during all those ages since the cessation of the sinter-bearing water-drip which had formed them.

I have said that this was a grotto, but it was, in fact, a perfect labyrinth of grottoes. So entranced were we by the beauties and marvels of the place that we clean forgot to leave marks to guide us back. When we remembered, it was to discover that we were lost.

Lost! We made light of it; but I am convinced that, in his secret heart, the discovery was an alarming one to every man. I know that it was so in my case. Visions of a fate similar to that which had befallen the Antarctican began to flicker and flash before my eyes; and, when three whole hours had passed and our extrication from this most wonderful but most fearful place was apparently as remote as ever, I began to curse that very moment when we had advanced beyond the harpy and the door.

Another hour passed—an hour such as I do not wish ever to go through again—and then suddenly, on our emerging from a long winding gallery, a loud shout went up, to be echoed and reechoed from the lofty walls. No marvel that we shouted, for we found ourselves approaching that very spot in which we had deposited the spool!

. . . . . was laughing and dancing, his tall form and lean features presenting a strange, eerie, maniacal appearance in the expiring light of the match.

In our advance, we had not noticed the mouth of this gallery to which we owed our escape from that maze of caverns and grottoes. Little wonder, though, that we had not seen that entrance. Forsooth, almost as much must have been missed as had been seen.

The experience had certainly been an unpleasant one; but, now that we stood safe, I was very glad indeed that we had got lost. For now we knew what it would mean to attempt the attainment of the Gardens of Paradise by these underground ways. What with this pleasant cogitation, I was constrained to remark that this subterranean route to Paradise would, I supposed, be very fine—if one could only find it; but that I preferred the sastrugi and the crevasses. This elicited from Frontenac a wan smile and a response to the effect that we had no one to blame but ourselves for what had befallen us—that, if we had only left marks, there would never have been a moment's uncertainty as to our position.

"Alas," thought I, "of what use is experience if a man will not profit by it?"

It was midnight when we stood again at the entrance, in the biting cold. A sound, mournful, fiercely sad, filled the air; the dogs were having a concert—old Ole Bull no doubt, as usual, leading. Strange, mysterious creatures! Why do they raise their voices thus, in a lament so weirdly sad and so fearful? There, in that lugubrious, savage howling, is encompassed, it seems, the sorrow and the travail of life, and the horror and the mystery that wait upon its end. Mysterious beings! Have they knowledge of cosmic arcana that even man never has glimpsed—or, having glimpsed, has only builded upon them cobwebby castles in the halls of which he finds himself entangled as some weak insect caught in the web of the spider; or sunless, horrible dungeons in which his soul wallows in cold obstruction and in foul despair?

The sun was low behind the southern mountains. His declination was now about 8° south, and so, if the apparent horizon had been coincident with the sensible—in other words, if the place had been an extensive plain—we should have had the sun, at this midnight hour, some three degrees above the skyline.

The air was without the slightest movement. The sky was clear, fleecy clouds hanging motionless in the blue immensity that arched over us. In the south, the sun turned the blue of the heavens—almost an azure—to amethyst and chrysoprase, primrose, gold and scarlet. The mountains were involved in deep violet shadows, here and there a peak burning with blood-red fire. It was a strange and wonderful scene; beautiful, in a way a terrible one, too.

Frontenac, as we made our way campward over the sastrugi of the glacier, was blind to all this beauty of sky and savage landscape. Sleeping Beauty's Cavern, its marvels and mysteries—it was of these that Frontenac was thinking.

"As for its physical properties, there are two things, Bond," said he, "that strike me as very remarkable. One is the high temperature of the cavern—51° Fahrenheit at the door—the other that there is only the gentlest indraught of air at the entrance.

"Why should there be a hurricane there?"

"A little reflection upon the phenomena presented by the equilibrium and the motion of elastic fluids," said he, "will show that there ought to be a very strong indraught."

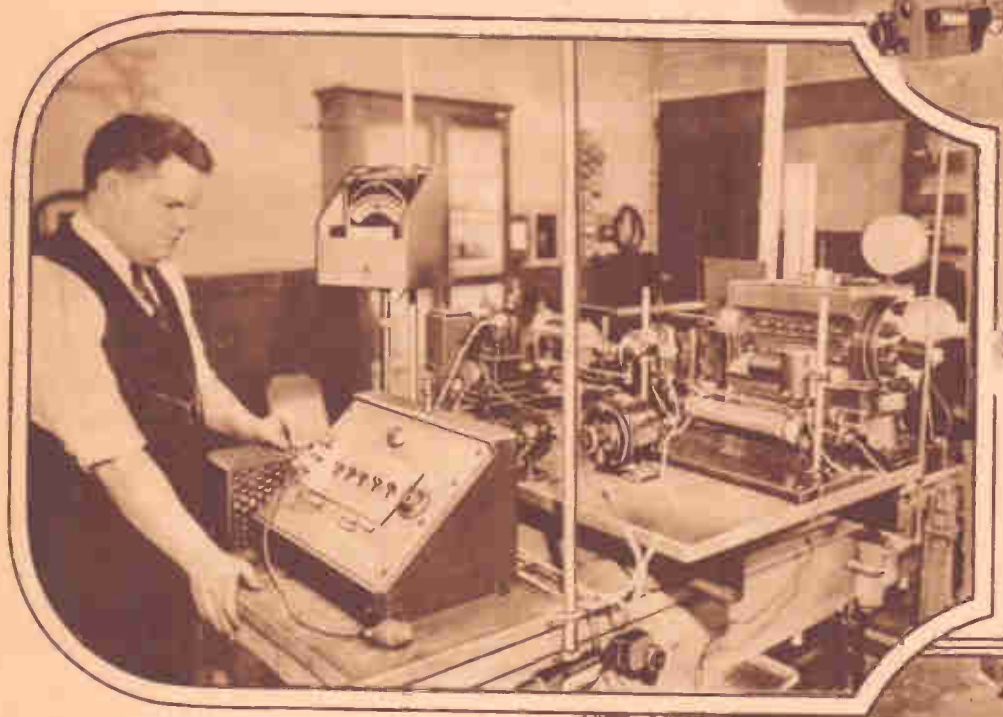
"But there isn't," was my sage observation.

(*Continued on page* 82)

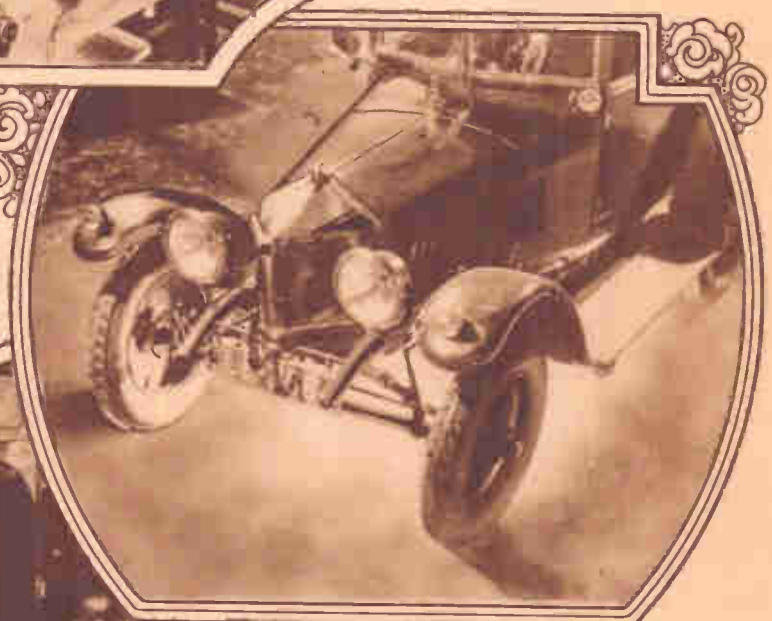
"And look at that!" exclaimed Frontenac, pointing to the next column. "There is another one!"

Automotive Novelties

A version of the motopeller made popular by SCIENCE AND INVENTION recently appeared on the grand skating rink at St. Moritz. Photograph above shows Miss Zoe Hall handling the device. A 1½ horsepower motor of special design is said to drive the device over the ice at express speed. The propeller at the rear of the device is enclosed in a housing of metal screening so as to prevent injury in case of accident.



What automobile owner and driver has not known the annoyance of a knock that cannot be traced to any of the ordinary sources? A stroboscope, manufactured in England, is now in use in the engineering laboratory of the University of Illinois and the cause of mysterious knocks may soon be determined. By means of the device it is hoped that records can be made on motion picture film which will aid in research work on internal combustion engines and lead to a better understanding of them and their troubles.

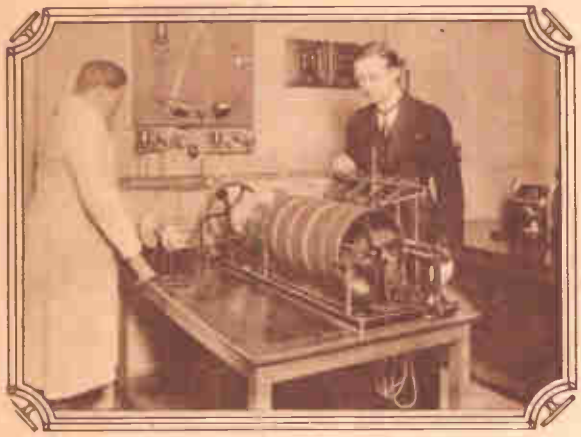


A new system of anti-glare motor car lighting has been devised by an English inventor, A. Kelway Ramber, and is said to be most effective. The device consists of five lenses placed under the body of the car through which the strong rays of a lamp are directed which light serves to illuminate the ground under and around the car, throwing it into relief.

Probably the greatest bug-bear of night driving with automotive vehicles is the danger encountered when approaching an oncoming car equipped with lights which dazzle and tend to temporarily blind the driver. Many accidents can be traced to this source. The two cars may crash together with disastrous results while at other times the partially blinded driver may steer to the side of the road and often drive into a ditch or fence, wrecking his own machine. A great many special lights and accessories for ordinary headlamps have been designed and tested. Some are effective, whereas others are total failures. Very often the great cost of a device of this nature is its chief drawback. As long as headlights are necessary for road illumination as well as for showing the presence of a car, there will be dazzling lights on the highways. One step forward is the system illustrated at the left and above. When approaching an oncoming car, the headlights can be turned off and those lights under the car will throw the body into plain relief so that the approaching driver can avoid it easily. On dark roads the headlights are turned on as usual.

Testing Motormen

By OUR PARIS CORRESPONDENT



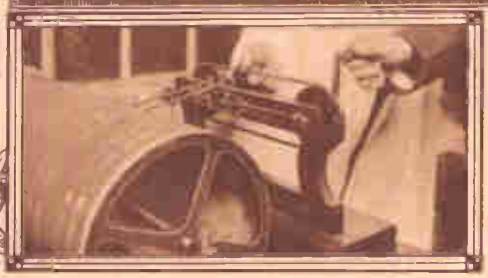
A new laboratory has recently opened in Paris, France, under the auspices of some of the distinguished members of the Government, the purpose and object of which is to test the qualities of prospective workers in various technical lines, in order to determine their adaptability for work requiring quick thought, good vision, and perfect control over operations of the hands and eyes. Our illustrations herewith show the main apparatus and testing machines which have been installed in this laboratory. In all cases the subject under examination is placed in contact with the apparatus designed to ascertain his ability for holding a certain type of position and various absolute measurements are taken.

The photo directly above shows the chart room in which the registering apparatus for various tests is installed. Charts, curves or graphs are obtained for the many varieties of tests and observations to be made. A cylindrical recording device is being inspected.

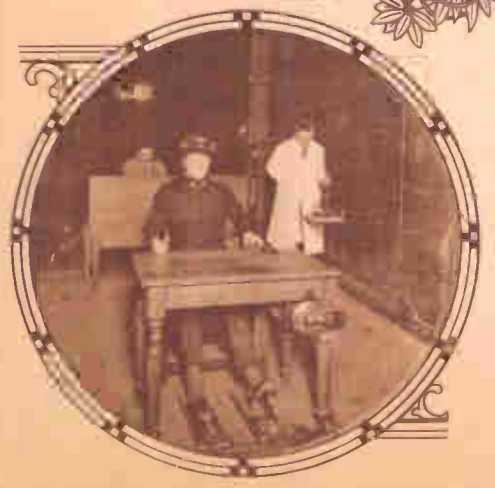
When a subject is to be examined for the position of a motorman on a trolley car, where quickness of thought and instant determination are an important factor, he is placed in a realistic reproduction of the front end of such a car as illustrated above. An observer seated directly to the rear records all movements and reactions.

At the right is shown a photograph of a subject under examination being tested for fatigue by the Harvey dynamograph. A certain operation is performed by the subject a number of times. Soon fatigue asserts itself and the efforts of the subject become weaker and weaker. The time required for reduction of speed or strength is recorded and charted.

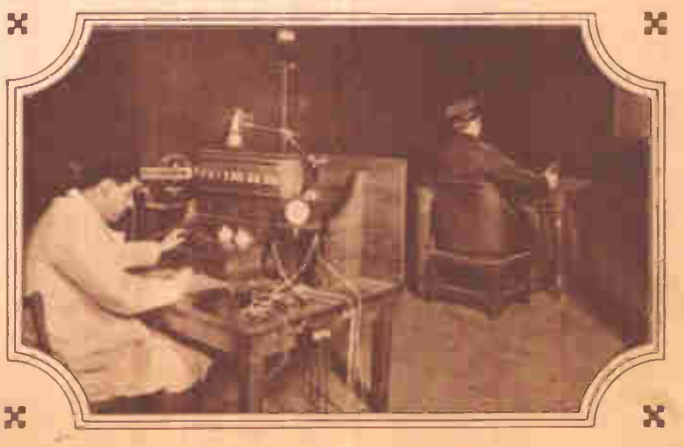
Below: Speed and distance are measured on the instrument illustrated. Notice the very fine scale and the two small pointers operating along it on the top of the apparatus. Using this device, the speed and accuracy of various movements of a certain subject can be quickly measured and compared with a standard.



At the extreme left is shown another test for motormen. Here the driver is placed on a platform and a motion picture projected on a screen in front of him detailing the incidents along a route. The candidate's reactions to the various illustrations are noted. The photo at the left shows the Benet oscillograph for measuring the speed of motor nerve impulses in the hand and arm.



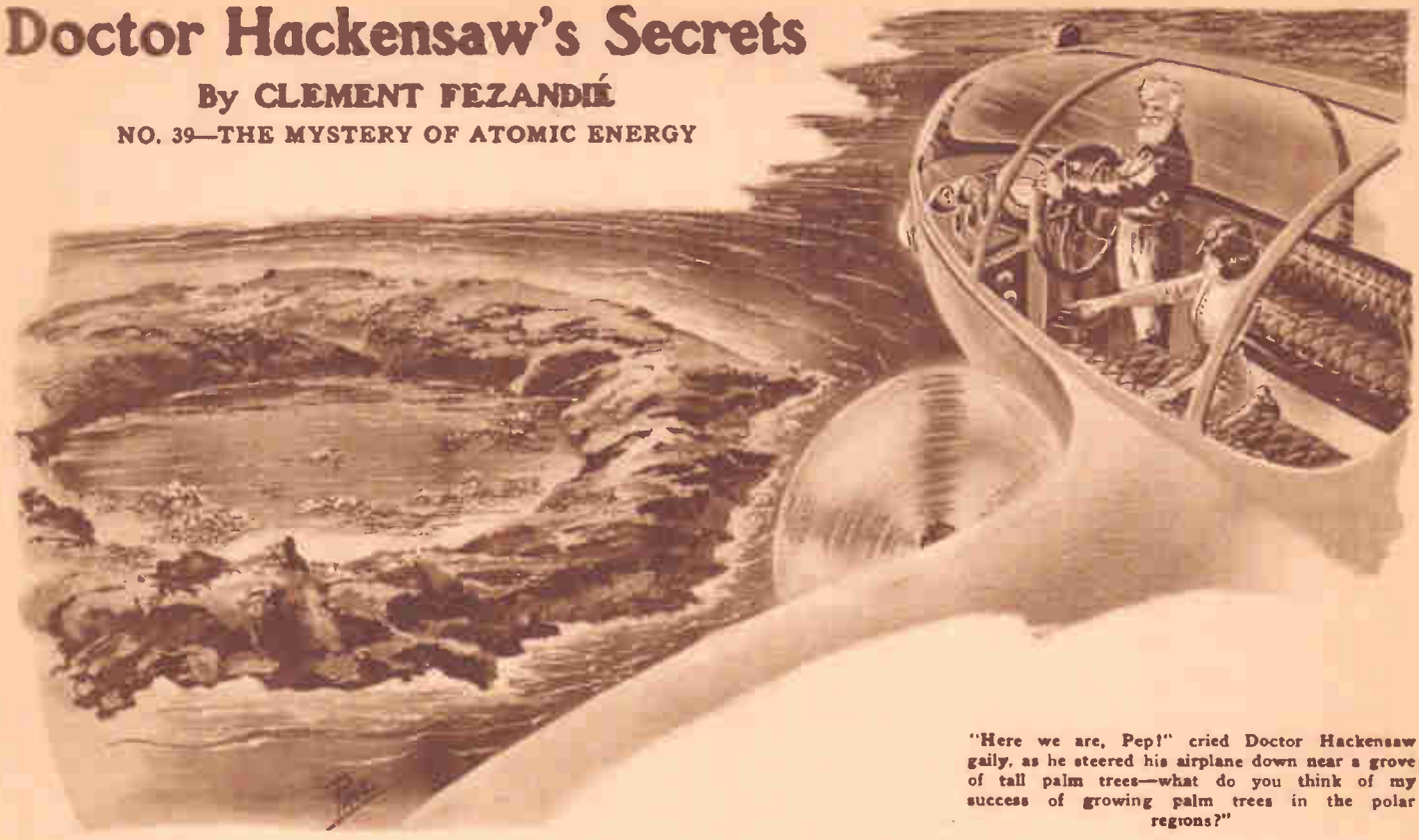
The reflexes of an automobile or 'bus driver are tested by psycho-galvanic apparatus as illustrated at the left. The response of the candidate to various suggestions is recorded and measured. The rear of the observation board connected to the device illustrated at the left is shown at the right. The observer has instruments directly in front of him which indicate and accurately measure movements of the subject.



Doctor Hackensaw's Secrets

By CLEMENT FEZANDIÉ

NO. 39—THE MYSTERY OF ATOMIC ENERGY



"Here we are, Pep!" cried Doctor Hackensaw gaily, as he steered his airplane down near a grove of tall palm trees—what do you think of my success of growing palm trees in the polar regions?"

(*Extract from Frederick Soddy's Book, "Interpretation of Radium:—*

"The discovery of radium has led to new conceptions of our ideas of matter. The old philosophers had already conceived the idea that the atoms of a body formed planetary systems of their own. But the knowledge that a cobblestone contains sufficient energy to blow up an entire city is a modern concept. Physicists now are endeavoring to find means of utilizing this latent energy. Let us hope they will not find it until mankind can be trusted to make proper use of the tremendous powers stored up all around us.)

"PEP!" cried Doctor Hackensaw, jubilantly, "I have found it."

"What have you found now?" asked Miss Pepita Perkins, lazily looking up from the novel she was reading.

"I've just made one of the greatest inventions that has ever been made!"

"It seems to me I've heard you say that before. Every one of your inventions seems to be the greatest ever made."

Doctor Hackensaw laughed. "Yes," he assented, "I suppose it's the same with an inventor as with a mother—her last baby always seems to her to be the finest."

"Well, what is it that you've invented this time?"

"I've discovered the means of releasing atomic energy!"

Pep looked blank. "What's that?" she asked.

"Good gracious! Haven't you ever heard of atomic energy? Then perhaps I'd better explain from the beginning so that you will understand things clearly. To begin with it has long been known that certain substances possessed a store of latent energy which they could release under given conditions. A lump of coal, for instance, seems inert, yet when we set fire to it it can give forth power enough to run our railroads and our steamships. But it was only with the discovery of radium that we began to understand that every substance possesses a tremendous amount of this latent power. If we only knew how, we could get far more work out of the cobblestone than we can at present out of a lump of coal of the same size. Both seem equally inert and harmless, but the power resides there just the same. Uranium disintegrates very slowly into radium, and radium disintegrates into lead, and in the transformation a large amount of energy is set free. Here the disintegration occurs naturally; we know of no means of hastening or retarding it. Now scientists are certain that any element in disintegrating into a lower one must likewise give out energy, and it is believed that the disintegration, like that of uranium is very slow—so slow as to be imperceptible. The thing to find was means to hasten it. If a log of wood is allowed to decay, it give out as much heat in the process as it would if burnt, but the decomposition requires years instead of hours. To get the heat or energy immediately, we must set fire to the log. In the same way, to get the energy from the coal we must start the disintegration by setting fire to the coal. Once lighted, a coal fire can keep itself up indefinitely—it needs merely to be started. The same must be true in getting atomic energy from stone. All we need is to find means of starting the disintegration—of kindling the atomic fire, so to speak. Once started, the disintegration itself will release enough heat to continue the process. It is this that I have discovered—the means of starting the molecules and atomic disintegration in stones, or more properly speaking in sand, for I found the stones were too large and too dangerous to handle. Sand is much easier to work with and can easily be obtained anywhere."

"Whew!" exclaimed Pep—

"For a long time I hesitated as to whether to make my discovery public or not. Mankind's moral progress is so slow compared to his scientific progress that it is dangerous to put too much power in his hands. Our

Pep could scarce believe her eyes. Here was a real tropical landscape with dates, bananas, oranges and cocoanuts.

new inventions the steamship, automobile and airplane are all utilized as war machines for killing off other men, and all new explosives are used as much for war purposes as for digging canals and other useful work. To give mankind the secret of atomic energy, by means of which a wheelbarrow full of sand would suffice to blow up all New York City, would be like putting a razor or a bomb-shell in the hands of a two-year-old baby. He would be almost certain to kill himself and would very likely do great damage to others. Hence I have kept my invention very quiet so far, but meanwhile I have quietly made arrangements for utilizing their energy for a number of different purposes that I think will result in immense benefit to mankind—I have chosen men whom I knew I could trust to act as my agents, and to none of them have I confided the real secret—the method of starting the disintegration, nor the equally important method of stopping it—or rather of limiting its ravages; for so far I have no means of stopping it:—I can only isolate the portion that is burning and let it go out of itself when the disintegration is complete.

"I use the term *burning* you understand, because it is convenient, though the process has little analogy to real combustion save that it releases energy, and this energy may be turned into heat, light, sound or electricity the same as any other form of energy."

"How do you isolate it?" asked Pep.

"Ah, my lass, that was a hard problem to solve, but it had to be solved at the very start. Otherwise if I once started disintegrating a small amount of earth, the fire, if I may call it so, would spread to the surrounding earth, and stones, rocks and all would begin to disintegrate in their turn and the whole terrestrial globe would be consumed. It would be as if the earth were a ball of coal and a coal fire were started anywhere on its surface. The fire would spread and spread until the layer of ashes was thick enough to keep away the air and prevent further combustion. There are coal fires in mines that have gone on for years. But enough of this talk. I start to-morrow by airplane to visit some of my atomic energy enterprises, and if you wish to come along, I shall be glad to take you. Our first stop will be at my plantations at the South Pole. Here I started the sand burning some three months ago, so we ought to find some tangible results.

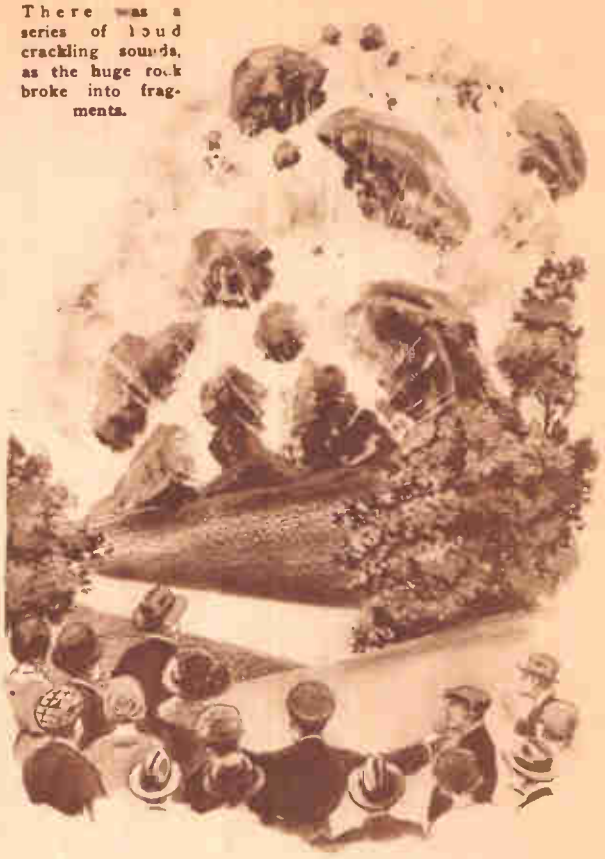
CHAPTER II—POLAR REGIONS MADE TROPICAL

"Here we are, Pep!" cried Doctor Hackensaw gaily, as he steered his airplane down near a grove of tall palm trees—what do you think of my success in growing palm trees in the polar region?"

Pep could scarcely believe her eyes. Here was a real tropical landscape with dates, bananas, oranges and cocoanuts growing, with prairies of grass and vegetables—and flowers of many varieties in full bloom, and yet circling it all—not five miles away—was the interminable field of polar ice.

"Gee!" she cried, "How did you ever do it, Doc!"

"Simply enough. All that is needed to change the poles into tropics is heat, and any form of energy can be transformed into heat. We are here on the Antarctic continent, and of course there is earth enough to furnish me all the atomic energy needed for thousands of years to come. Of course I brought with me a small amount of pulverized sand with which to start operations; for I had first to melt the field ice to get down to the solid earth. After that I could pulverize and screen the earth itself for my fuel. I use the word 'screen' just as I use the word 'fuel,' because the proper word does not yet exist. No screen made would powder my earth to the necessary degree of fineness. It is an almost impalpable dust that I need, in order to keep my atomic energy under control, and even this dust I must dilute with a great deal of inert gas or I would blow my engines to pieces."



There was a series of loud crackling sounds, as the huge rock broke into fragments.

"But didn't you tell me that you only started work here three months ago?"

"Yes."

"Yet here you have palm trees over fifty years old, growing and bearing fruit."

"Yes, Pep. I thought you knew that full-grown trees are nowadays transplanted as easily as small ones. Some genius discovered that successful transplantation depended on the number of roots preserved. So horticulturists nowadays spend years in preparing trees for transplanting. They cut back the roots of the growing tree, forcing new roots to sprout close to the tree. In a few years all the roots are in one clump close to the trunk instead of spreading out some two hundred feet in all directions. The full-grown tree with all its roots can then be transplanted with ease and a millionaire who builds himself a house in a desert can surround his mansion with a grove of secular trees in the course of a month instead of having to wait fifty years for them to grow. I found these trees ready prepared, and had a special airplane truck constructed to bring them here, as soon as my ground was ready to receive them.

"How do you like my antarctic farm? I have here all the productions of the tropics, of the temperate climes, and of the poles. I can have torrid summer weather here, and a five-mile ride will bring me to perpetual ice and snow where I can skate or sleigh-ride or hunt polar bears and seals at pleasure. My air here is at present almost free from germs—though of course it will not long continue so.

"When you've admired everything enough,

(*Continued on page* 74)

Doctor Hackensaw's joy was great to perceive that several vessels were already in the canal making their preliminary trip. "It won't be long," said he, "before a railroad, too, follows the line of the canal."

Sympathetic Inks

Their Preparation and Use

By A. N. MIRZAOFF

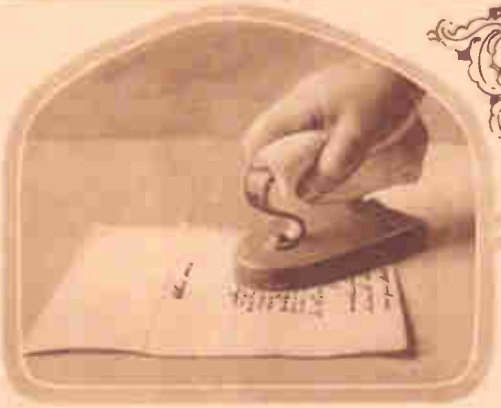
In the use of all sympathetic or so-called invisible inks, a gold pen or a steel pen that has never been used should be employed. Above is shown a secret (French) message written with bismuth nitrate or lead acetate being developed in a solution of a soluble sulphide or by sulphuretted hydrogen, either gaseous or in solution.

At the left we show a very common method of producing invisible writing. The juice of a bisected onion is used for the writing and is later developed by exposing the paper to heat.

If writing is traced with a very dilute solution of copper sulphate in water it will be invisible, but may be developed by exposing to the vapors of ordinary household ammonia.

In all cases where heat is necessary for the development of writing which has been performed with liquid which in itself is not visible, a warm flat iron may be pressed into service as illustrated at the right.

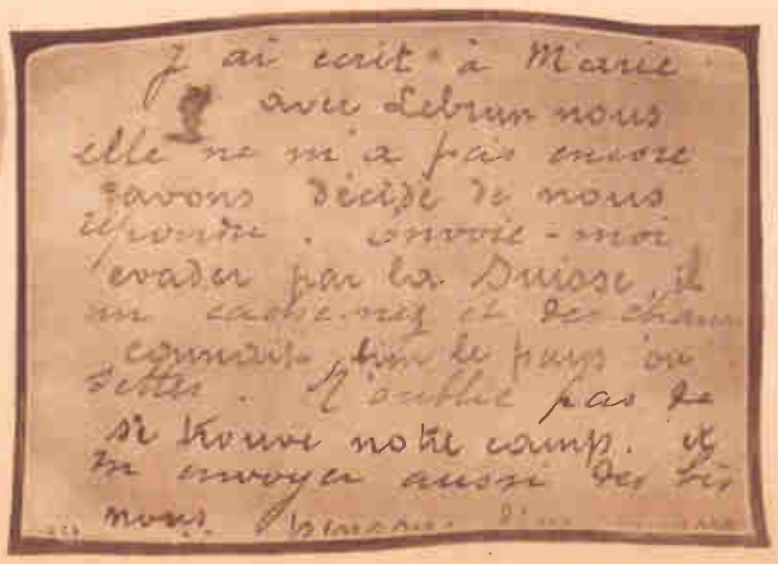
The oldest preparations employed for sympathetic inks are vegetable juices. These have now given place to numerous new ones developed by the science of chemistry. However, the juice of an onion or a lemon is still in favor for this procedure by those who do not care to go too deeply into the subject. The juice of a turnip is also useful and all of the above are developed by heat.



Certain mineral salts in very weak solutions may be used as sympathetic inks to be developed by heat. Among all of these, cobalt chloride or nitrate may be termed the classics.

Above: Treating copper sulphate writing with ammonia. Blotting paper is saturated with the ammonia solution and the paper upon which the writing is to appear is laid upon the blotter.

Another method of developing writing which requires the use of heat is shown above. The paper is held directly over the chimney of a kerosene lamp. The rising hot gases cause the writing to become visible.



The cobalt inks mentioned on another part of this page have invaded the field of literature, their most notable use being described by Edgar Allen Poe in his famous story, "The Gold Bug." Other inks not mentioned above are weak sulphuric acid to be developed by heat and two others, that are rather uncommon, described below. It is said that ammonia can be used and will develop by placing the writing for an hour on moist blotting paper. Writing done with nitrate of silver using a gold or glass pen in an almost dark room and enclosing in a light-proof envelope, will be visible on exposure to light. At the left we show a letter written by a French prisoner, every second line being written with sympathetic ink and constituting the real message.

Stereoscopic Movies

New System for Producing Relief Motion Pictures Using Ordinary Projection Apparatus.

MONSIEUR DENIETO DAPONTE INVENTOR OF THE "PULSOGRAPH PRINCIPLE" OF RELIEF MOVIES

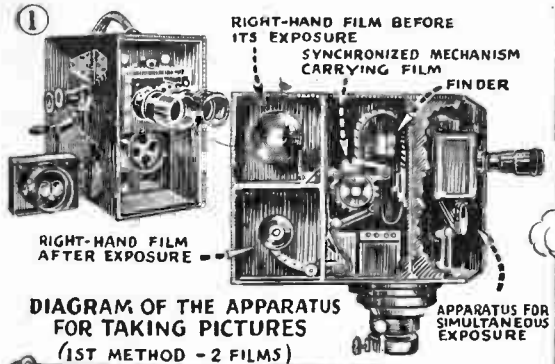
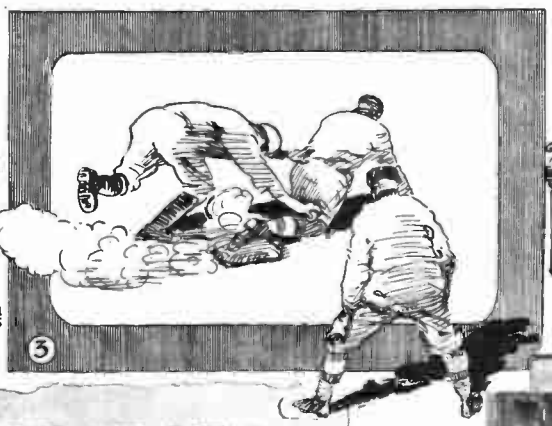
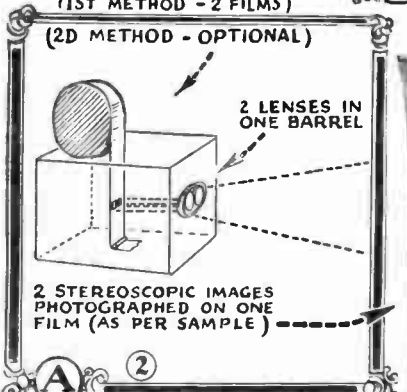
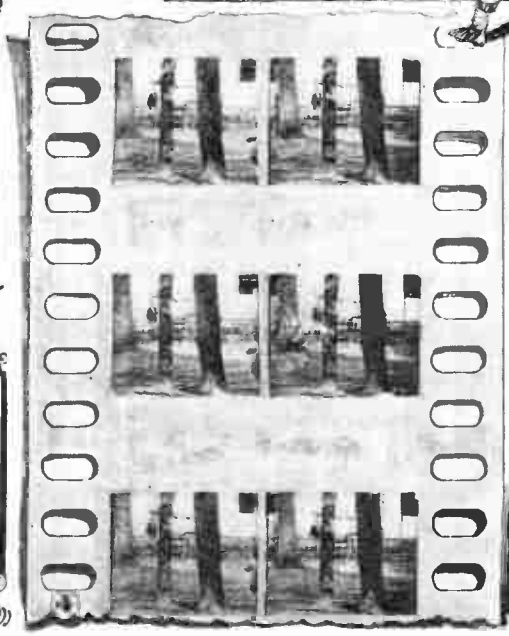


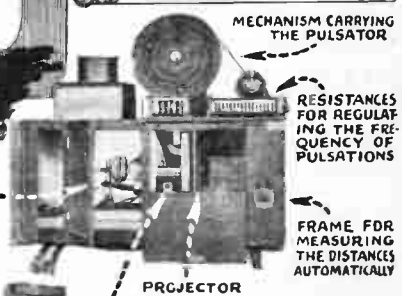
DIAGRAM OF THE APPARATUS FOR TAKING PICTURES (1ST METHOD - 2 FILMS)

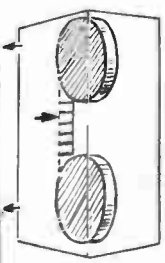




The mechanism for taking stereoscopic motion pictures on two separate films running side by side is illustrated in Fig. 1. Fig. 2 immediately above shows the taking of these pictures on but one strip of film also with two lenses. At the right is a positive print.



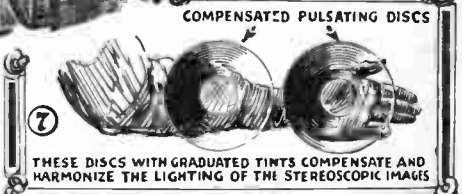


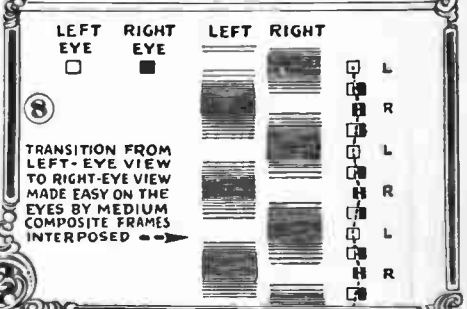


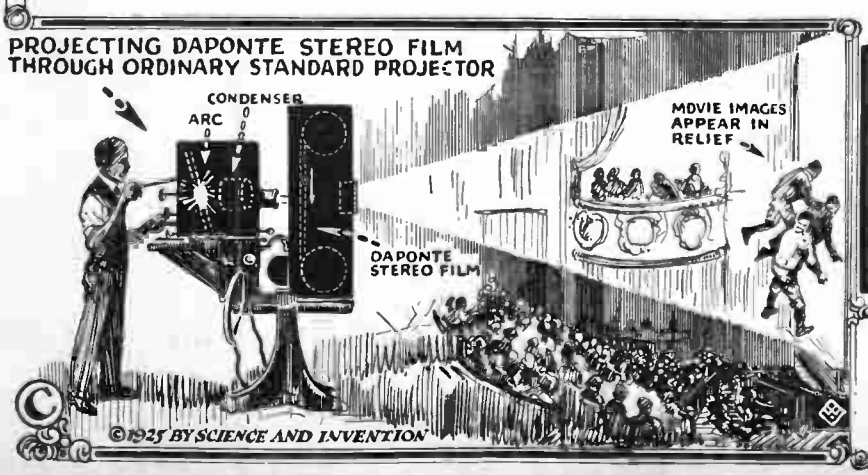
Above is the printing mechanism of the Daponte method of producing relief movies. This is again illustrated at the left.

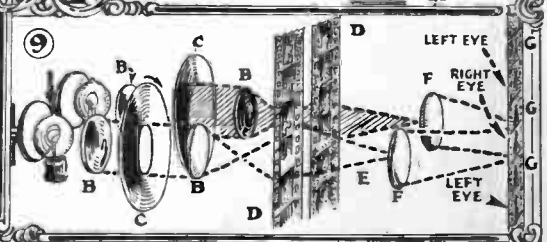
ORDINARY FILM PRINTER PUSHED UP IN FRONT OF DAPONTE PROJECTION APPARATUS AND SINGLE FRAME POSITIVE MADE.

A HIGHLY efficient method of producing stereoscopic moving pictures which appear to the audience as in illustration 3, is the invention of Monsieur Denieto Daponte. The negative is taken in duplicate in this system, there being two lenses set at certain definite distances apart, which distance is variable. As the camera is ground, both films are simultaneously exposed. These films after having been developed are then placed in a special printing apparatus shown at 5. Here there are two sources of light as illustrated at 9. The beams from the incandescent bulbs pass through condensers B, and then through compensated pulsating disks. These are round disks of glass which rotate. They are tinted in such a manner that when one disk is completely opaque, the other is transparent. It will, therefore, be seen that the transition of the scene takes place; first as it would be viewed through the left eye, and thereafter as it would be viewed through the right eye. This is clearly explained in the diagram at 8, and the pulsating disks are shown in Fig. 7. Immediately above in the center of the page there is a strip of film Fig. 4, which is a positive print from the negative in the second method of obtaining stereoscopic photographs but the two images are photographed on one film.









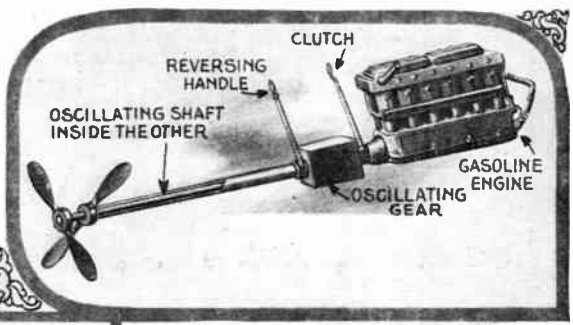
The diagram Fig. 9 illustrates how the images are made upon one single film to be used in the ordinary projection apparatus. When the intensity of light increases for the right eye, it decreases for the left eye.

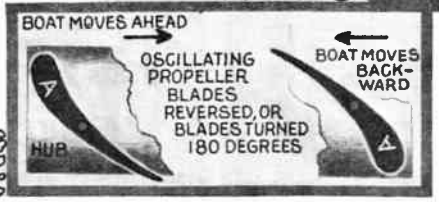
An Oscillating Propeller

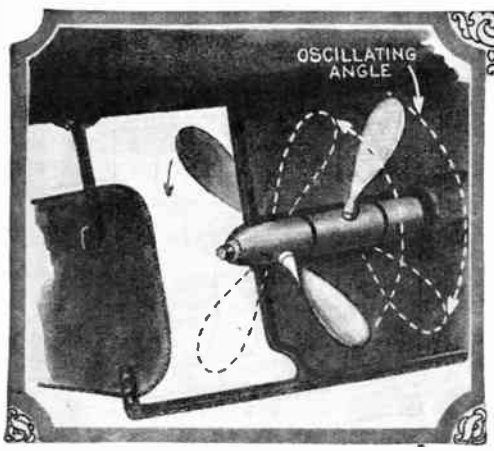
By RICHARD NEUMANN

The illustration above shows one of these new water craft, plainly denoting the position and appearance of the two oscillating propellers which are capable of not only propelling the boat forward, but also of operating it in a reverse direction.

Below will be seen a photograph of the power unit of this new boat utilizing two propellers which instead of revolving, oscillate back and forth with a predetermined synchronism. The controls are all located in a convenient position for the operator.

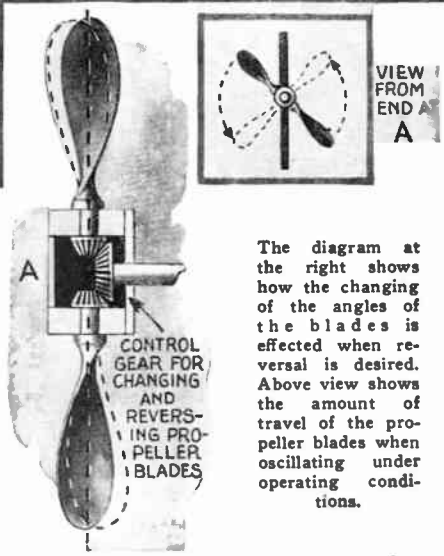






The movements of the two oscillating propellers when in action are indicated in the above diagram. In operation, the propellers are first at right angles to each other as shown in the solid lines, and then they proceed through 90 degrees to the dotted line position.

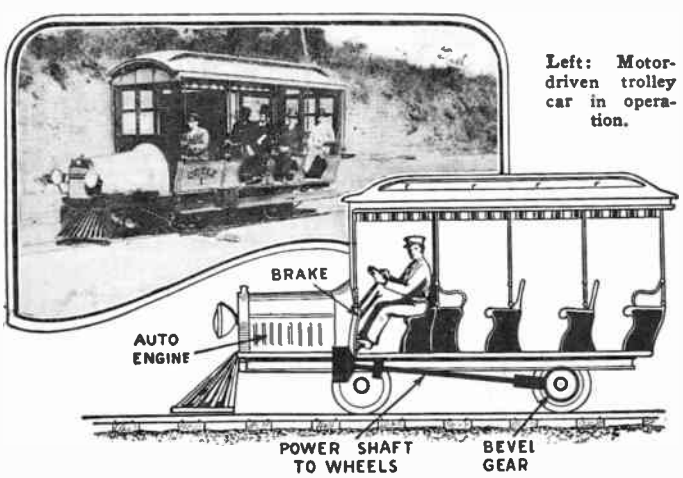
A THIRD system of propulsion for motor-driven ships, considering the side wheel and the screw propeller as the other two, has been devised by an Austrian engineer. This system is described and illustrated here and is the first one to approach a correct imitation of the natural methods of propulsion used by fish. Furthermore, it is a known fact that rotating surfaces produce a lower pressure for a given applied power than oscillating surfaces and this fact duly considered and studied led to the invention of the oscillating propeller. Possibly this system may soon be applied to airplane flight with a success equal to that achieved in maritime use.



The diagram at the right shows how the changing of the angles of the blades is effected when reversal is desired. Above view shows the amount of travel of the propeller blades when oscillating under operating conditions.

The illustration in the above center shows cross-sections of the propeller blades and the positions they take in forward and reverse travel. The change in the angle of the propeller blades is effected by the operator with the controls shown in the upper right-hand illustration.

Gasoline Trolley Car

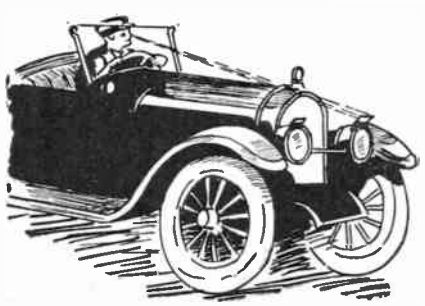


Left: Motor-driven trolley car in operation.

A new type of trolley car operating on standard tracks, yet entirely self-contained is illustrated above. A standard automobile engine furnishes the power and the control of the entire device is similar to that of an automobile. The engine drives the rear wheels through a reducing bevel gear.

Auto Light Tell-Tale

When driving along well-lighted streets at night it is often vrey difficult to ascertain whether or not the headlights of your car are burning. It is often not noticed that they are out until a policeman stops you and gruffly warns you to turn on your lights or get out and fix them. Such an embarrassing situation can be avoided by the use of the devices illustrated here, one being attached to each headlight.



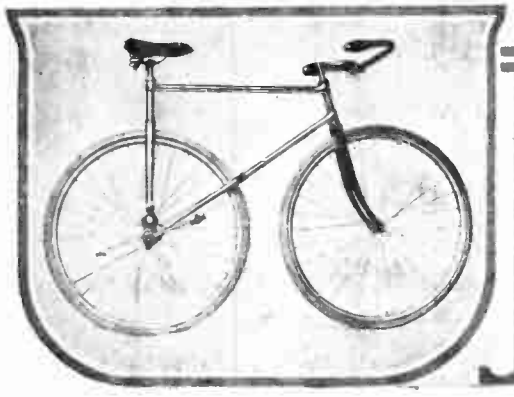
This tell-tale device consists of a mirror which reflects the beam of the headlight through a small red glass. A glance at the near side of the red lens immediately tells whether or not the headlight is burning.

Unique Bicycles

Trick, Theatrical and Amusing Types of Bicycles

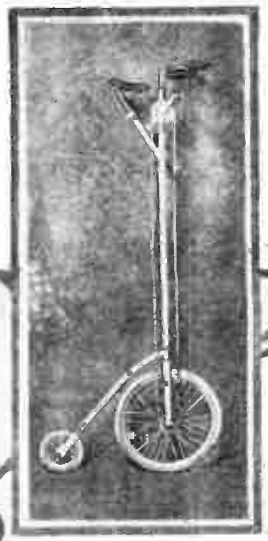
By MAJOR CHARLES G. PERCIVAL, U. S. A.

The miniature bicycle shown in the photograph above is perfect in every mechanical and functioning detail. This tiny bike was made for the performing monkey on the theatrical circuit. It is exactly twenty inches long, and will revolve in an ordinary twenty-eight inch bicycle rim. It is a treat to watch its tiny owner propel it on a table top.

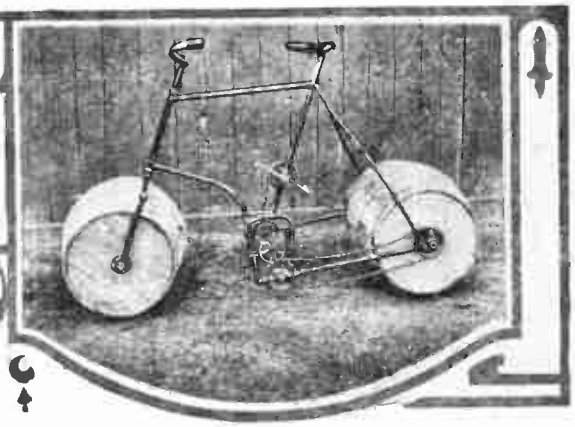


Above: The quick change bicycle which can be converted instantaneously into a truss frame for boys, and a drop frame for girls.

The bicycle well known to the vaudeville-going public is shown above. It turns within the smallest possible circle, and the faster the pedals are rotated, the slower it seems to go. The gears at the rear are responsible.

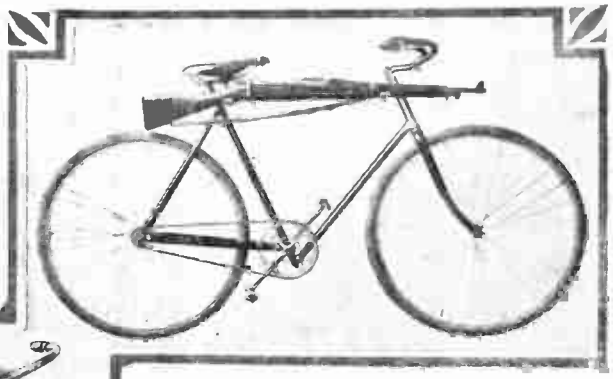


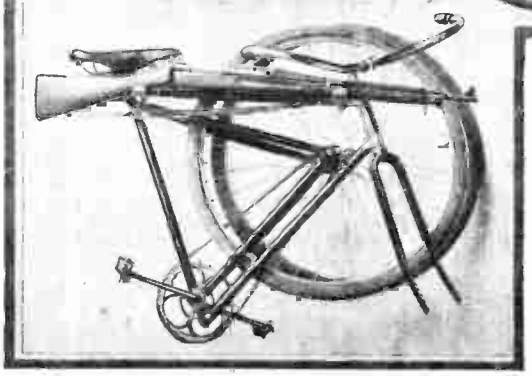
The world's smallest wheeled and longest chained bicycle.



Here is the oddest and most unique bicycle ever built. Its wheels are composed of ordinary flour barrels instead of the regulation wire rubber-tired wheels. Otherwise it is a bicycle in every detail, having an iron pipe frame, sprocket, chains and other necessary parts. The frame has been redesigned to carry the barrel-wheels.

In the long chain bicycle the rider sits five and a half feet from the ground. The chain is eleven feet long. A real oddity in the way of a bicycle is illustrated above. The frame consists of a third wheel and steering is accomplished by a fourth wheel.



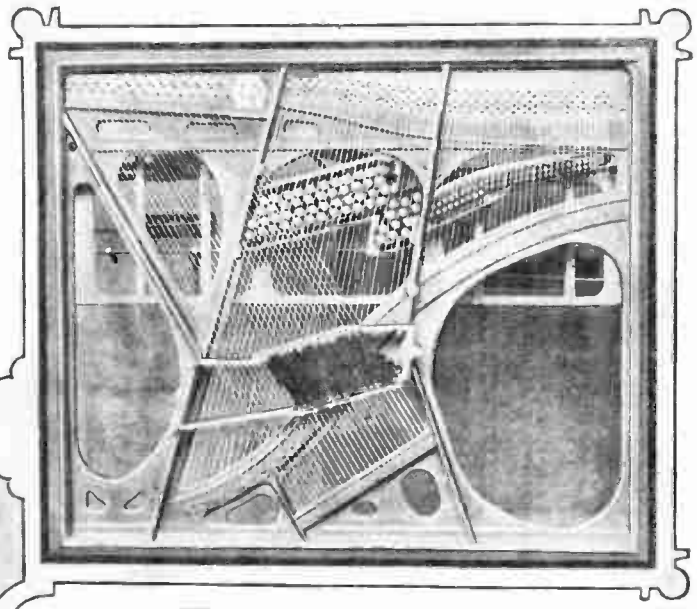


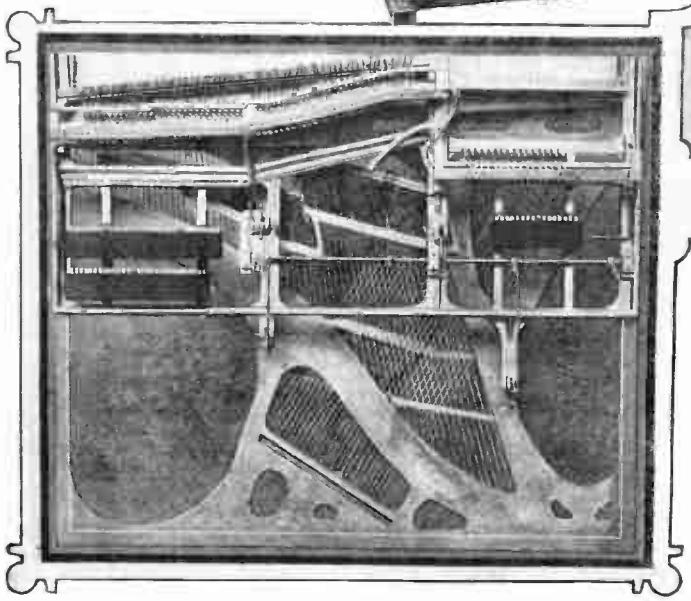
For the traveler, the vacationist, the motor camper and tourist, there is available the collapsible bicycle, which by a simple twist of two wing nuts is demountable. It packs securely and compactly in a twenty-six inch carrying case provided with a handle. The whole is no larger than milady's hat box. The photo shows the bicycle standing in front of the case from which it was removed.

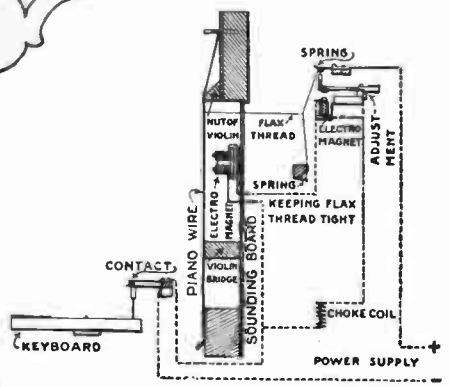
The bicycle shown above and to the left is intended for military uses, state troopers, boy scouts, travelers and hunters, is modern and up-to-date, equipped with coaster brake and rifle carrying brackets. Loosening two wing nuts permits it to be folded up as shown in the photo to the left. While in this folded position, it can be carried comfortably over the shoulder, its total weight is but twenty pounds.

Electric Piano

A novel electrical piano of French design was recently described in *La Science et la Vie*. We show herewith at the immediate right a view of the piano. It differs very little from the standard type of instrument with which we are all familiar, but in action it depends upon electricity and magnetism produced thereby. The views at the extreme right and below show the arrangement of the strings.

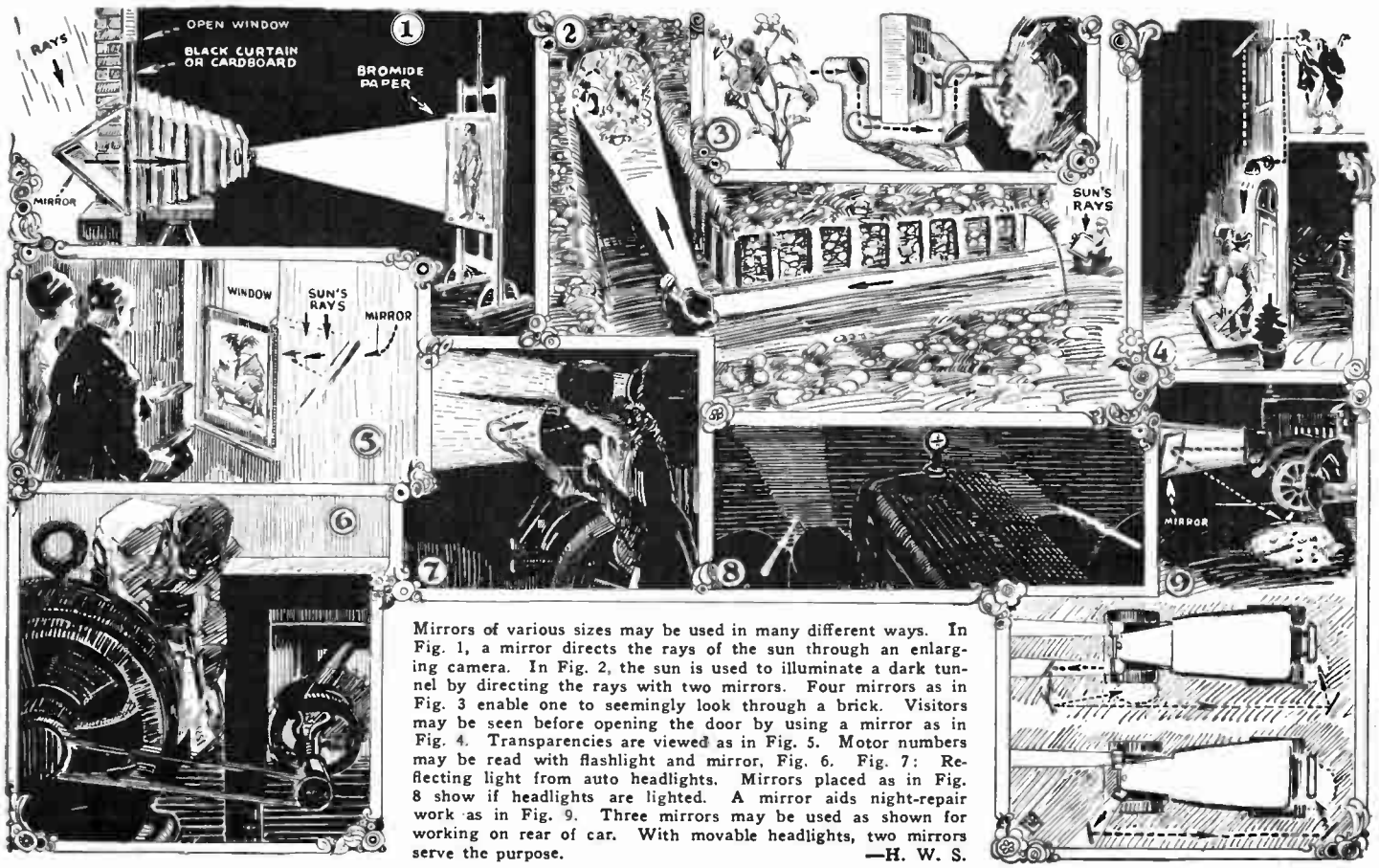






In this electric piano, the strings are vibrated by means of electro-magnets instead of hammers. A schematic diagram of the method is shown at the left. Pressing a key on the keyboard closes a circuit through an electro-magnet, which attracts the piano wire and sets the same in vibration. A second electro-magnet, equipped with an adjustment, breaks the circuit just after the key is pressed and so leaves the string free to vibrate.

How Mirrors May Be Put to Work

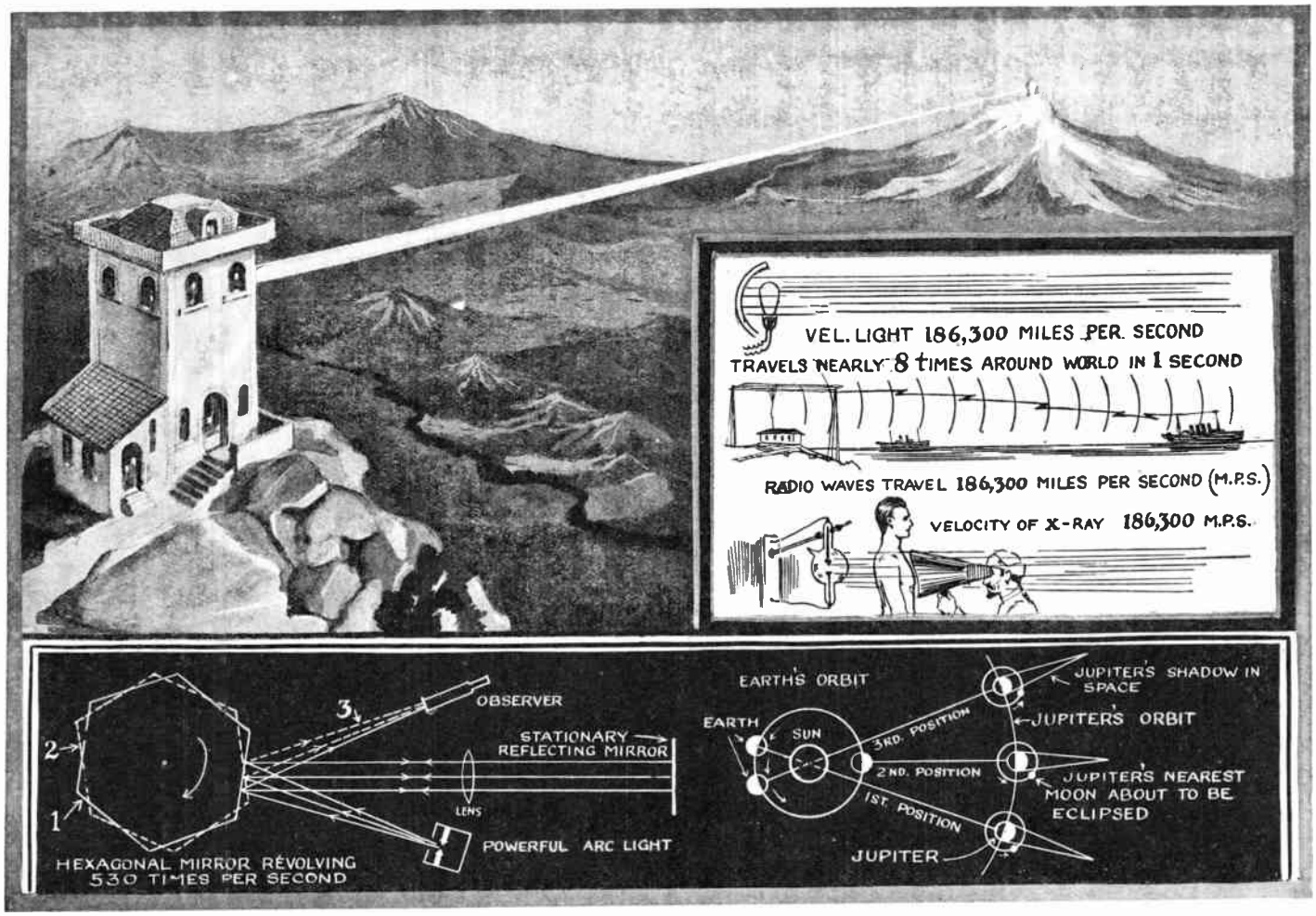


Mirrors of various sizes may be used in many different ways. In Fig. 1, a mirror directs the rays of the sun through an enlarging camera. In Fig. 2, the sun is used to illuminate a dark tunnel by directing the rays with two mirrors. Four mirrors as in Fig. 3 enable one to seemingly look through a brick. Visitors may be seen before opening the door by using a mirror as in Fig. 4. Transparencies are viewed as in Fig. 5. Motor numbers may be read with flashlight and mirror, Fig. 6. Fig. 7: Reflecting light from auto headlights. Mirrors placed as in Fig. 8 show if headlights are lighted. A mirror aids night-repair work as in Fig. 9. Three mirrors may be used as shown for working on rear of car. With movable headlights, two mirrors serve the purpose.

—H. W. S.

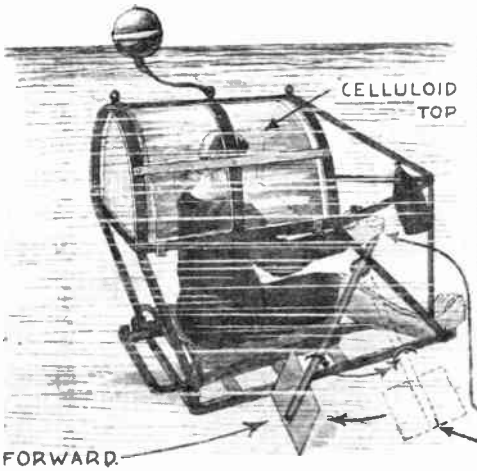
Timing the Swiftest of Vibrations

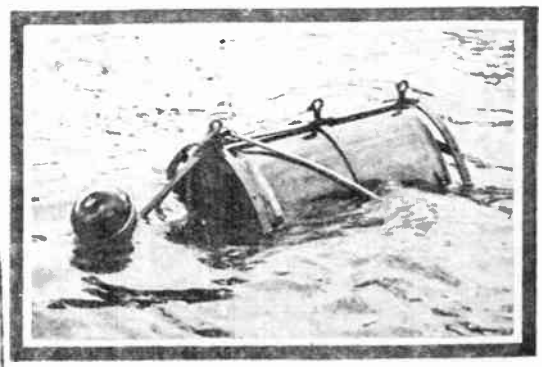
By DR. HAROLD RICHARDS, PH.D.



Dealing with the swiftest vibrations known to man, light, Professor A. A. Michelson has recently accurately measured the time required for a beam of light to negotiate a 44-mile round trip between Mt. Wilson and Mt. San Antonio. The rays were sent out by an air-driven mirror revolving 530 times per second, and on their return, were caught at an angle by the following face of the rotating mirror and deflected to the observer. The time was given by the speed of the mirror and the angle through which it turned before the light came back. The velocity was 186,300 miles per second. The probable error in Professor Michelson's experiments is said to be only one part in 10,000. The distance was measured to an accuracy of three inches in 22 miles. Our lower right-hand illustration shows how the speed of light was first determined. The length of time required for light to cross the earth's orbit when observing an eclipse of one of Jupiter's moons was found to vary. Roemer, an astronomer of 1675 thus calculated the speed of light at 186,600 miles per second, only 300 miles error. Pretty close for that early day.

A Reconstructed Diving Boat of 1602

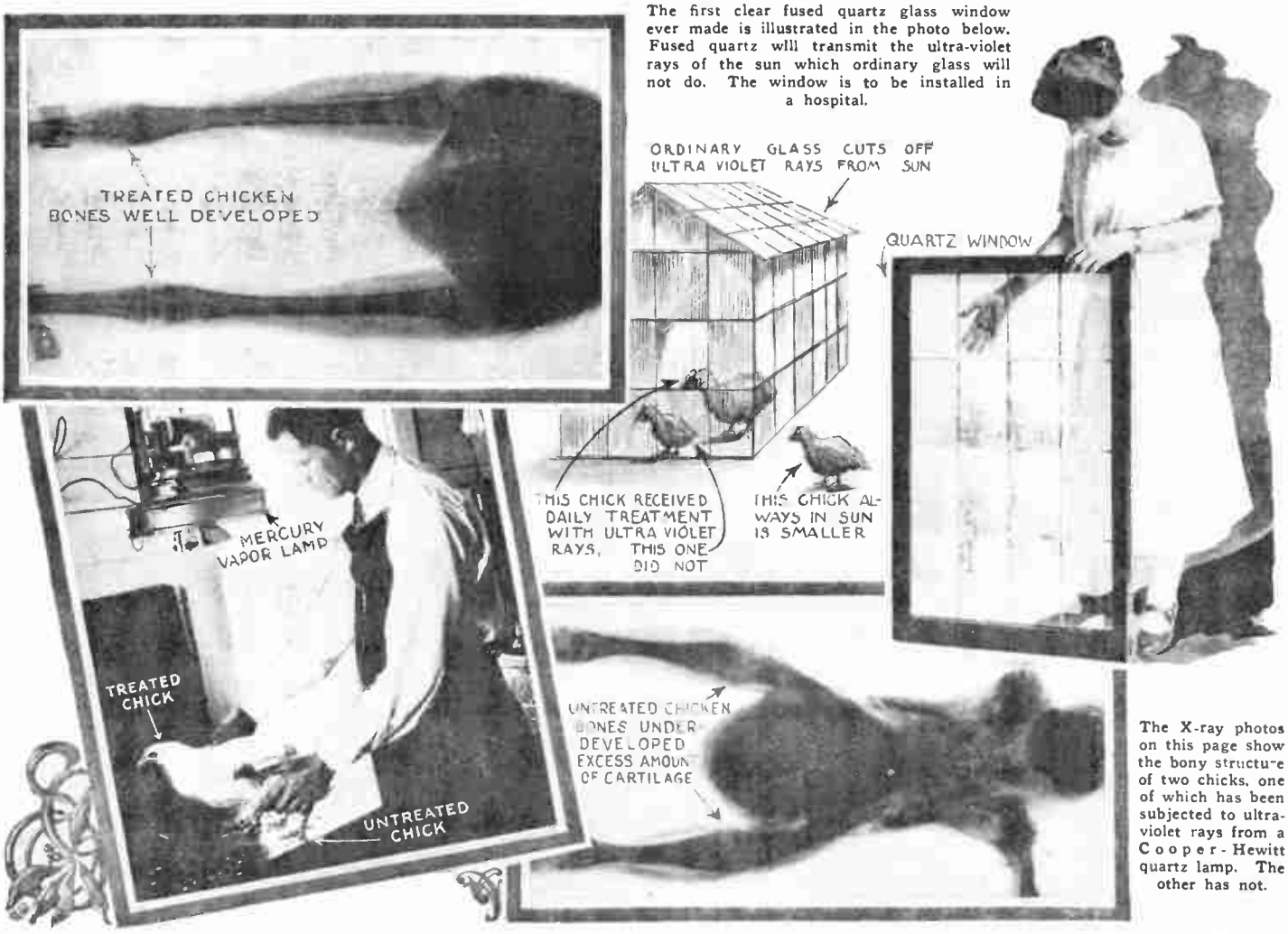




A diving boat constructed by Cornelius Drebbel in 1602 has been reconstructed by Dr. Naber. At the left is shown Dr. Naber with his model and a man in it showing how it is operated. Our center illustration shows the device under the water with the operator propelling it along. Working the paddles in a manner opposite to that usually used in rowing propels the device forward. The air contained within the celluloid top after the manner of a diving bell supplies the operator with air for short dives. Photo at right shows the diver leaving the apparatus.

Fused Quartz Glass Windows

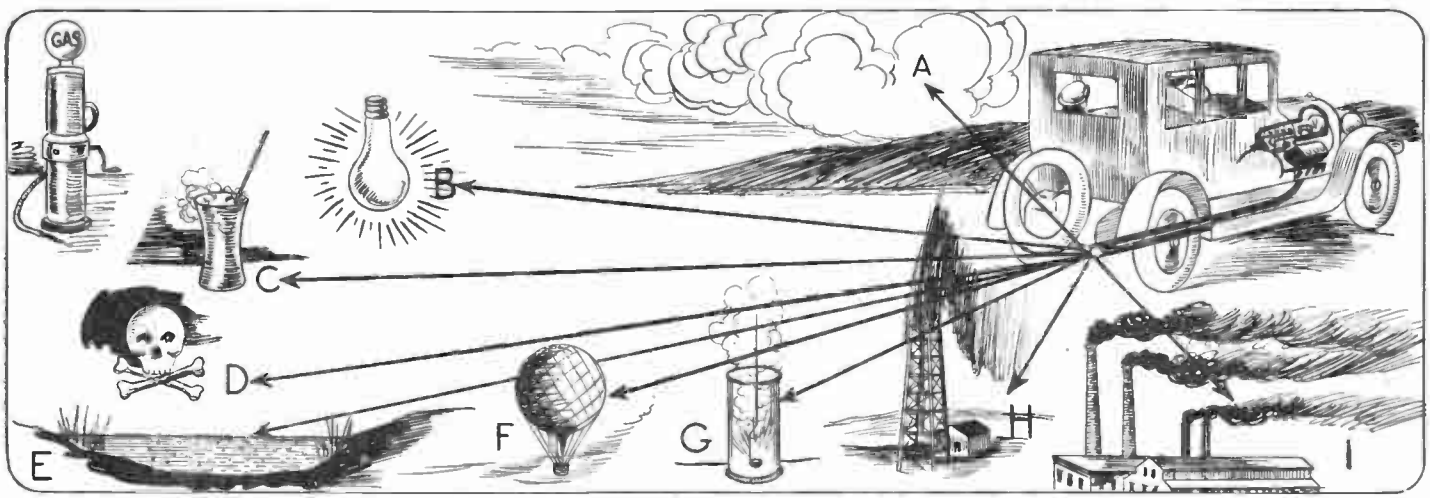
The first clear fused quartz glass window ever made is illustrated in the photo below. Fused quartz will transmit the ultra-violet rays of the sun which ordinary glass will not do. The window is to be installed in a hospital.



The X-ray photos on this page show the bony structure of two chicks, one of which has been subjected to ultra-violet rays from a Cooper-Hewitt quartz lamp. The other has not.

Experiments were made on chickens hatched at the University of Maine. These chicks were not permitted to run in the open or out-of-doors. They were raised in the greenhouse. Ultra-violet rays which do not penetrate ordinary glass consequently had no access to the chickens. One group of chickens was treated daily for fifteen minutes with light from an ultra-violet ray lamp. These chicks weighed five times as much as the untreated chicks, and were larger than chickens exposed to the sunlight. The bony structure is much better developed in the treated chicks.

What Comes Out of An Automobile Exhaust



The products of an automobile exhaust are illustrated in the diagram above. Gasoline used as fuel contains eighty-four per cent carbon and sixteen per cent hydrogen chemically combined. One pound of gasoline requires 15.17 pounds of air to completely consume it. Air contains a twenty-three per cent. by weight of oxygen to seventy-seven per cent. of nitrogen, not in chemical combination but merely mixed. Water (steam), as indicated in A of the above diagram, is produced in large quantities in the exhaust gases of an automobile engine. One pound of gasoline completely consumed will yield 1.44 pounds of water. The engines of the Shenandoah are equipped to save this water to balance the loss of fuel. The residual or unconsumed part of the air in the exhaust is nitrogen argon, neon, etc. Nitrogen is used to fill high wattage lamps, B. The bubbles in soda water, C, are produced by carbon dioxide. One pound of gasoline gives over three pounds of this non-poisonous, non-combustible gas which tends to cause suffocation if inhaled in large quantities. A deadly gas, carbon monoxide is also produced. It is explosive when mixed with air, and four parts in ten thousand is injurious. Methane as indicated at E, or marsh gas, the chief constituent of natural gas and the fire damp of coal mines, is an ingredient. In the exhaust gases we find hydrogen. This is lighter than air, hence used for filling balloons, as shown at F. It will burn as an explosive when mixed with air. Oxygen as shown at G, is present. This gas makes combustion (explosion) possible. Hydrocarbons unconsumed gasoline, and cylinder oil vapors at H, and carbon soot at I are present in the exhaust.—O. Ivan Lee, B. Sc.

Transmutation—Is It Possible?

What the Scientist Has to do Before we Can Make Gold from Mercury or Other Elements.

By CHARLES T. DAHAMA, Ph.D.

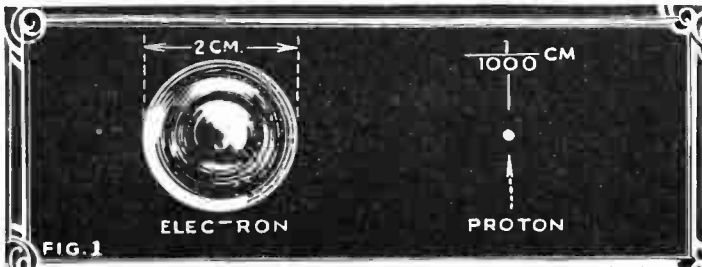


FIG. 1

Before the real meaning of transmutation can be grasped the fundamental facts concerning the atoms must be understood. All matter is composed of electricity, negative charges called the electron, and positive the proton. They are drawn to scale above 10,000,000,000,000 times actual size.

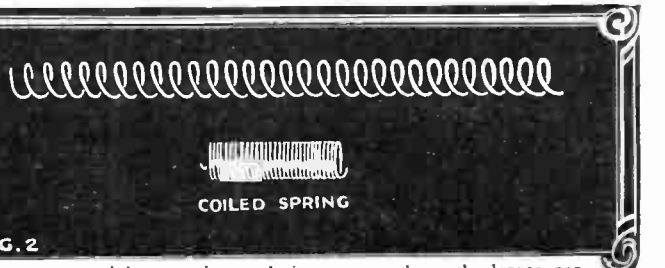


FIG. 2

The proton weighs two thousand times as much as the larger particle, in spite of the fact that the quantity of electricity present is the same. According to Einstein mass and energy are interchangeable, and a compressed spring would weigh an infinitesimal amount more than when uncoiled.

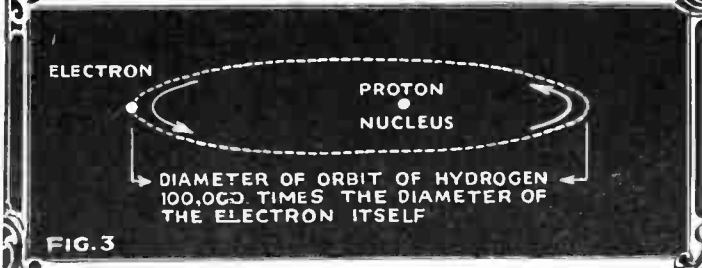


FIG. 3

The huge weight of the proton is due to the energy of compression. The simplest of atoms is hydrogen, composed of one electron revolving about one proton. The negative sign of the electron is equalized by the positive charge of the proton and the atom is stable.

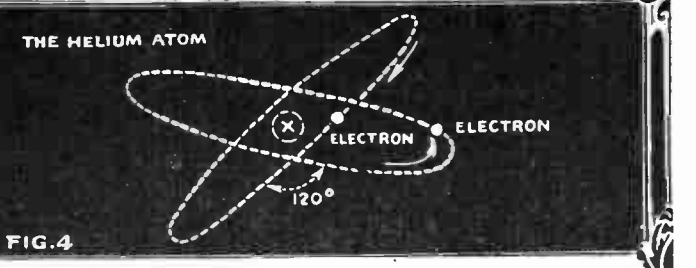


FIG. 4

In the helium atom the relative sizes of electrons and orbits are the same as for hydrogen. The nucleus is situated in the region marked X. This nucleus is four times as heavy as that of hydrogen and has two positive charges. It thus attracts two electrons.

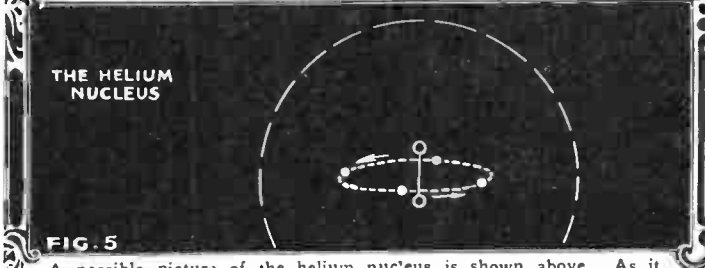


FIG. 5

A possible picture of the helium nucleus is shown above. As it weighs four times as much as hydrogen, it obviously must contain four protons, and since each proton has a positive charge, it will be necessary to have two electrons in the nucleus. Two protons are neutralized within the nucleus and two more in outer orbits.

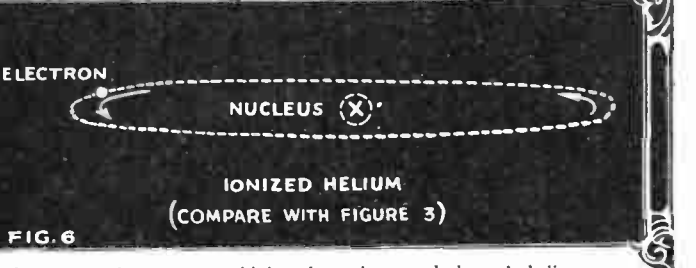


FIG. 6

If an electric current at high voltage is passed through helium one of the outer electrons may be detached. When this happens the atom is said to become ionized. The current has no effect on the nucleus and no transmutation takes place.

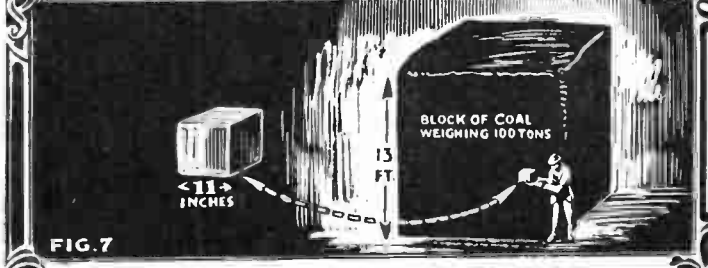


FIG. 7

The helium nucleus weighs less than the hydrogen into which it might be decomposed. Compare Fig. 6 with Fig. 3. To break it up, the total energy of the thirteen foot cube of coal would only change four grams of helium (11" cube) into 4,0.32 grams of hydrogen.

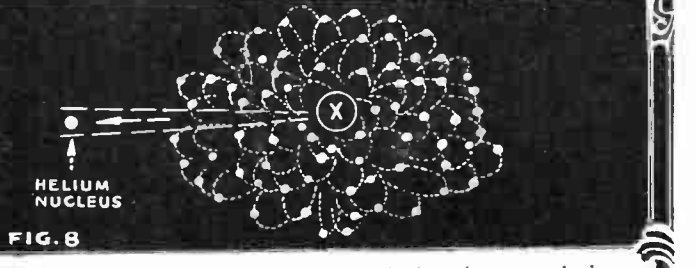


FIG. 8

Helium is probably the most stable body in existence and along with extra electrons and protons goes to make up nuclei of other atoms. Radium shown above constantly explodes, giving off a helium nucleus. The remaining atom is the unstable element niton.

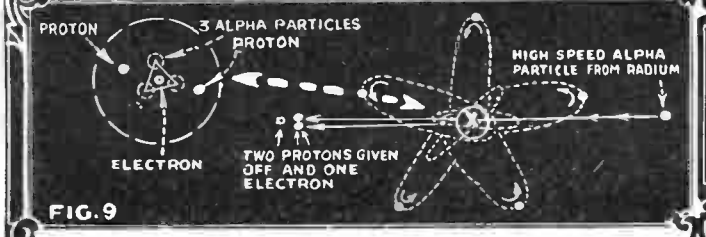


FIG. 9

The alpha particles or helium nuclei ejected from radium possess more energy in proportion to their size than any other object known. By bombarding nuclei of other atoms with these particles Rutherford was able to produce true transmutation.

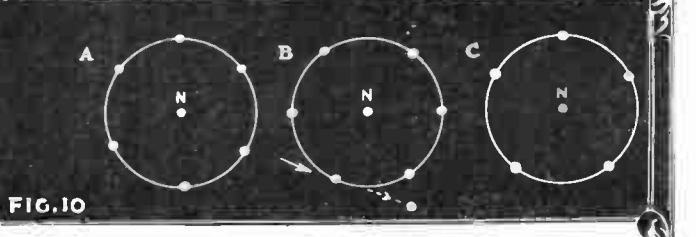


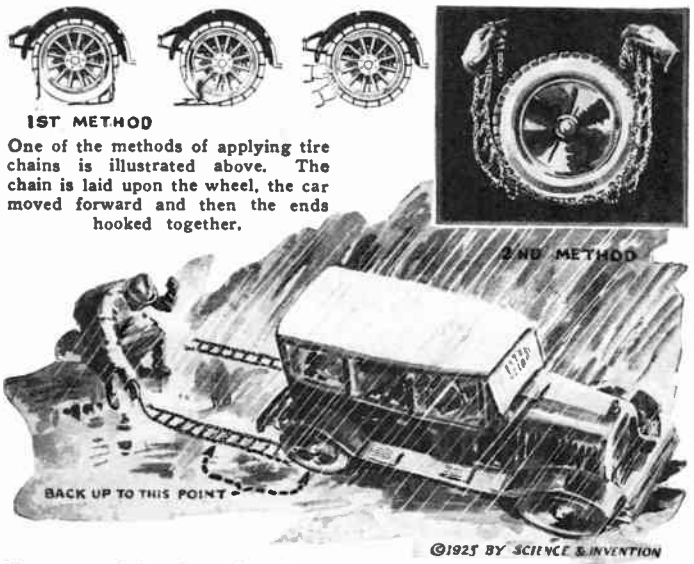
FIG. 10

To transmute an element the nucleus must be disrupted. Thus the instant that the current is cut off the ionized mercury, C., regains its lost electron and becomes normal again. If gold is produced from mercury it was there at the beginning.

Colored Luminous Paint

Mr. A. Strobl is the exponent of the art of painting pictures with oil colors and luminous paints. A sample of one of these pictures is shown in the oval in the illustration above and to the left. This picture is colored and pretty to look at in daylight. After being exposed to light of any source and taken into a dark room, it appears as indicated in the other oval at the right center above. In darkness the sky, water, house and moon all take on different colors, their luminosity being distinctly colored. Mr. Strobl has also outlined artificial flowers with luminous paints which are even more striking in darkness than in a lighted room. The paints in color are also used for decorating laces on costumes. Hallowe'en novelties which grace the page have been treated in a similar fashion. The statue when illuminated reflects the light in accordance with the way it is flashed upon the object while being exposed to light.

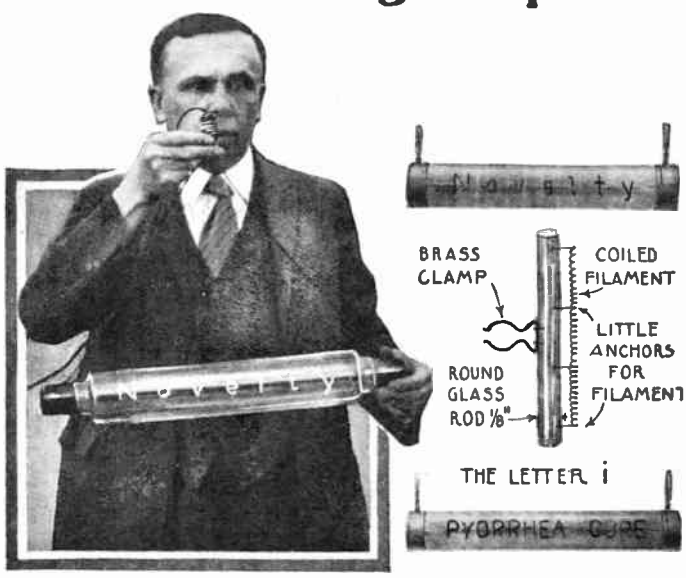
Applying Chains



One of the methods of applying tire chains is illustrated above. The chain is laid upon the wheel, the car moved forward and then the ends hooked together.

The two methods of applying tire chains to automobiles indicated above are found to be the most practical under all weather conditions. In the first, the chain is placed over the wheel, the car moved forward for a distance about a foot, and then the ends of the chain are hooked together. In a second the chain is laid upon the ground, the car backed upon the chain, and then the ends lifted and hooked together as shown.

Advertising Lamp



The novelty lamp illustrated above is the invention of Mr. H. Hartman. Upon a glass rod running from one end of the lamp to the other, a number of letters are clamped. These letters are of glass and contain little anchors which hold the filament. Three or four letters are connected in series and the groups then connected in parallel to the line wires. These are placed in the glass tube, which is then evacuated. —Holmes Feature Service.

Roller Shoes

By DR. ALFRED GRADENWITZ

We are all familiar with roller skates, bicycles and motorcycles. While the latter may be used on rough roads, ordinary roller skates require a smooth surface.

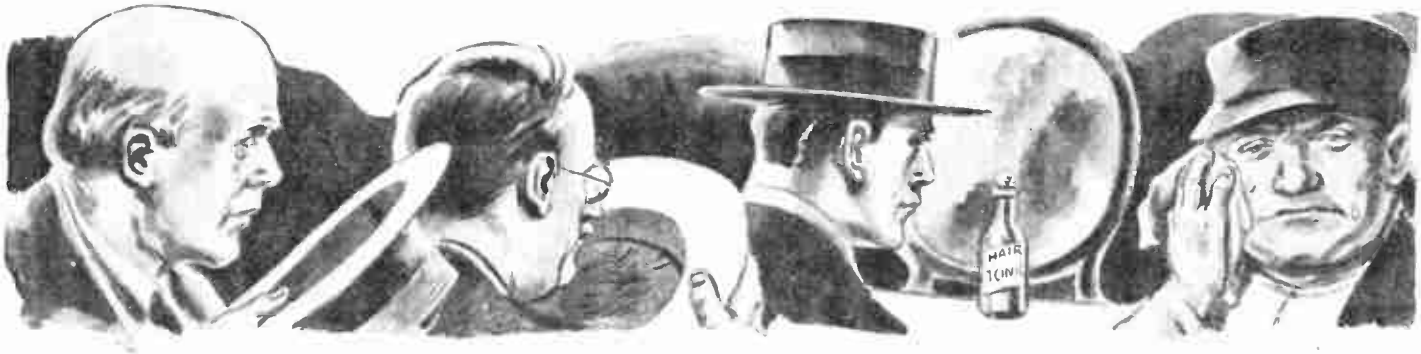
The German invention illustrated here has rubber-tired wheels about 5 inches in diameter. The weight of both skates is about seven and a half pounds.

The feats with the skates as illustrated in these photos were performed on very rough grassy soil, on which a speed of more than ten miles an hour can easily be attained and ditches and other obstacles are jumped over with absolute safety. Each skate has three wheels.

Your Hat a Detective

The contour of the inside of the hat adapts itself to wearer's head. The perspiration line on sweat band shows configuration of forehead.

Each man takes off his hat differently, and always leaves finger prints on the brim. These can be caught by micro-photograph.

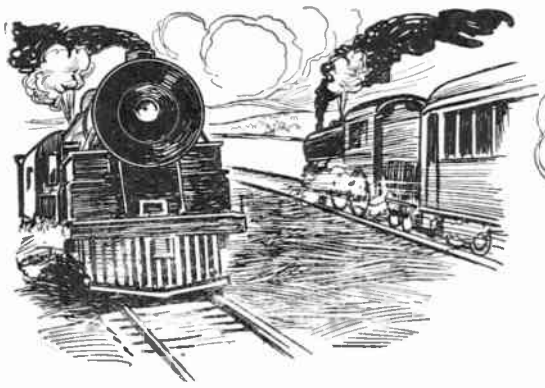


In a straw hat the crown lining frequently shows if a man has a heavy growth of hair, or if he is bald or nearly bald. Small hairs may even adhere to the joint of the sweat band at the back.

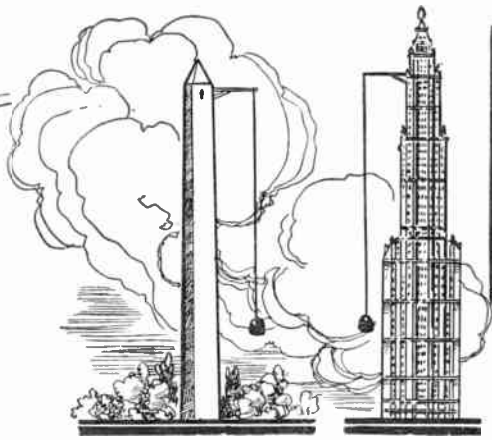
Smell is another point that might well aid detectives. Perspiration possesses a characteristic odor, and if the man uses a tonic or oil, it does not even need a bloodhound to tell it.—The Hat Retailer.

Scientific Puzzles and Oddities

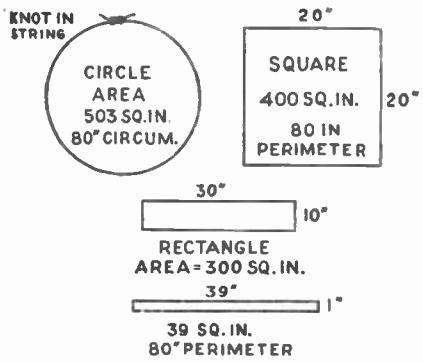
By LESLIE R. JONES
Manual Arts and Radio Instructor, Waltham High School



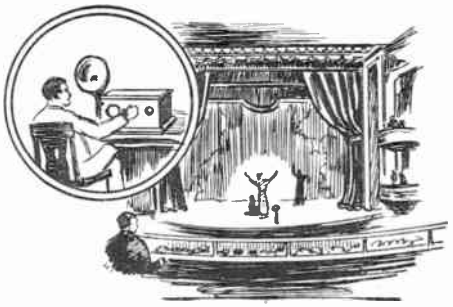
Why is the sound of a locomotive whistle of higher pitch as the locomotive approaches the listener, and falls in pitch as it recedes from the listener?



Approximately how far away would the storm be if it takes 5 seconds for the sound occurring with the lightning discharge to reach the ear?

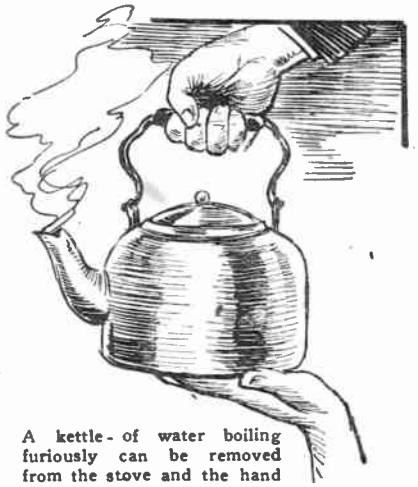


All of the figures above have the same perimeter; in the case herewith it is 80 inches. Nevertheless the area in each case is different. Why is the area of the circle the greatest?

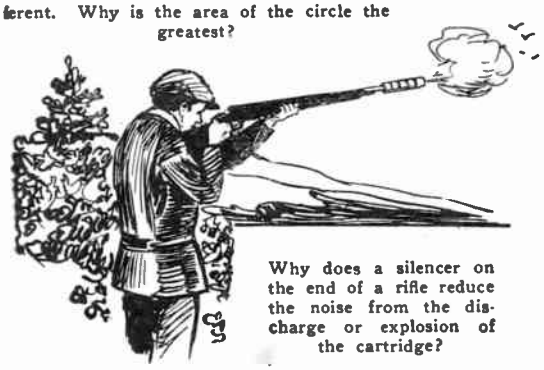


Above: upper illustration: two arms are extended from the Washington Monument and the Woolworth Building respectively. Plumb lines are hung from each of them. Will these two lines be parallel? If not, why not?

Lower illustration: Who will hear a play broadcast from a theatre first, the man listening in on a radio set 1,000 miles away, or the man sitting in the balcony. Why?



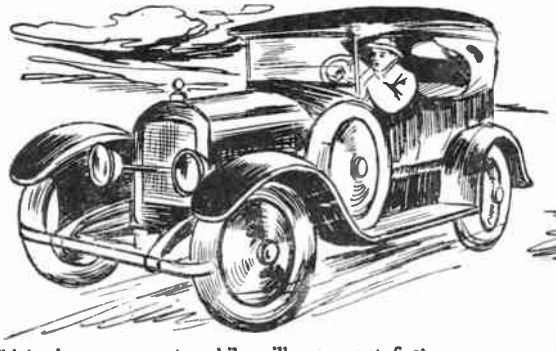
A kettle of water boiling furiously can be removed from the stove and the hand placed on the bottom for a few seconds. It will feel cool. Why?



Why does a silencer on the end of a rifle reduce the noise from the discharge or explosion of the cartridge?

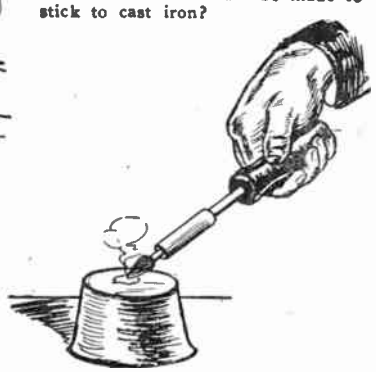
A hard-boiled egg can be held in the hand after being removed from boiling hot water for a few moments; soon it becomes uncomfortably warm. Why?

How can an egg be put into a bottle having an opening smaller than the egg without breaking the shell? Below: how can solder be made to stick to cast iron?



Which tire on an automobile will wear out first, assuming that the automobile is used for regular service over all kinds of roads?

Assuming that sound could travel from the earth to the sun, how long would it take for a man's voice to be heard on the sun?



Answers to questions above will be found on page 95.

MAGIC By "DUNNINGER"

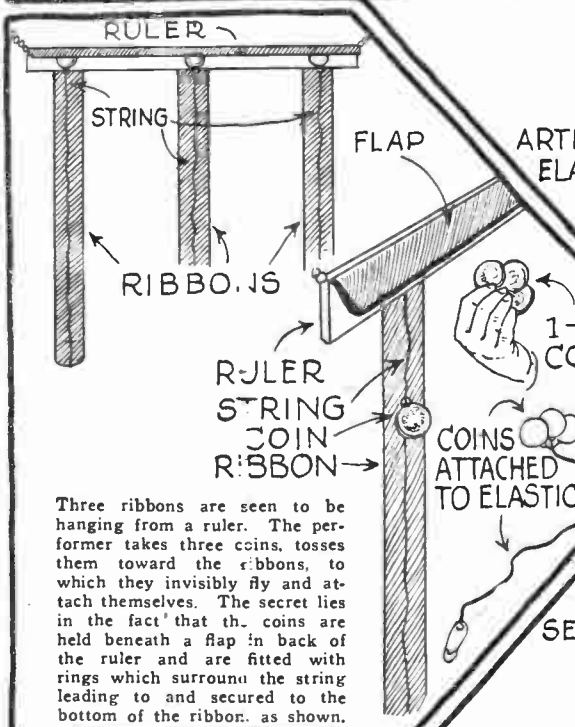
THE MAN WHO MYSTIFIED

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

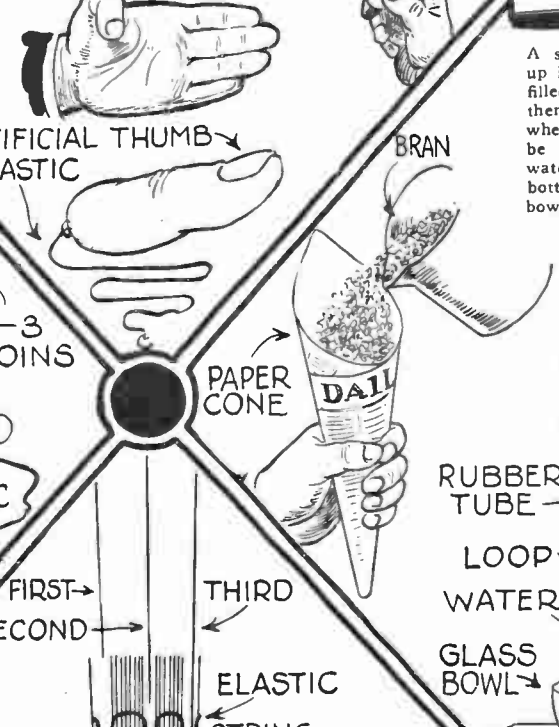
NO. 26 OF A SERIES

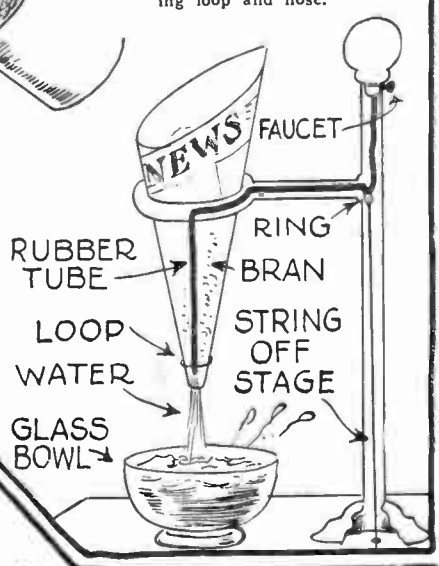
In this version of the stunt of removing the thumb, you can actually show your audience that the thumb has been removed by holding it up in the other hand. The palm of the right hand is closed about the left thumb, and under cover of this closure the left thumb is bent back. The right hand contains the artificial thumb, and as the hand is drawn away, the artificial thumb is brought to view. In seemingly replacing the thumb, the artificial member is released and snaps behind the coat of the performer.

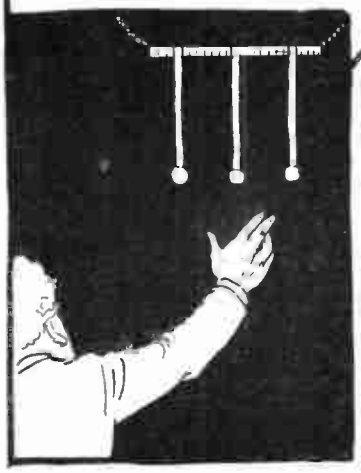
A sheet of newspaper is rolled up into the form of a cone and filled with bran. The cone is then placed in a suitable holder when the bran will be found to be seemingly converted into water, which pours out of the bottom of the cone into a glass bowl. Note method of concealing loop and hose.

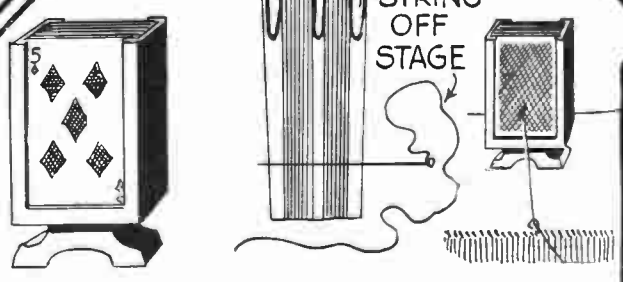


Three ribbons are seen to be hanging from a ruler. The performer takes three coins, tosses them toward the ribbons, to which they invisibly fly and attach themselves. The secret lies in the fact that the coins are held beneath a flap in back of the ruler and are fitted with rings which surround the string leading to and secured to the bottom of the ribbon, as shown.

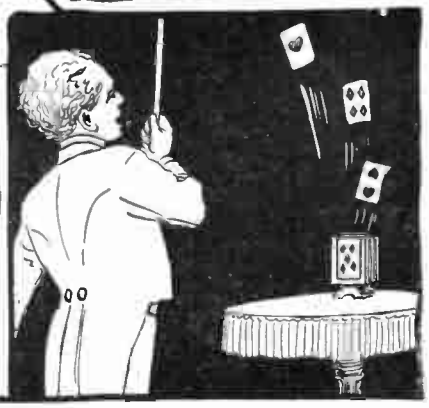








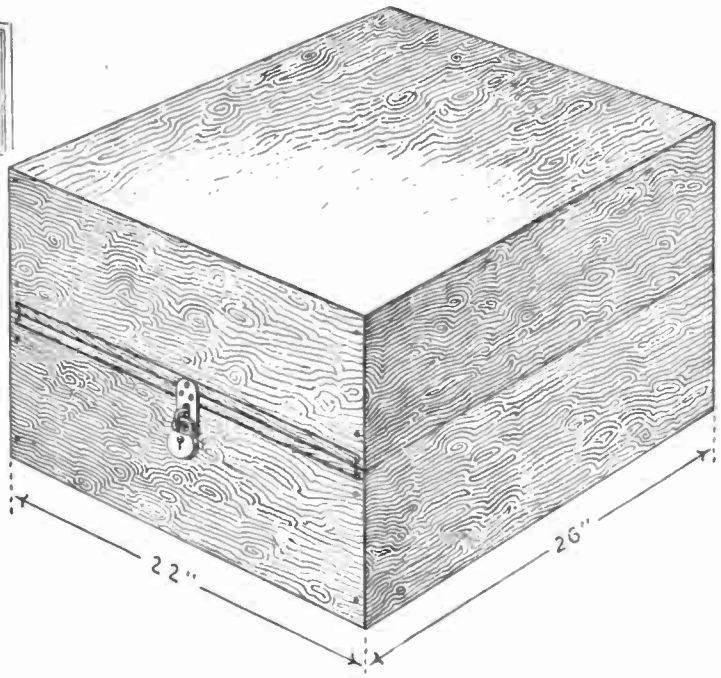
The improved method of producing rising cards is illustrated here. A hole is punched through all of the cards and then the three selected cards are pushed down between the deck, passing over a rubber band. After this a threaded needle is inserted through the hole, and the string passes to an assistant off-stage. As he gradually draws upon the string, one card after the other shoots up from the deck.



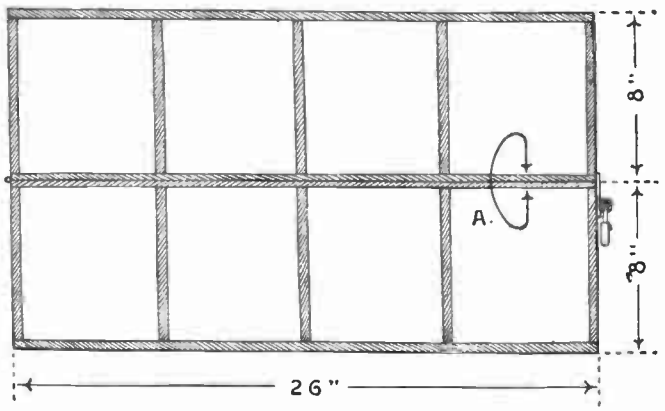
Folding Bookcase

By G. H. WAETJEN

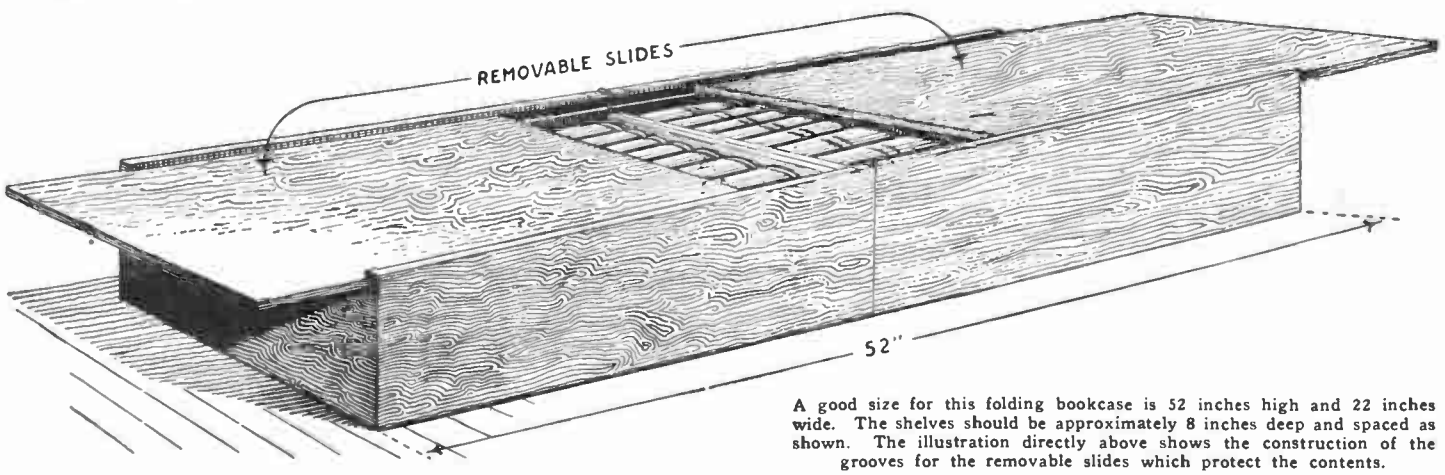
This new folding bookcase may be readily built by anyone at all handy with a saw and hammer. It may be built of any material, although oak is preferable and it may be stained to match any furniture in the room for which it is intended. In the type illustrated, eight shelves are provided and the entire case is ninged in the middle. When moving, insert the slides, fold the case in the center and padlock it. No further packing is then necessary.



Although folding furniture of various designs is by no means new, here is one piece that differs considerably from the usual run. With this bookcase, it is not necessary to remove the volumes from the shelf when folded up as shown. Slides prevent the contents from shifting.



Above is shown a cross sectional view of this bookcase when folded for shipment. The removal slides indicated by A, amply protect the contents and prevent the books from becoming mixed up during moving.



A good size for this folding bookcase is 52 inches high and 22 inches wide. The shelves should be approximately 8 inches deep and spaced as shown. The illustration directly above shows the construction of the grooves for the removable slides which protect the contents.

The Five Sense Mystery Solved!

By HUGO GERNSBACK

Thousands Of Replies Received, Yet Only One Was Nearly Correct

The prize of $20.00 for the nearest correct answer to our Five Sense Mystery Contest goes to

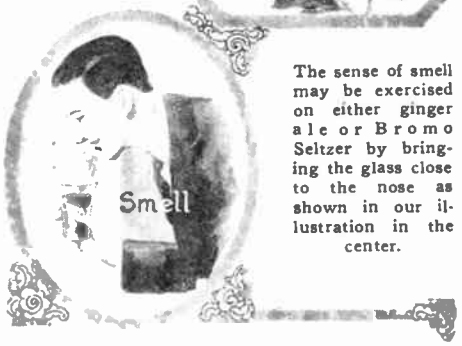
Mr. John Toomey,
1836 West Hasting Street,
Chicago, Ill.

The rules of this puzzle contest stated that the subject to be named was an inanimate thing that could be tasted, smelled, heard, seen and felt without touching the particular thing. The correct answer to the author's puzzle at the start of the contest was *ginger ale*. See illustrations at right. Mr. Toomey's answer to this puzzle was Bromo Seltzer, which, although not absolutely correct, fulfills all of the conditions of the contest and therefore was awarded the prize. Honorable mention goes to S. Anania, of McKeesport, Pa. His answer was root beer, but this substance does not fulfill the requirements as well as Bromo Seltzer to whose selector was awarded the prize. Hundreds of other replies to this puzzle contest included such things as electricity (there was a predominance of letters giving this answer), fire, steam and miscellaneous objects including many kinds of liquids which do not effervesce.

Without touching, either ginger ale or Bromo Seltzer may be tasted as above, because of its bubbling action, the bubbles flying onto the tongue.

Of course, it is obvious that under practically all conditions, the liquids may be seen unless hidden from sight.

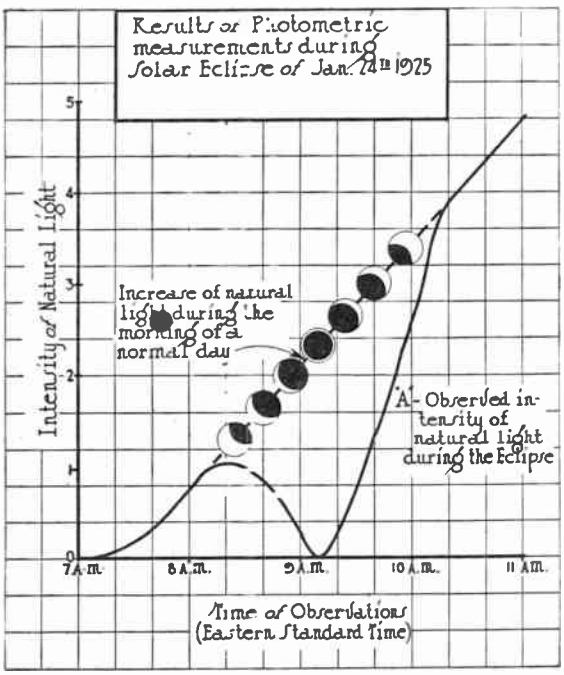
The effervescing or bubbling of the liquids gives forth a distinctly audible sound which may be readily heard by holding the ear in close proximity to the container as at the right.



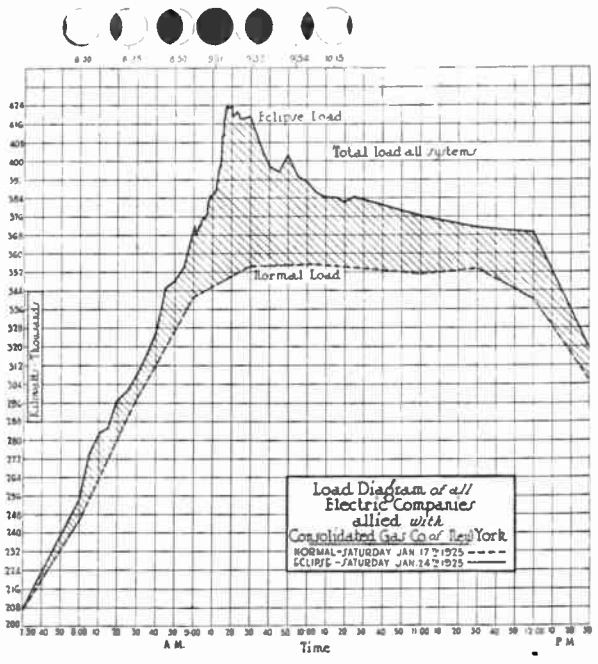
The sense of smell may be exercised on either ginger ale or Bromo Seltzer by bringing the glass close to the nose as shown in our illustration in the center.

While a glass of ginger ale or Bromo Seltzer is effervescing, if it is held close to the mouth, the spray from the bubbles may be distinctly felt on the sensitive skin of the lips.

Effect Of Eclipse On Lighting Systems



DURING the recent total eclipse of the sun visible in New York City, many astronomical and scientific features noticeable during this period were being studied by various parties. Much material covering the eclipse has been published in the pages of this magazine and it was thought that another aspect of the phenomenon would be of great general interest to our readers. This point was the effect of the reduction in daylight during the eclipse on the electric lighting supply of the cities in the path of totality. Since a great portion of New York City was in the path of totality, the figures compiled by the electrical supply companies of that city may be taken as an excellent example of the effect. Charts herewith show the added load on the circuits during the eclipse.



The chart at the lef above puts forth three different phases of interest in comparing the load on electric light lines during the total eclipse. The line beginning at 7 A. M. and proceeding upward at an angle toward the maximum intensity of normal light indicates the usual increase of daylight from 7 A. M. to 11 A. M. The curved line A shows how the intensity of natural light varied during the eclipse. The black and white circles show successively the various stages of the eclipse from the beginning through totality to the end. At the point of totality, the natural light was at a minimum. We may now turn to the chart at the right above which gives a direct comparison of the normal load required for electric lighting and power with that used during the period of the eclipse. The dotted line indicates the normal load, while the solid line shows the number of thousands of kilowatt hours used by New York City and supplied by all the power systems therein during the eclipse period. The shaded portion gives an idea of the quantity of electricity over that normally consumed which was required during the eclipse.

Everyday Chemistry

By RAYMOND B. WAILES

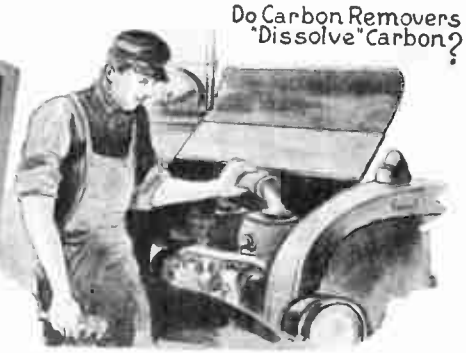
Are The Golden Sign Letters Really Gold?

Yes. Gold leaf is used as it does not oxidize and always appears bright.

99 999/1000% Pure — But What Does It Mean?

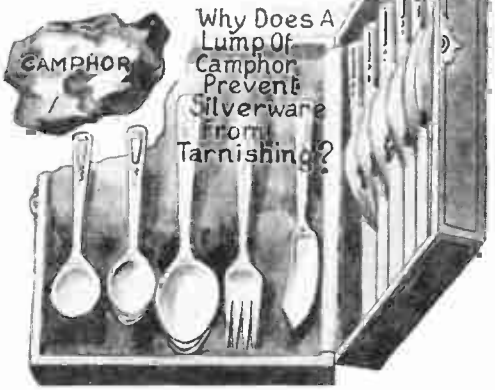
Nothing. Usually our only concern about purity is in foods.

Do Carbon Removers "Dissolve" Carbon?



No. Some removers loosen carbon from the cylinder walls so that it may be blown out with the exhaust gases.

Why Does A Lump Of Camphor Prevent Silverware From Tarnishing?



Because camphor vaporizes which vapor condenses upon objects such as silverware and prevents air from reaching the surface.

Are Grain And Wood The Only Two kinds Of Alcohol?

No. There are many other kind, such as propyl, butyl, amyl, hexyl, heptyl and many others.

Why Is Bread Usually Toasted For The Sick?

Toasted bread converts the starchy matter into a more easily digested substance, dextrose.

How Is the Fireproof Wood Treated?

By permeating the pores with ammonium phosphate under heat and pressure.

What Is The Liquid Which makes the Cuticle Come off?

Usually a weak solution of caustic soda or lye and perfume.

"Seidlitz Plaster" "Or Soda Water Plaster" Lining Keeps the House Warm

If viewed in cross-section, a new wall-plaster appearing on the market would appear as above. The air spaces in the plaster keep the house warm because of their insulating property.

Why Are Bronzing Powders So Difficult To Mix With the Lacquer?

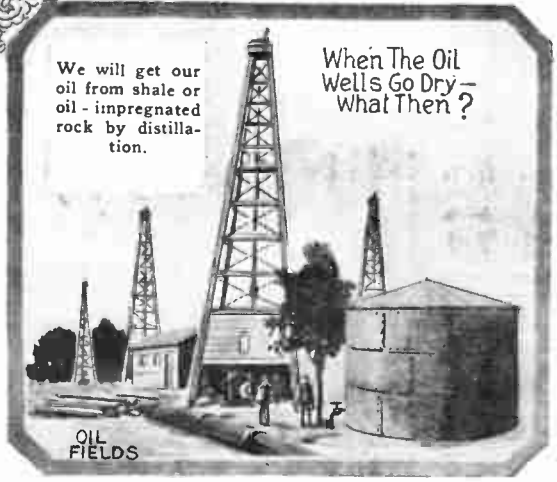
Because finely divided powders adsorb gases and this film makes mixing difficult.

Moth Balls have A Competitor!

This competitor is a substance called paradichlorbenzene which has been found to be a far better moth repellant than camphor.

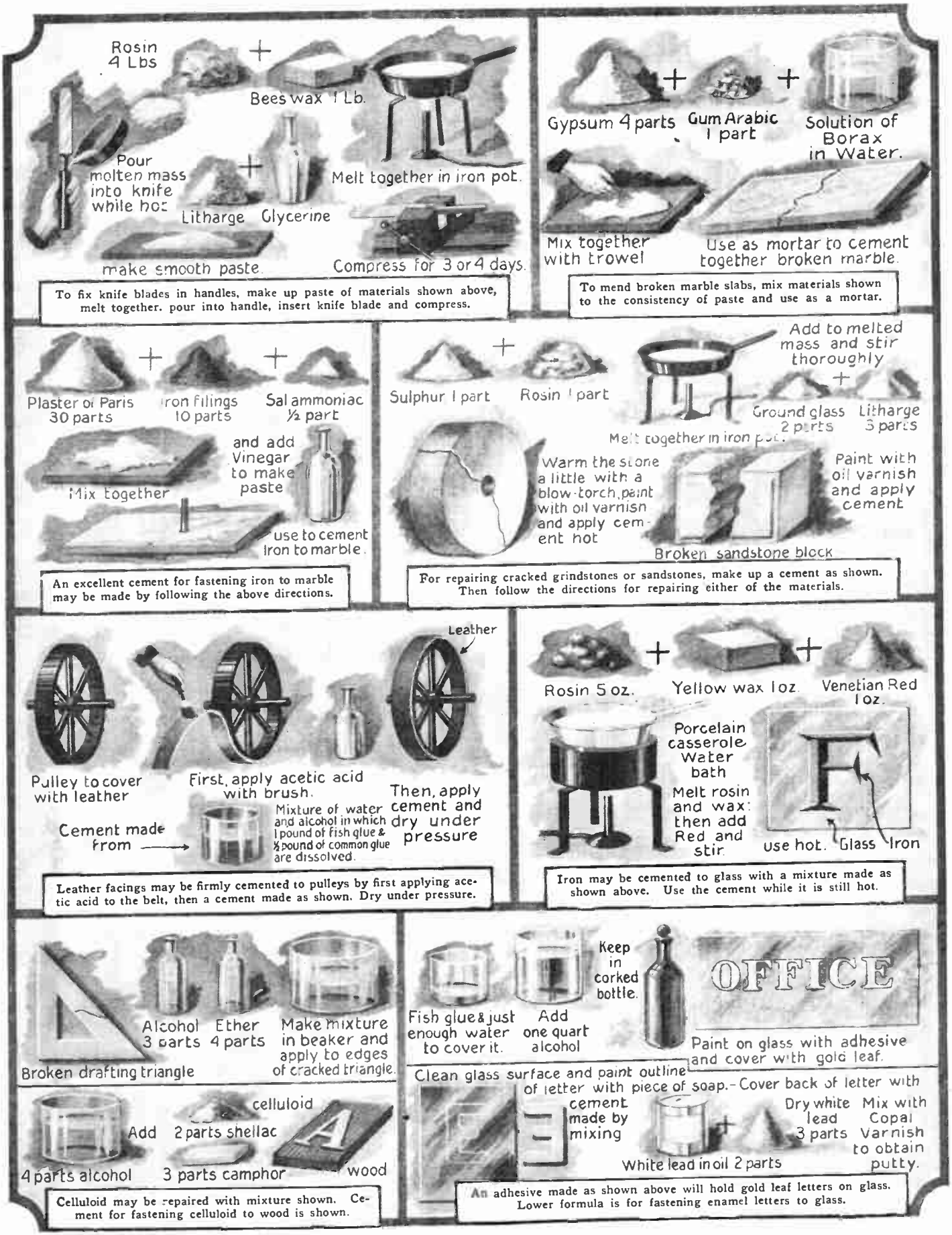
We will get our oil from shale or oil-impregnated rock by distillation.

When The Oil Wells Go Dry — What Then?



Useful Cements and Their Uses

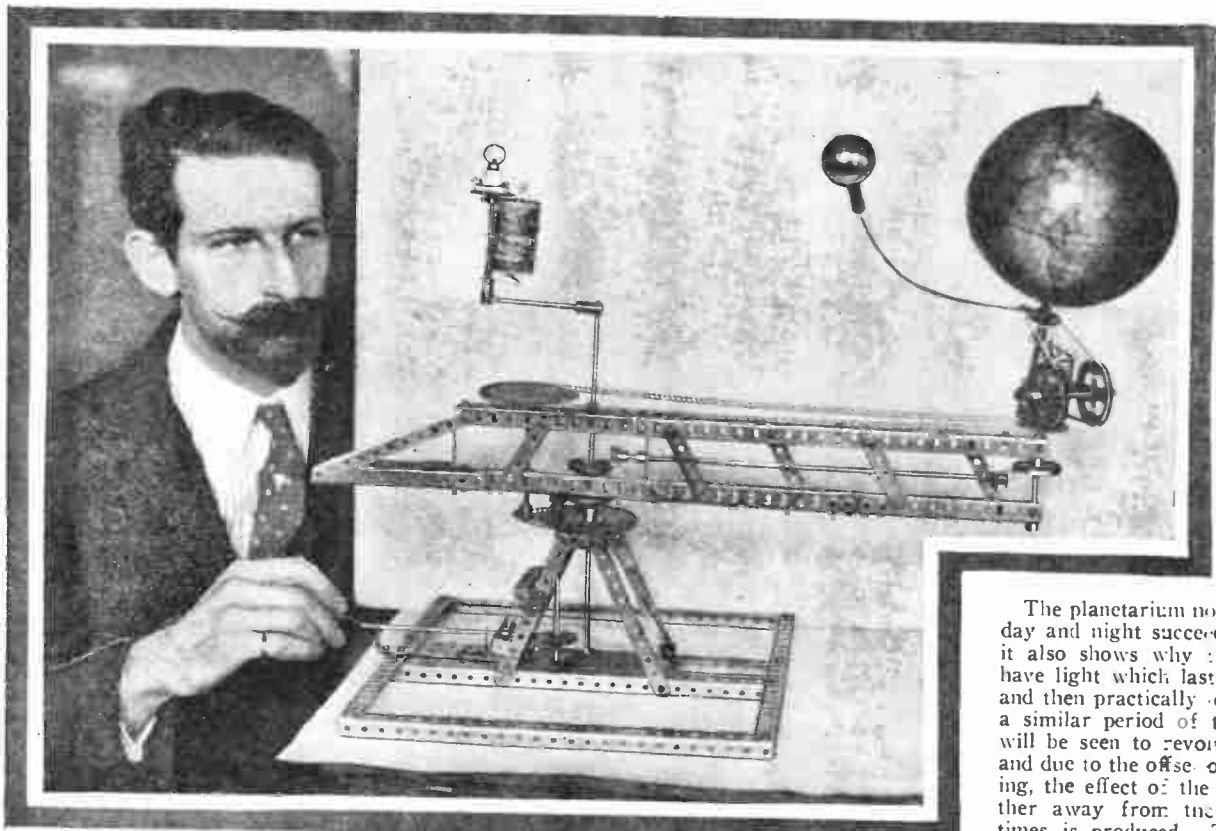
By ISMAR GINSBERG, B. Sc., Chem., Engr.



THE CONSTRUCTOR

Model Demonstrates Eclipses

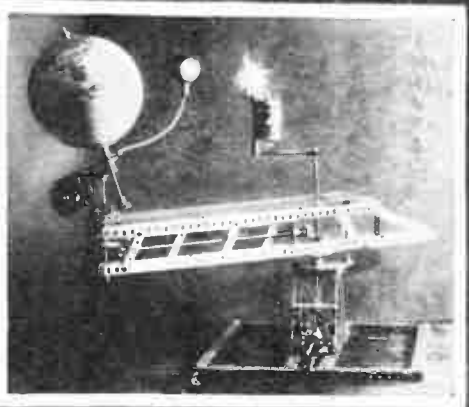
By DR. ERNEST BADE

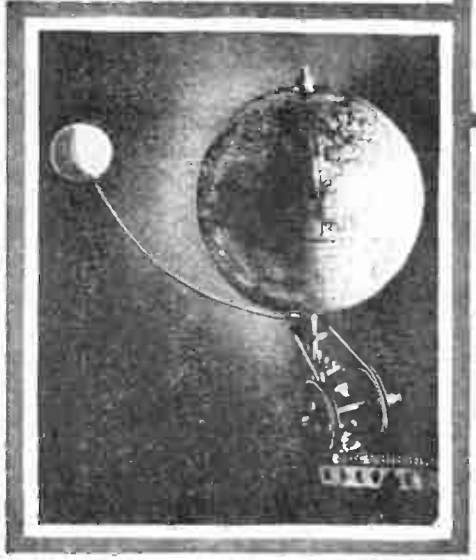


At the left is shown the completed model of a planetarium, a machine which exhibits clearly the motion of the earth and the moon and the orbits of both of these bodies about the sun. It also shows the different positions of the earth in summer and winter.

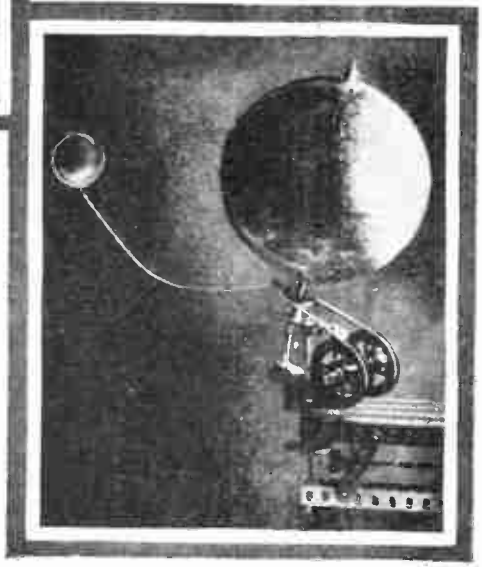
The planetarium not only shows how day and night succeed each other, but it also shows why the polar regions have light which lasts for six months and then practically total darkness for a similar period of time. The earth will be seen to revolve about the sun and due to the offset of the sun mounting, the effect of the earth being further away from the sun at various times is produced. The diameter of the sun is 866,400 miles and it is about 92,900,000 miles from the earth. The moon, on the other hand, has a diameter of 2,163 miles and is about 238,854 miles away from the earth. The mean diameter of the earth is 7,917.6 miles. To build a machine in these exact proportions is not practical. If the sun were taken at 70 centimeters in diameter, the earth would only be 6.3 centimeters in diameter, while the distance between would be 70 meters.

The photo at the right shows the position of the earth and moon when the northern hemisphere is nearest the sun, or when the earth reaches perihelion on or about the third of January of every year. This explains why the winters in the northern hemisphere are milder than those in the southern hemisphere. The photo below shows the full moon as exhibited by this model, whereas the one at the lower right-hand corner of this page shows an eclipse of the moon.

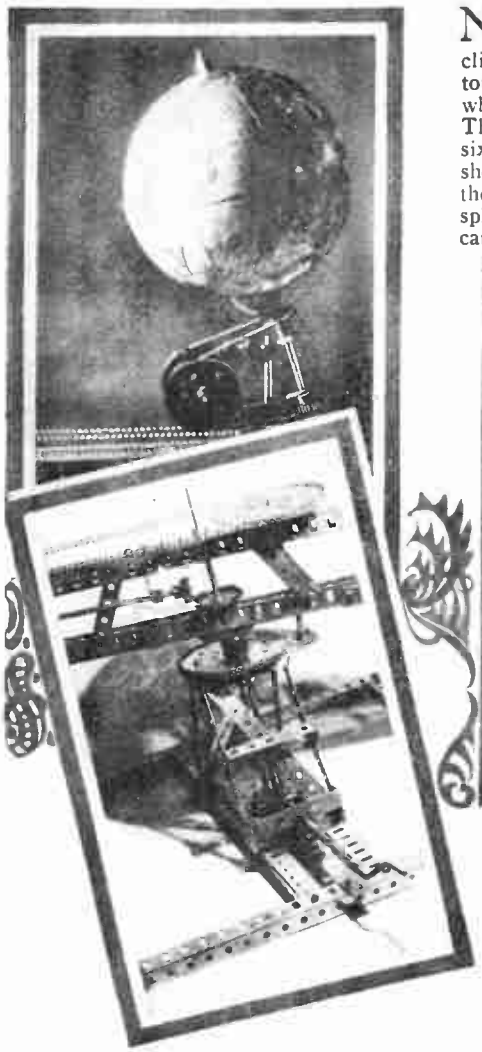




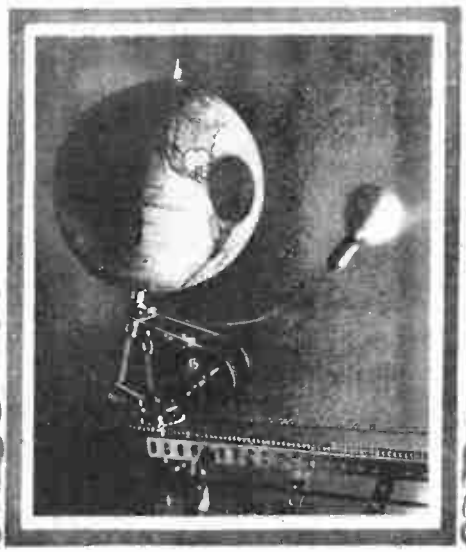
THE model of the planetarium shown on this page is made entirely of toy constructor or erector parts and such materials as are found in any five and ten cent store. A small single cell flashlight battery, with bulb and socket form the sun which throws its beams of light upon the moon (made from a Christmas tree decoration) and the earth (a ten cent globe). By following the construction shown on the next page, anyone can duplicate the highly instructive model illustrated. It will be observed that the earth is mounted on its axis in such a way that it is tilted to an angle of about 23 degrees, perhaps not accurately but near enough for ordinary instructive purposes.



NOT only does the photo at the left show summer in the northern hemisphere, but due to the inclination of the earth on its axis, with its north pole toward the sun there is light at the north pole, while the south pole is enshrouded in darkness. This position is almost constantly maintained for six months of the year. At the right the photo shows the converse of the above with daylight at the south pole and summer in the southern hemisphere. Note how the mechanism which holds and causes the earth to rotate swings to different places.

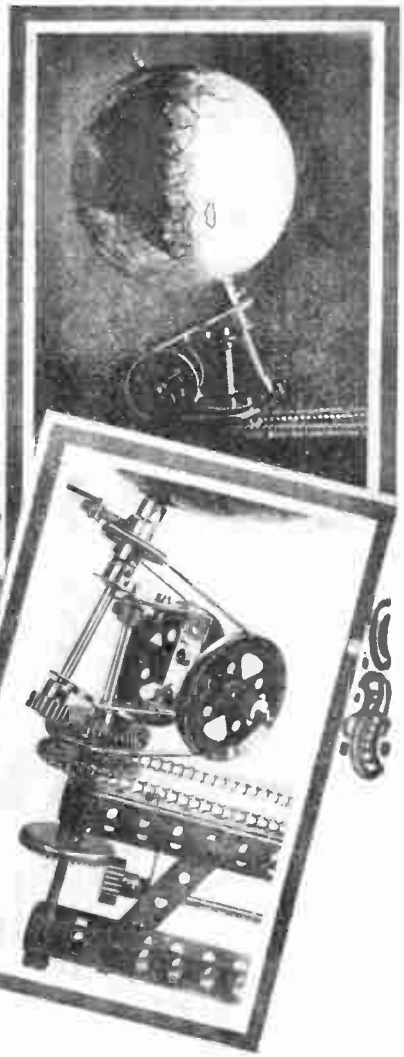


Above photo shows the driving part of the planetarium consisting of crank handle driving two bevel gears which change the horizontal drive to a vertical drive.

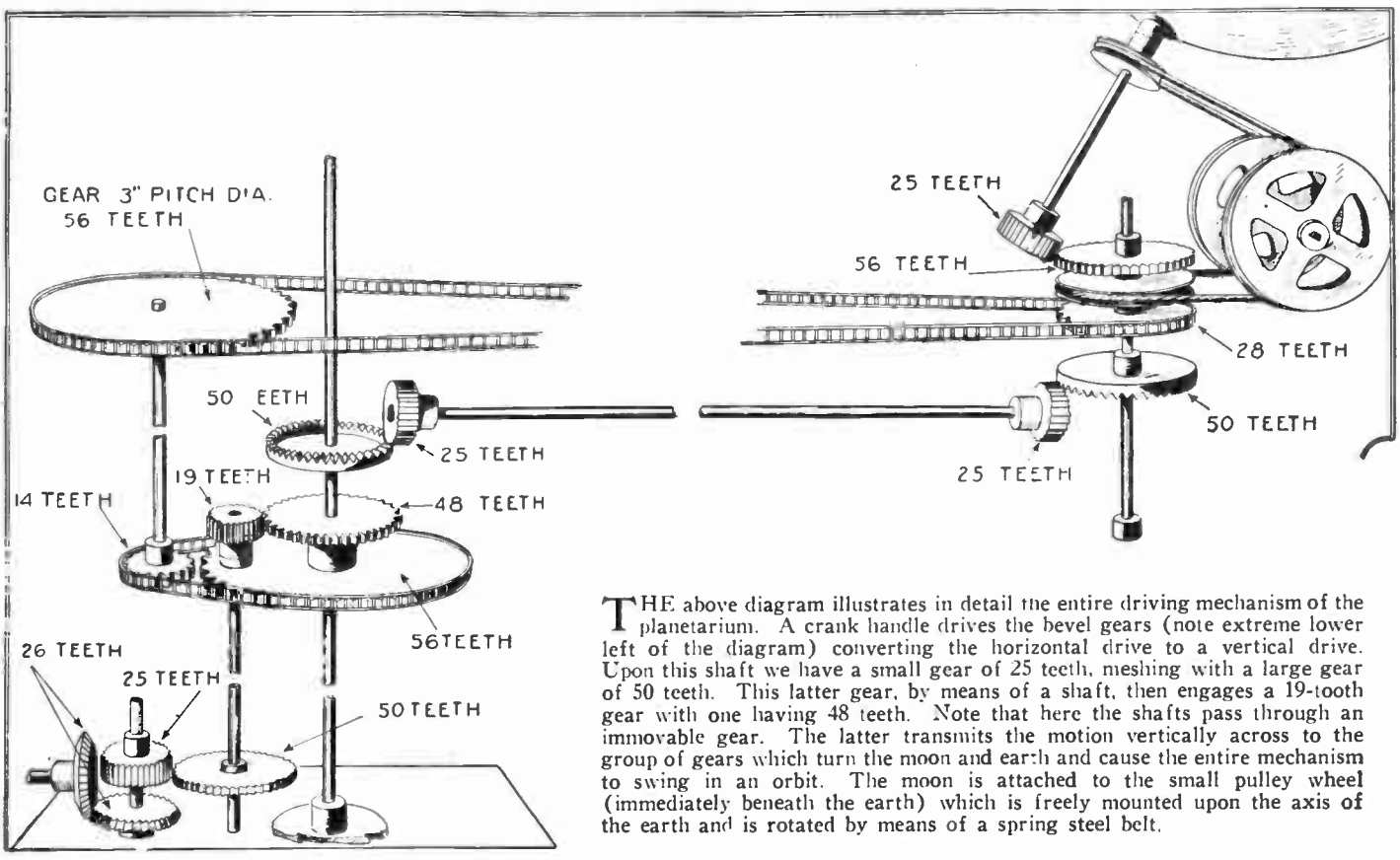


When the moon gets between the earth and the sun, we have an eclipse of the sun. This is strikingly illustrated above. Then as the moon rotates, the various phases, new moon, first quarter, full moon, and last quarter are shown to the student. At the same time that the moon moves around the earth, the earth will be seen to turn around on its axis and both will be moving along their orbits, about the sun, with the moon acting as a satellite of the earth.

Reduction gears are attached to the vertical drive, the final pinion passing through the immovable large sprocket wheel which turns the two horizontal arms.

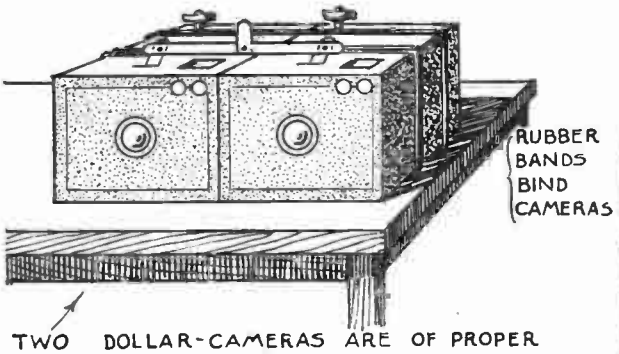


The above photograph shows the pinion driving the crown gear which turns a shaft to which the earth is geared. Note the pulley wheels and the belt for turning the moon.

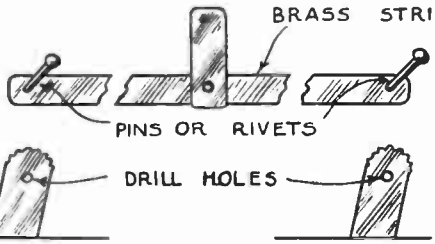


THE above diagram illustrates in detail the entire driving mechanism of the planetarium. A crank handle drives the bevel gears (note extreme lower left of the diagram) converting the horizontal drive to a vertical drive. Upon this shaft we have a small gear of 25 teeth, meshing with a large gear of 50 teeth. This latter gear, by means of a shaft, then engages a 19-tooth gear with one having 48 teeth. Note that here the shafts pass through an immovable gear. The latter transmits the motion vertically across to the group of gears which turn the moon and earth and cause the entire mechanism to swing in an orbit. The moon is attached to the small pulley wheel (immediately beneath the earth) which is freely mounted upon the axis of the earth and is rotated by means of a spring steel belt.

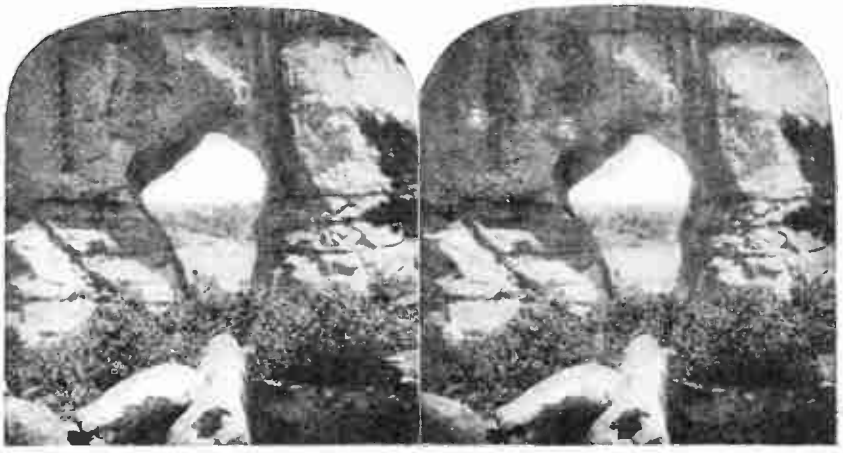
The Stereoscope—



TWO DOLLAR-CAMERAS ARE OF PROPER SIZE TO TAKE STEREOSCOPIC PICTURES

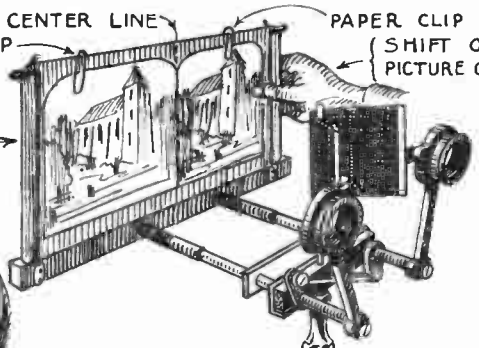


The above illustration shows how two cameras of the dollar type may be bound together by rubber bands, to produce stereoscopic pictures.



The photo above is a typical stereoscopic picture.

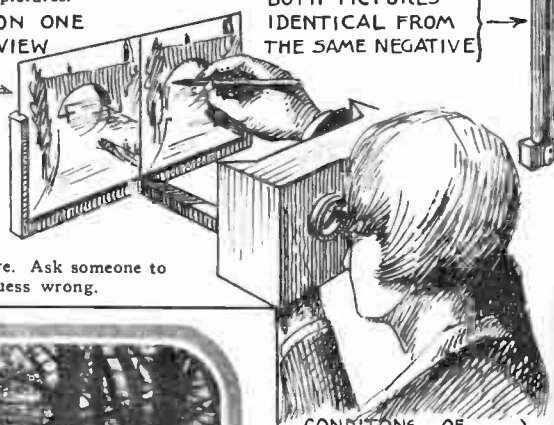
FILMS WHEN DEVELOPED SHOULD BE MARKED AND PRINTED SIDE BY SIDE ON SAME PAPER—THUS

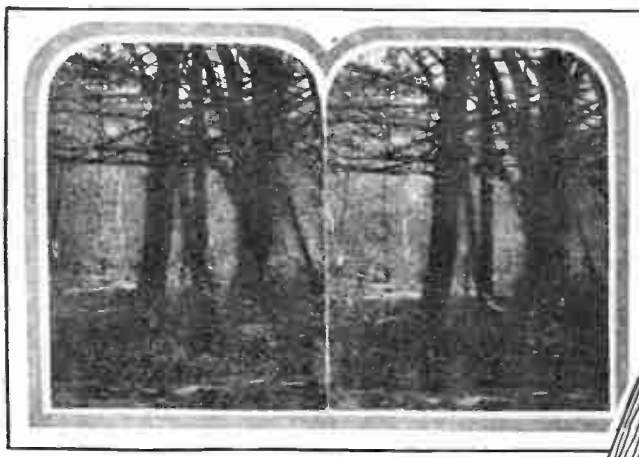


BOTH PICTURES IDENTICAL FROM THE SAME NEGATIVE

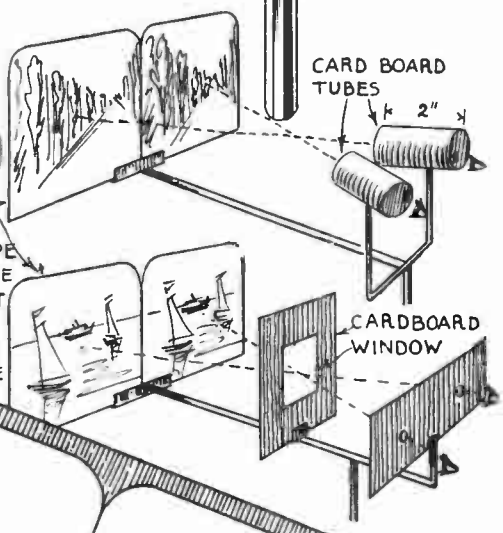
PLACE A SMALL MARK (×) ON ONE PICTURE OF A STEREOSCOPIC VIEW AND LET A PERSON POINT IT OUT

Place mark on left hand stereoscopic picture. Ask someone to point to mark. Invariably they guess wrong.



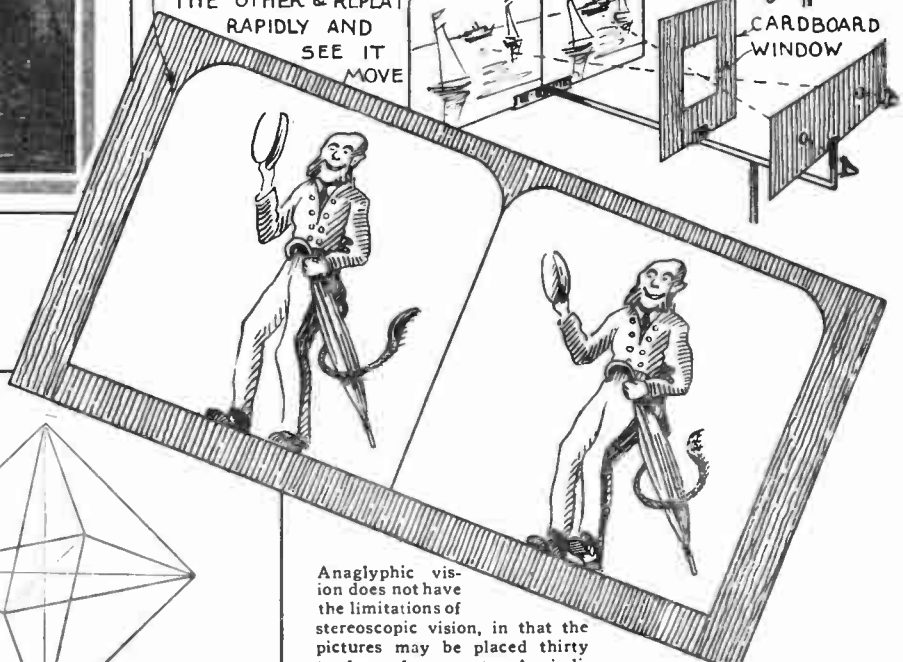


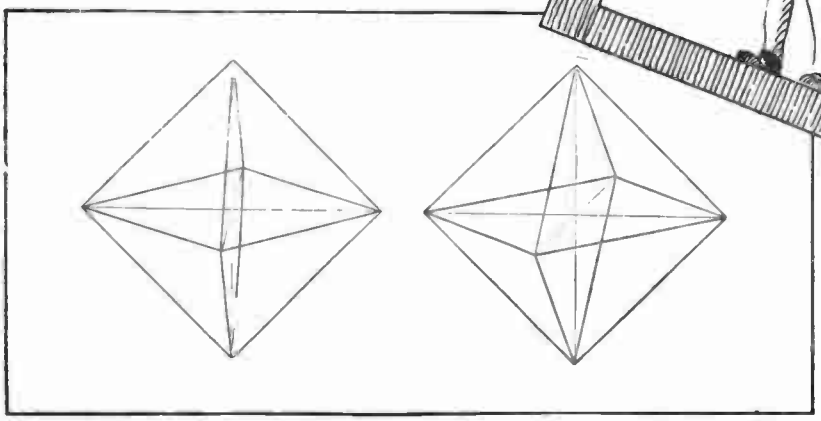
The stereoscopic view above is produced from one negative, two prints being toned slightly differently. They are clipped to cardboard and placed in a stereoscope, and shifted until the proper view is obtained. If the figures at the right are placed in a stereoscope and the eyes opened and closed alternately, they will seem to move.



CONDITONS OF ANAGLYPHIC VISION

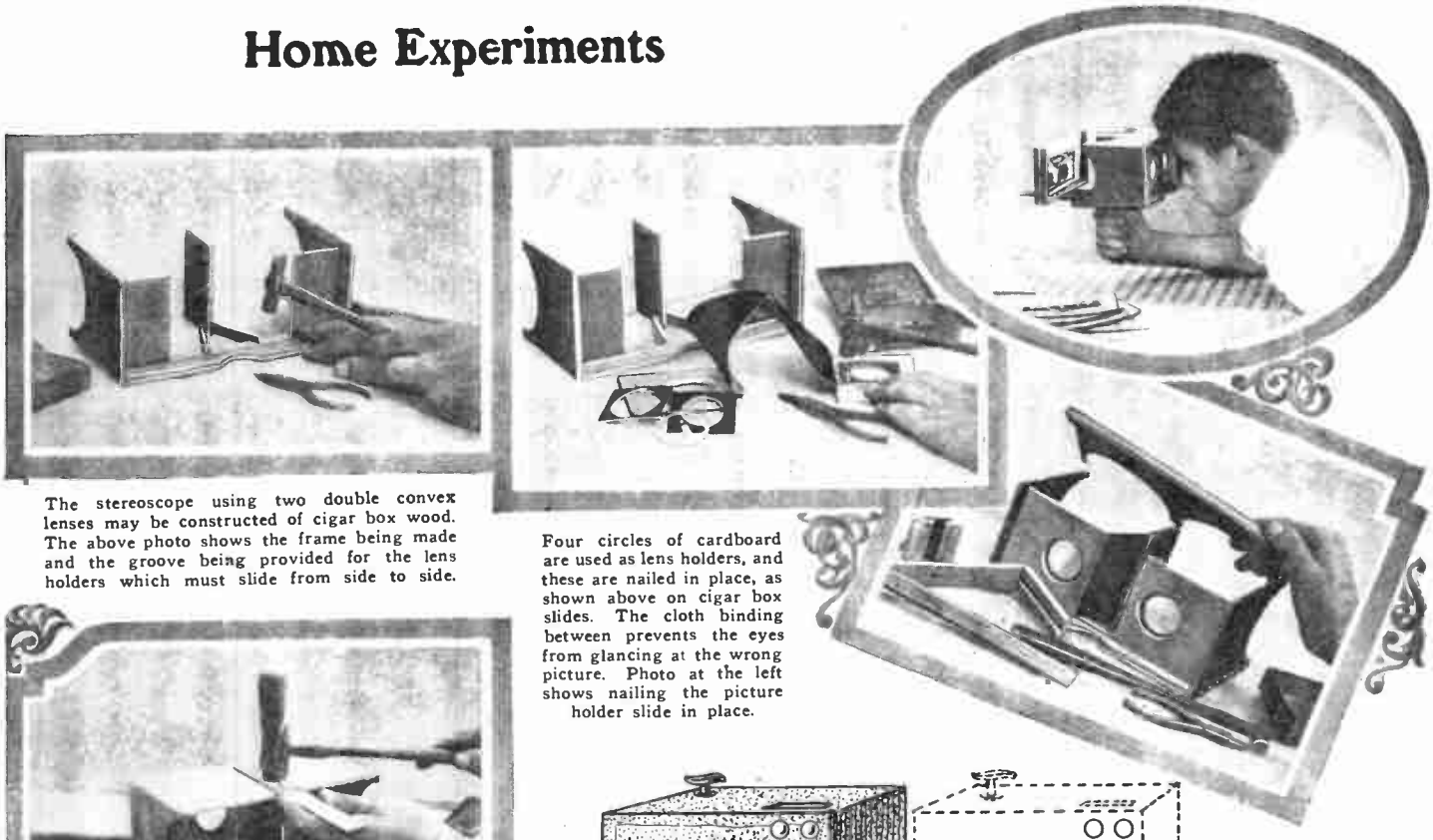
PLACE IN STEREOSCOPE OPEN ONE EYE & CLOSE THE OTHER & REPEAT RAPIDLY AND SEE IT MOVE





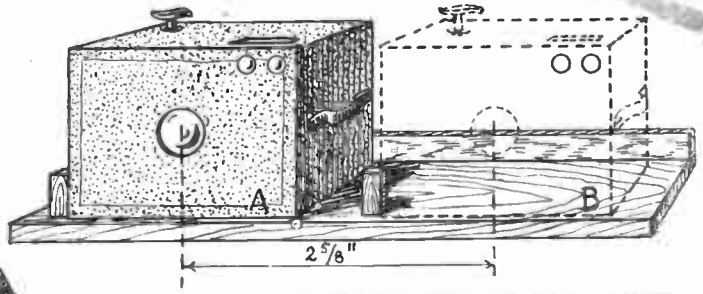
Anaglyphic vision does not have the limitations of stereoscopic vision, in that the pictures may be placed thirty to forty feet apart. As indicated above, the right eye looks at the left picture, and the left eye looks at the right picture. This is rather a strange condition at first, but finally by using the cardboard window and the tubes, as indicated above, a third picture will appear in stereoscopic form. The diagram at the left is to be viewed in this manner.

Home Experiments

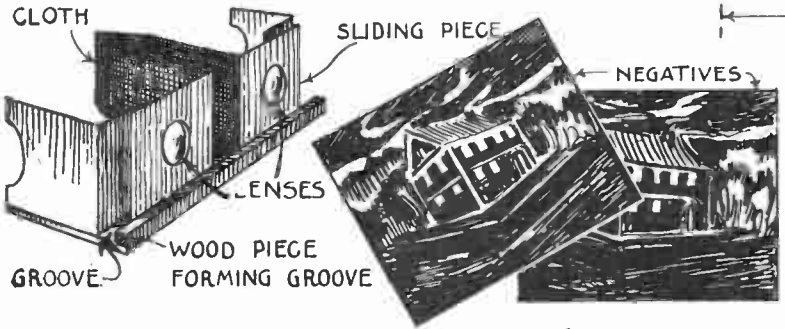


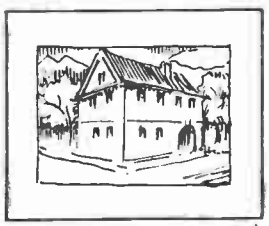
The stereoscope using two double convex lenses may be constructed of cigar box wood. The above photo shows the frame being made and the groove being provided for the lens holders which must slide from side to side.

Four circles of cardboard are used as lens holders, and these are nailed in place, as shown above on cigar box slides. The cloth binding between prevents the eyes from glancing at the wrong picture. Photo at the left shows nailing the picture holder slide in place.

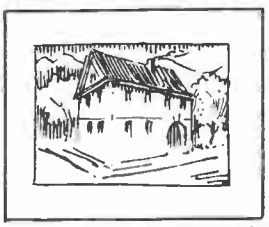


The diagram at the left shows how stereoscopic pictures may be taken with one camera.

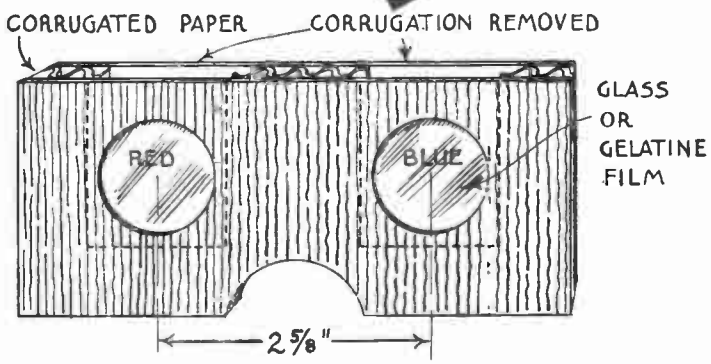


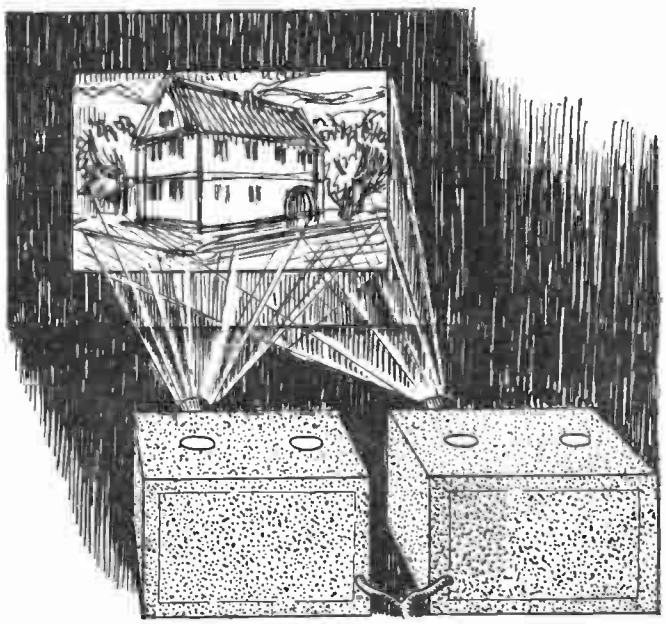


PRINT ONE ON BLUE PRINT PAPER (NOT TOO DARK)



AND THE OTHER ON A PAPER THAT WILL GIVE A RED BROWN PRINT.





On the top of this page Dr. E. Bade shows by photos how to make a stereoscope using two double convex lenses. The reason that this device is comparable with the regular type of stereoscopes is that by properly sliding the lenses out the eyes may be forced to look through the very edge of the lens, duplicating the effect produced by the better class of stereoscopes. The diagram of the device is indicated on this page. Mr. C. E. Payne suggests that stereoscopic photographs be taken in the usual way and that they be printed upon blue and red printing out papers. Perfect stereoscopic results are obtained from this method. The illusion of moving pictures from a stereoscopic view or from two slightly different illustrations was suggested by C. Brust while Dr. Alfred Gradenwitz furnished the material for anaglyphic vision or stereoscopic vision without a stereoscope. Stereoscopic experiments are interesting and are the means of spending a very pleasant evening, serving to instruct simultaneously with their entertainment.

Making Toy Balloons

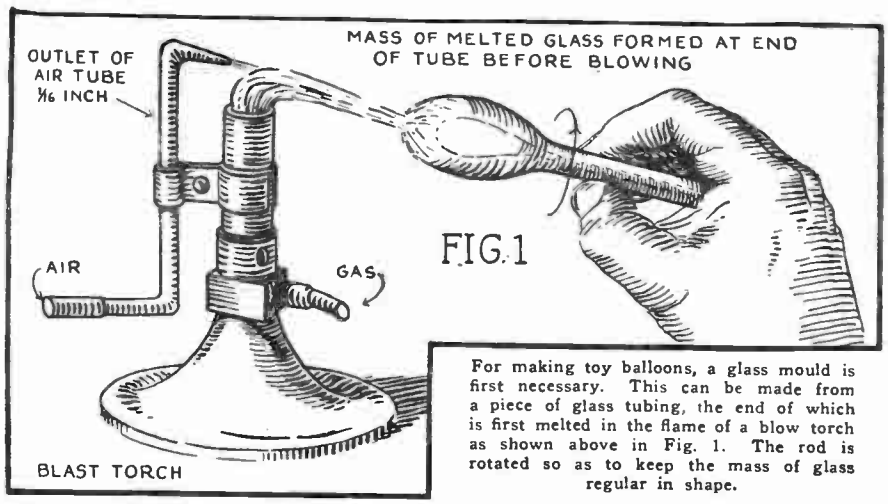


FIG. 1

For making toy balloons, a glass mould is first necessary. This can be made from a piece of glass tubing, the end of which is first melted in the flame of a blow torch as shown above in Fig. 1. The rod is rotated so as to keep the mass of glass regular in shape.

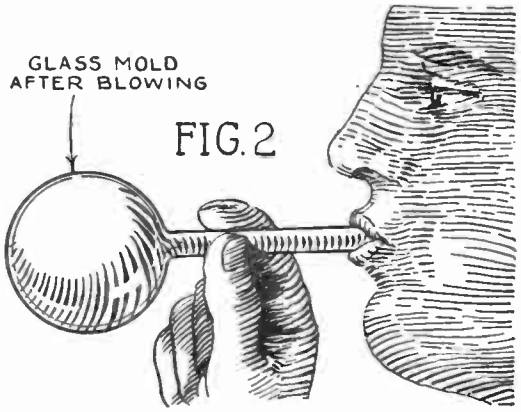


FIG. 2

After a sufficiently large mass of melted glass is formed, a bulb is blown on the end as shown in Fig. 2. It may take several attempts to produce a satisfactorily shaped mold. The air pressure should be slowly and evenly applied, continually rotating the tube. As shown in Fig. 3, other forms may be used for large molds.

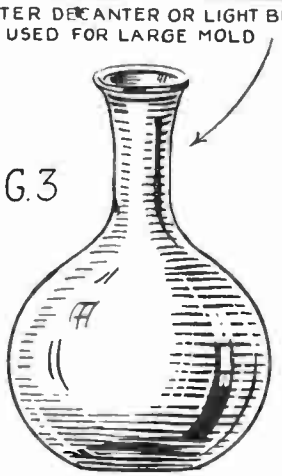


FIG. 3

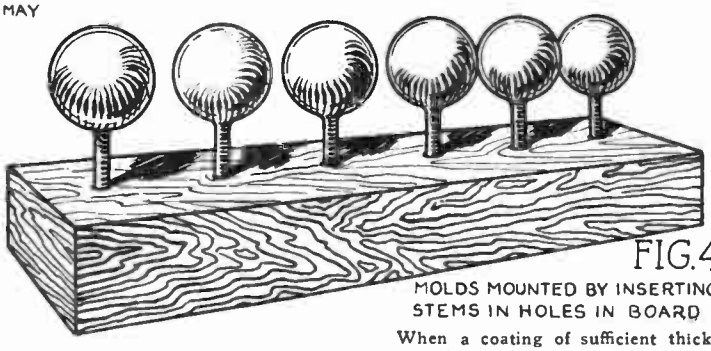


FIG. 4

MOLDS MOUNTED BY INSERTING STEMS IN HOLES IN BOARD

Mount the molds as shown in Fig. 4. Then suspend them in a solution as in Fig. 5. The solution is made by cutting four ounces of crepe rubber into fine bits and dissolving it in gasoline.

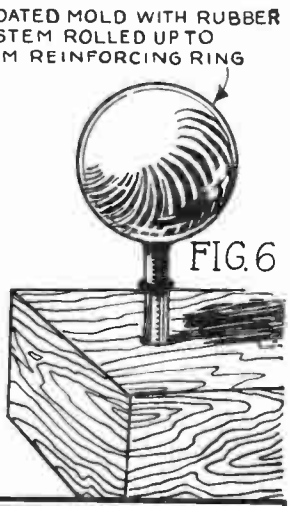


FIG. 6

When a coating of sufficient thickness is obtained, remove and proceed as in Fig. 6. Then dip in solution of 2 ozs. sulphur chloride and 20 ozs. carbon disulphide to vulcanize. Test solution to be sure that it vulcanizes properly.

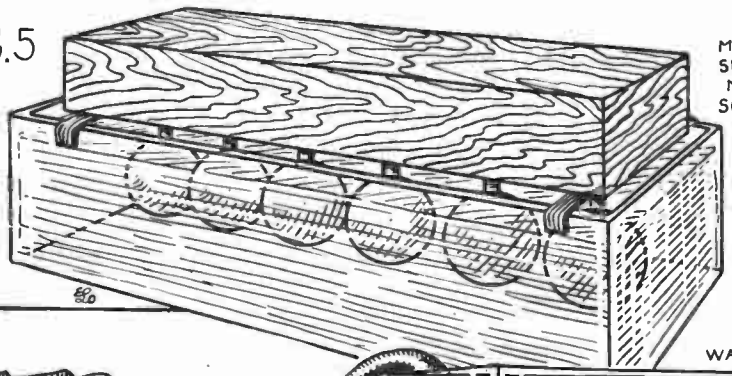


FIG. 5

METHOD OF SUSPENDING MOLDS IN SOLUTIONS

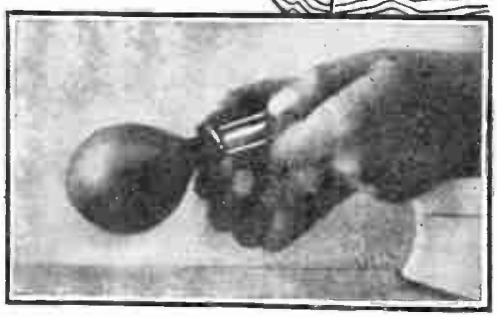


FIG. 7

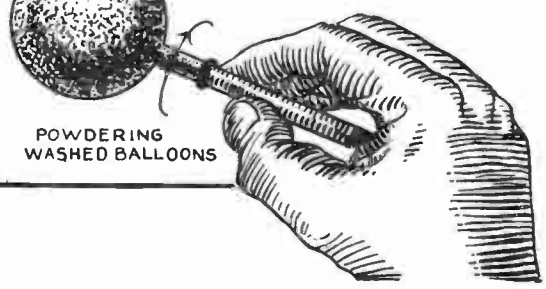
Wash the balloons thoroughly as shown in Fig. 8

WASHING VULCANIZED BALLOONS

FIG. 8

After the balloons are thoroughly vulcanized and washed, remove them with the molds from the supporting block and cover each one with talcum powder. Remove from the mold, turning inside out and coat other side with powder. The balloons can be filled with hydrogen as in Fig. 9. Use hydrochloric acid and zinc.

—R. R. Henderson.



POWDERING WASHED BALLOONS

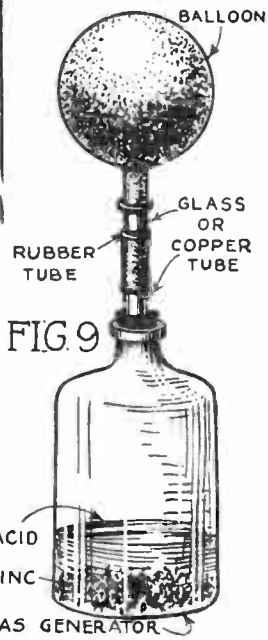
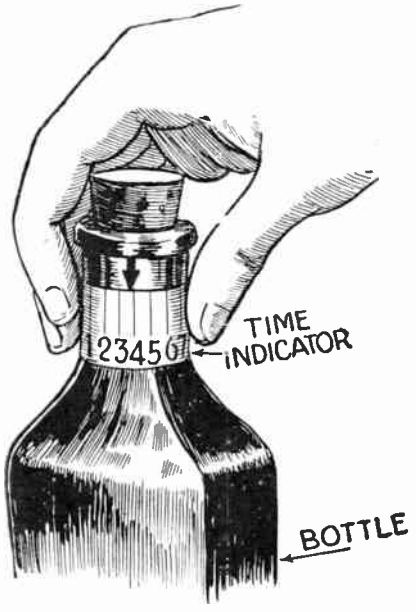


FIG. 9

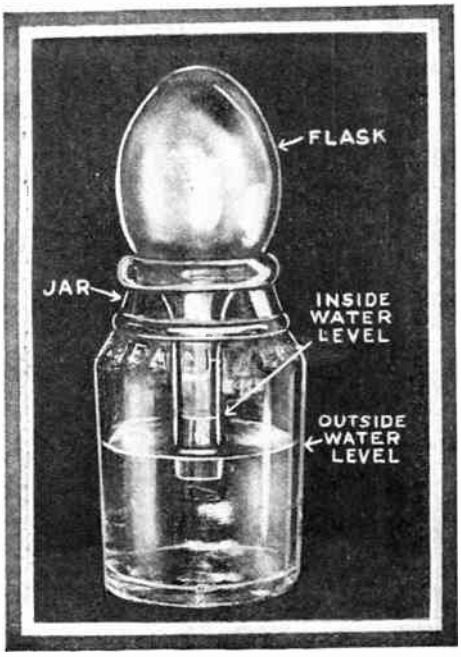
HOW TO MAKE IT

Reminder



A strip of white paper placed around the neck of a bottle with the ends pasted together so that the resulting band can be turned, serves as a reminder of the exact hour when medicine is to be taken if it is marked with the various hours as shown above. An arrow is to be painted on the neck of the bottle. When one dose is taken the band is turned so that the arrow points to the next hour at which the dose is to be repeated. —K. B. Murray.

Barometer



One of the simplest weather forecasters is the water barometer. A simple one may be made as shown above. A flask of any available size is inverted in a jar which is half full of water. It will be found that the water will rise or fall in the neck of the flask in accordance with atmospheric pressure. A rise indicates fair weather, while a fall means a change.
—S. Leonard Bastin.

Restoring Tracings

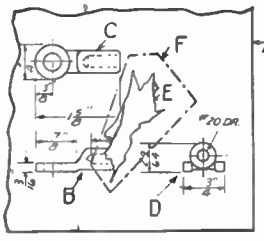


FIG. 1

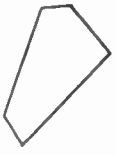


FIG 2

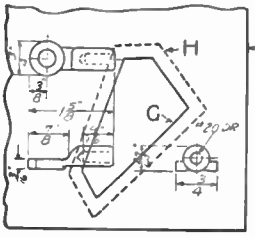


FIG. 3

FIG 4

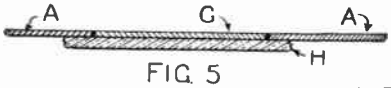
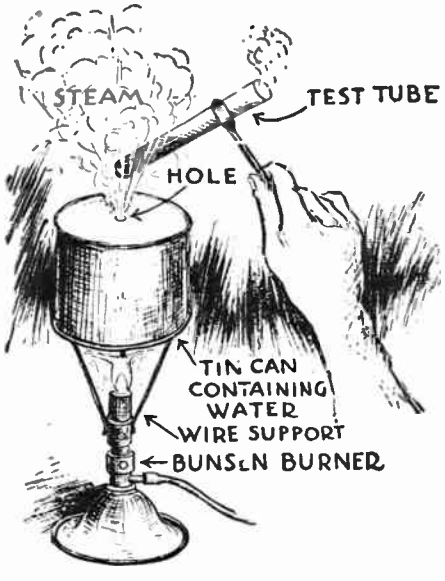


FIG. 5

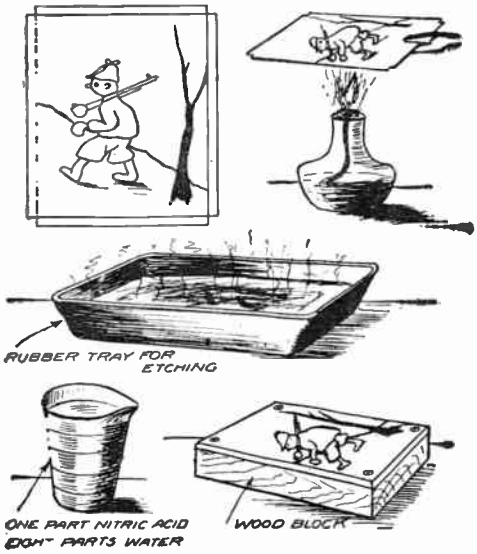
When a tracing is mutilated as shown in Fig. 1, it may be restored. The tear is at E. A second sheet of tracing paper is placed beneath the drawing and a section, F, is cut from both cloths, obtaining a strip from the new sheet which will fit into the removed portion of A. The new piece is placed and fastened with an overlapping strip and collodion. In Fig. 5, A is the original sheet, G the replacement, and H the binding strip. The removed portion is redrawn on the new piece.
—Gustavo Gallopin.

Test Tube Heater



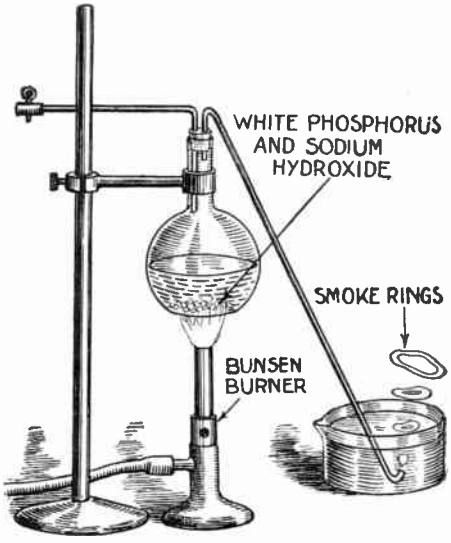
When materials in a test tube have to be carefully heated, the device illustrated above comes in very handy. A small tin can is fitted with a wire support and held above a Bunsen burner. Water is poured into the tin can and the cover, with a hole punched therein, placed in position. Heating the water soon evolves steam which in turn may be used to heat the test tube.
—Robert Rogers, Reporter No. 11,229.

Zinc Cuts



To make your own zinc cuts, draw the required picture on a sheet of zinc with printer's ink mixed with oil of wintergreen. Cover surface with powdered resin and fuse over flame. The sheet zinc is then etched in a bath of one part nitric acid to eight parts of water contained in a rubber tray. The zinc plate is then carefully washed and may be mounted on a wooden block ready for use in a press.
—George J. Gould.

Smoke Rings



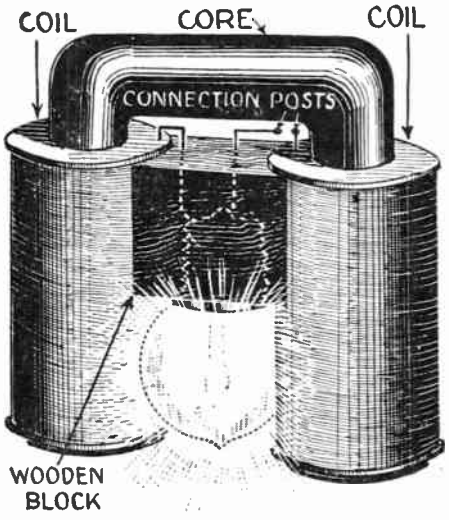
By setting up the apparatus as shown above and boiling the solution, phosphine will be evolved and when the bubbles reach the surface of the water in the beaker, they will spontaneously catch fire and form smoke rings. Before starting experiment, it is advisable to pass illuminating gas through the flask to remove all the oxygen that may be contained therein. The second tube shown is for this purpose.

WRINKLES

RECIPES & FORMULAS

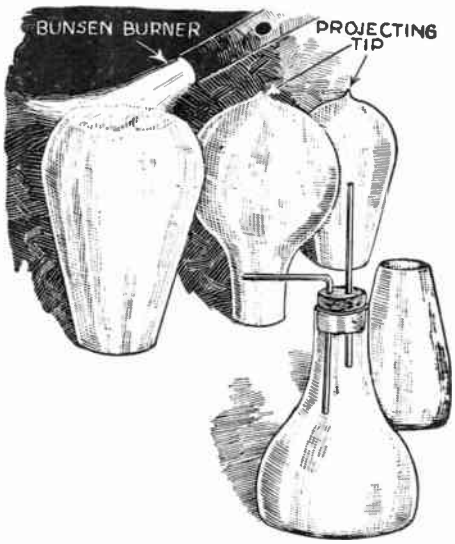
Edited by S. Gernsback

Trouble Lamp



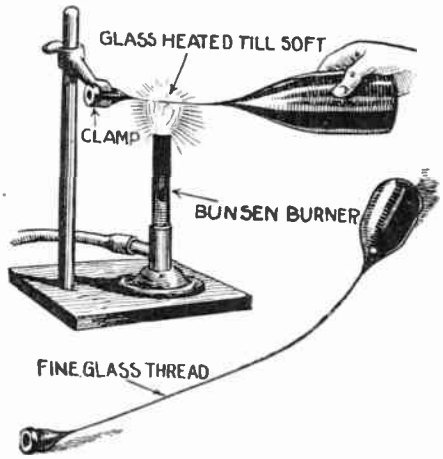
A handy trouble lamp for use around an automobile is made as shown above. The magnets will hold the lamp in any position, while the current is on and if the unit should become detached and fall, the magnets protect the lamp.
—William Nicholson.

Flasks



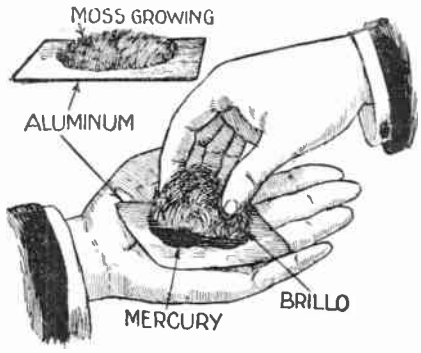
Handy flasks may be made from various types of electric light bulbs. The brass base is cut off and the edges of the glass rounded. If flame is then applied to the opposite end, the glass will be depressed so as to form a base.
—G. M. Blackford.

Glass Threads



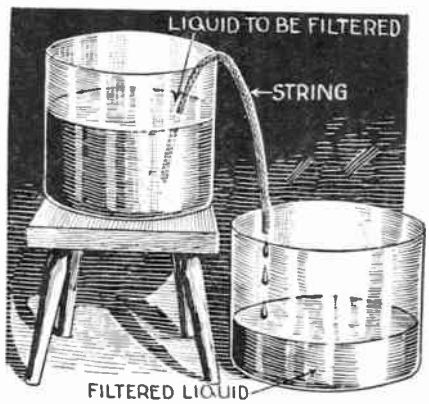
Fine glass threads are often required in various experiments. They may be quickly and easily made as illustrated above. Clamp the neck of a bottle in position and then heat the point shown. When the glass is softened, throw the bottle as far away as possible. A long fine glass thread will result.
—Arthur A. Blumenfeld.

Aluminum Oxide



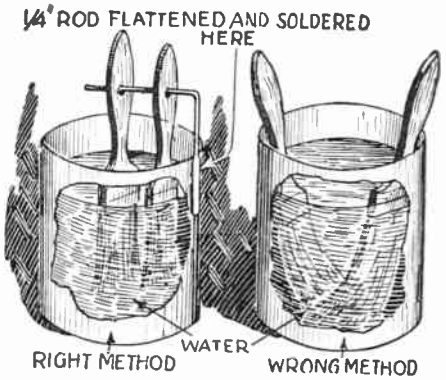
A pretty experiment involving the preparation of aluminum oxide may be performed as above. Place a few drops of mercury on a strip of aluminum and rub briskly with steel wool for a few seconds. A moss-like substance, aluminum oxide will "grow" on the aluminum.
—Arthur A. Blumenfeld.

String Filter



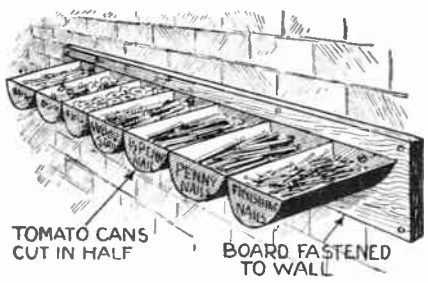
By wetting an ordinary cotton string, it may be used as a filter as shown above. The end from which the filtered liquid drips must be lower than the surface of the liquid to be filtered.
—Arthur A. Blumenfeld.

Paint Brushes



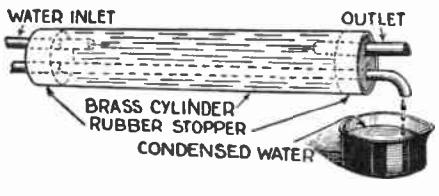
When paint brushes are left standing in water as at the right, the bristles are pressed out of shape. If, however, holes are drilled in the handles, the brushes may be protected by the water and the bristles kept straight by suspending from a rod as shown.—F. J. Wilhelm.

Parts Rack



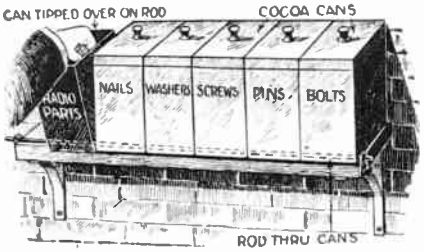
A rack for holding various small parts around the shop may be made from several tomato cans cut in half and mounted as shown above.
—F. J. Wilhelm.

Condenser



A chemical condenser may be quickly made from a few odds and ends as shown above. A brass cylinder, 3 glass tubes and 2 rubber stoppers are required. They are assembled as shown above and water lead into the inlet pipe whereupon it cools the continuous tube and flows out of the outlet.——William F. Pond.

Rack



Another rack for various parts may be made of large cocoa cans placed on a shelf which does not extend quite to the edge of the can. A rod passed through them serves as a pivot.
—F. J. W.

Readers Forum

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

ANTI-GRAVITATION SCREEN

Editor, SCIENCE & INVENTION:

In one of Clement Fezandié's articles on the "Dr. Hackensaw's Secrets" series, about the perpetual motion machine, there was a sentence which reads: "At the bottom of this heavy cylinder that you see here is a gravitation screen that may be opened or closed at will. When closed, the attractive force of the earth is partially or wholly shut off. The air above the car loses its weight and the atmospheric pressure from below will force the car upward with a pressure that can reach as high as fifteen pounds to the square inch."

I wish to disagree with this statement. I maintain that if an object should lose its gravity, there would be no natural force to start it moving unless it would be the tendency for movable objects to fly away from whirling objects, as might be the case on this earth. I believe that an object without gravity, would have no friction, and if it were started moving it would keep on moving forever until something stopped it. This would be perpetual motion, in itself, provided that gravitation could be removed without incurring a loss of energy.

If the cylinder spoken of were to do as the author states, would not the air above the cylinder have to be treated also? In an earlier issue where Dr. Hackensaw made his Rad-aluminum, he says: "A piece of it flew up to the roof because it was so light." As his gravitation screen was made out of this material, I would not call his machine an anti-gravitational machine, but rather a device which was carried up by a metal very much lighter than the air. Considering the other side of the question, however, a metal that is lighter than air might be one that gravity had but little effect upon. If the machine had no gravity, however, I do not believe that it would act in the manner described, so I am asking your opinion on this matter.

I enjoy SCIENCE AND INVENTION very much and am especially interested in the new story about the Antarctic, "The Living Death."

ARTHUR J. SNYDER, Springfield, Idaho.

(You can well realize that the atmosphere of this earth is held down to the earth by means of the pull of gravity. Consequently if an anti-gravitational screen were employed, the air immediately above the anti-gravitational screen would rush upward. Surrounding air not affected by the anti-gravitational screen would rush in to fill the place vacated by the rising air, and as the surrounding air rushes in it in turn becomes affected by the anti-gravitation screen and moves upward rapidly. Consequently any object in this particular zone would be lifted upwardly by the rising air or by the atmospheric pressure acting beneath the object. It is for this reason that the assertion made in Clement Fezandié's story is scientifically correct, even though it is far fetched. Up to the present time no anti-gravitation screen has been developed, although experiments along this line were made using high frequency currents to create the desired effect. You must realize that the anti-gravitation screen would be effective, regardless of whether an atmosphere were present or not. If the area in which it works were devoid of atmosphere, then the slightest push would cause the machine to rise upwardly. If the machine were lighter than air, it could but rise in the air to such a height until a state of indifferent equilibrium, as we may call it, were produced, where the buoyant gas or body would float in a rarefied atmosphere. Consequently a machine lighter than air could not possibly rise as high or as rapidly as a machine acted upon by an anti-gravitational screen. The whirling tendency of the earth need not necessarily have any effect on the end result of the operating devices. Your statement to the effect that "a metal that was lighter than air might be one that gravity had little effect upon." is therefore answered in the negative.—EDITOR.)

FORTUNE TELLERS

Editor, SCIENCE AND INVENTION:

Will you please tell me through your Readers' Forum column what the fortune teller's trick is? I always regarded fortune tellers as liars, but I went to one of them more out of curiosity than anything else. This woman read the top of my head and many of the things she told me came true. After I had been informed as to past and present conditions, I began to wonder how she knew of those things. I went to another fortune teller and to my surprise the second fortune teller told me about 95 per cent. of the same information which was given to me by the first one. Since that time I have been to about half a dozen of them, and they all told me about the same thing.

Now don't think for one moment that they told me I would be a millionaire, and that everything they said tickled my vanity. As a matter of fact they told me as many good things about myself as those which were bad.

I then went to a gypsy who was one of the types who go into a trance and then went to another who used a crystal globe to gaze into, and they told me the same thing. How do they do it?

I took a friend of mine to another one, and although the advice given me was much the same as on all of the previous occasions, that given to my friend was entirely different, and those things which were told about him were as true as those told concerning me. I am not signing my name or giving my address because if some of my other friends would see it in print, they would ridicule me and call me superstitious.

What I would like to know is how can a fortune teller foretell the things which are to happen in years to come, and which already has been done for me? Do they use tricks, or are they born with that power to foretell a person's future? Are they mind readers, and if so now can they foretell a person's future which shortly thereafter comes true when the person himself who is having the reading did not know of those things, nor did he have the slightest inkling as to their possibility?

Regarding perpetual motion, if the inventor will show you his perpetual motion motor working, and show you how the same is constructed, will you give him the $1,000 at any time or have you a limited time when this award expires? Would you claim any rights to the invention? I have built a motor which though not working as I expect it should, is running by itself. At the present time, however, the motor always runs at the same speed, and I cannot make it go slower or faster. I intend to correct this later on.

A READER, Cleveland, Ohio.

(There is absolutely nothing in fortune telling. This statement we make to include the ordinary fortune telling, palmistry, phrenology, astrology, and any other form of fortune telling which may exist now or at any time. The palmist, astrologer and phrenologist works on the law of averages. He realizes that a certain type of hand is found more often in a certain class of men having certain characteristics than in others. By the callouses on the person's hand, he can tell whether the individual is a hard worker or whether he pushes a pen. Nevertheless, he could often meet a man whose hands are well calloused, and who is a literary genius, but if we take one hundred men with callousd hands, we would probably find that ninety-nine of those hundred performed manual labor. Consequently, the fortune teller could not be far from correct. The same is true of the phrenologists and the astrologers, but neither of them are infallible by any means. By taking advantage of a man's facial changes when certain things are told him, the would-be fortune teller can expatiate upon his or her original statement and make it sound really wonderful.

Furthermore, those traits of character which do not befit the individual are not remembered by him. Those of which he is conscious are easily remembered, and consequently he thinks the fortune teller is particularly wonderful. We only remember the things that please or greatly displease us.

We are conscious of the fact that in making these statements we will hear from a great many astrologists, palmists and phrenologists, all purporting to tell us how absolutely scientific their various methods are. Nevertheless, we have an outstanding award at the present time under the heading of our psychical contest, which gives to any individual the sum of $1,000 should he foretell an event of such a nature that he will have no control over the same, and we will be glad to extend this so that it will include phrenologists, palmists and other fortune tellers possessing so-called powers of divination.

With reference to the perpetual motion machine, we would advise that if your device operates as stated, and it uses as its principle of operation gravity, the same could be classed as a perpetual motion machine. Of course, a device working on temperature changes, atmosphere pressure changes, natural evaporation or any of the other natural phenomena, could not be considered to be a perpetual motion machine. Such a device would not work under all the conditions of our daily life. The device you have suggested would have to be eligible in this contest, and although there is a time limit to the contest which must be made in accordance with the post office regulations, the contest will be extended for another year when the time elapses, unless someone comes to claim the reward in the interim. The prize has been extended to the sum of $5.000.—EDITOR.)

HEAT CONDUCTIVITY OF WATER

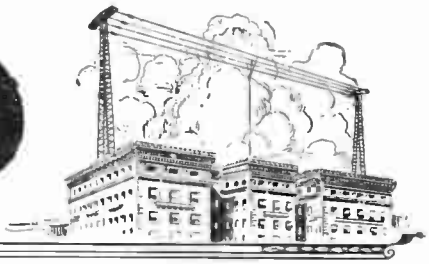
Editor, SCIENCE AND INVENTION:

I notice in the February issue a questionable demonstration of the heat conductivity of water. Maybe the author of the subject would be interested in knowing that the gasoline should have been ignited under the vessel of water instead of upon it. I wonder if the housewife could cook food under a flame, just as easily as she could by placing it over the flame.

The author of that article might be interested in knowing also that there are millions of internal combustion engines using water to conduct heat away from them, and multitudes of homes are using water to conduct the heat to their different rooms. No—water is not such a bad conductor of heat at that.

(Continued on page 80)

RADIO



Radio From Cellar to Garret

The loud speaker system installed in this house is quite easy to duplicate. A pair of wires run through all rooms where a loud speaker is wanted. The loud speaker is then plugged in at will by the use of a jack and plug system.

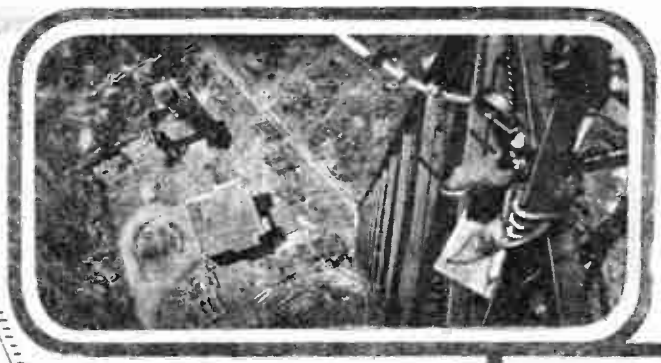
THIS is a happy family, since loud speakers have been installed in every room. Grandpa now enjoys his daily dozen. It certainly gives him a great appetite for his morning meal. Willie is very busy in his "laboratory" developing the new "Dumbodyne" circuit. Milady in her chamber is dressing to the tune of some snappy music. The maid does her serving with light steps. Mother no longer has to tell baby bedtime stories, the radio does that now. Aunt Jemima certainly does prepare delicious flapjacks, according to the latest recipes. Before the radio was set up, sister and her boy friend used to sit around and. . . . but now they are learning the latest dance steps to tunes coming from a popular orchestra. Dad is busy developing a new circuit, which to his mind, will work wonders. Messenger boys enjoy coming to this house even though they don't get a tip, because now they can hear the latest tunes, long before they are out for sale to the public.

Dangerous Static

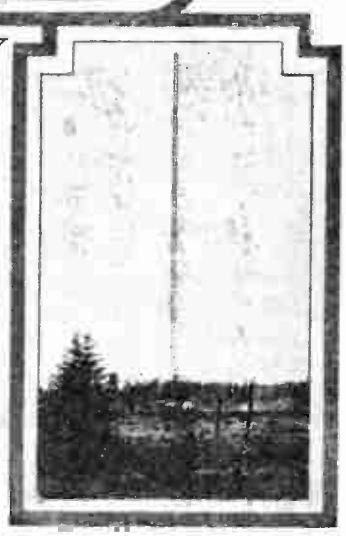
By HENRY A. DENEEN, Reporter No. 17,129

The author swinging aloft on one of the very large high tension insulators, surveying the wonderful view of the surrounding country and unconcerned i.. his elevated position.

While engaged in cleaning the insulators of the antenna system, the accumulation of static may become so great as to render one unconscious if by chance he accidentally touches the aerial wires. Station KEK at Hillsboro, Oregon, is an especial one where the ungrounded antenna becomes excessively charged to a high potential in a period of less than two hours. The diagram shows how the charge is induced from overhead clouds and grows weaker near the ends of the wires. It is necessary to short-circuit the system at the top through the steel mast.

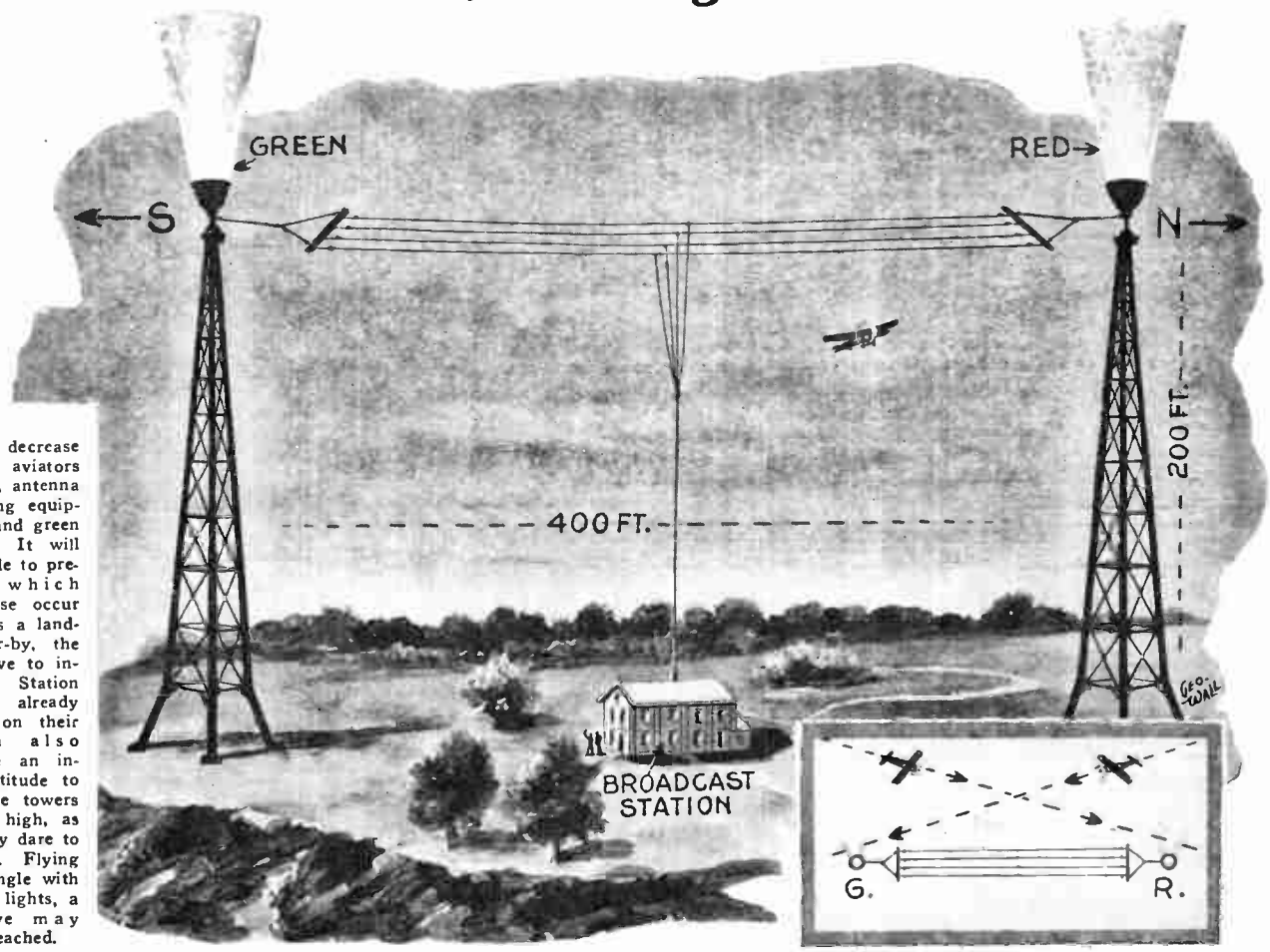


Looking down from the precipitous height of 600 feet to terra firma. From this position one is apt to contract a severe case of dizziness which may cause him to lose his nerve and let go. Steeplejacks find great joy in doing their precarious work.



Pointing upwards as straight as an arrow, the mast is awe inspiring.

Aerial Guide for Night Fliers

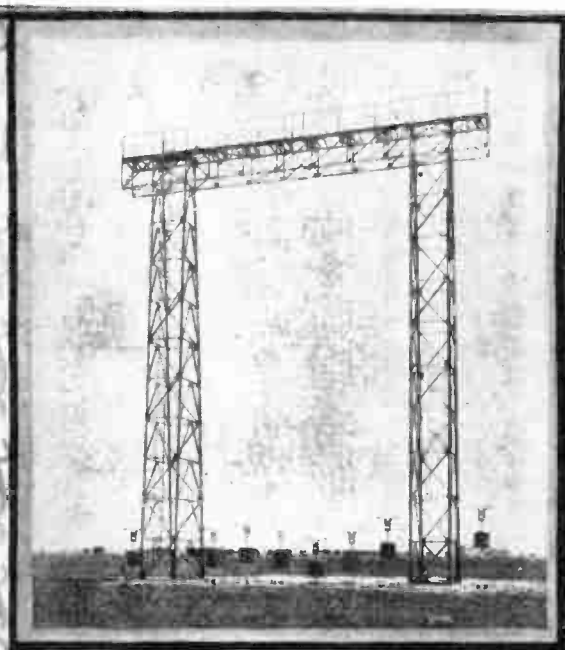


In order to decrease the danger to aviators flying at night, antenna masts are being equipped with red and green signal lights. It will thus be possible to prevent mishaps which might otherwise occur and if there is a landing field near-by, the lights will serve to indicate it. Station WLW has already placed lights on their towers which also serve to give an indication of altitude to the pilot. The towers are 200 feet high, as low as one may dare to fly with safety. Flying at a certain angle with respect to the lights, a given objective may readily be reached.

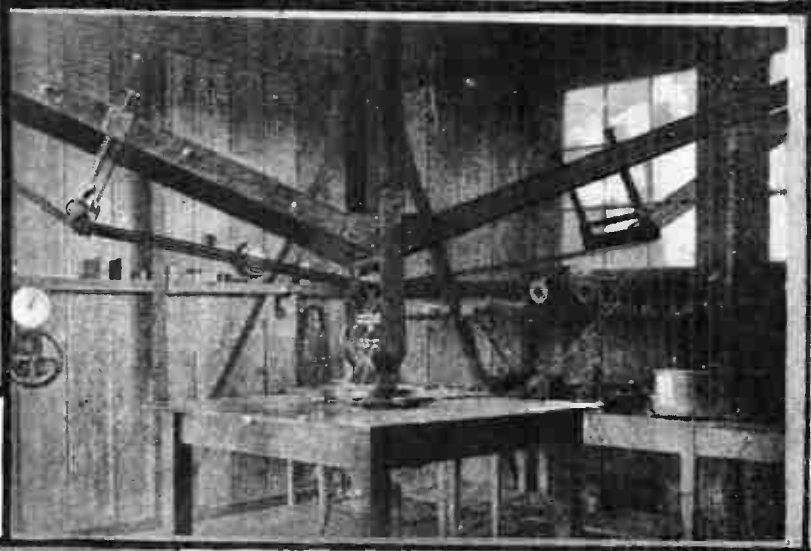
Monte Grande Station

By DR. ALBERT NEUBURGER

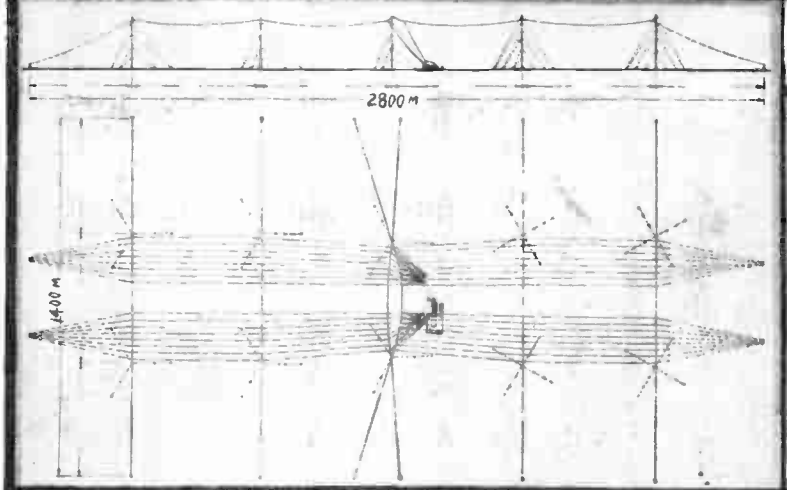
Recently completed, a very large radio station which will keep Argentina in constant touch with nearly all countries of the world, the Monte Grande assemblage ranks as one of the most powerful in existence. Located a distance of 12 miles from Buenos Aires, the 2,800 meter antenna, a veritable giant of the T type, radiates on a wave-length of 17,300 meters. It points in the direction of northeast to southwest, towards Europe. Each of the 16 wires comprising the aerial is nearly 1 mile long, more than 1,000 huge insulators being necessary to support them. Immediately underneath the antenna is buried a vast network of wires used on the ground connection.



Towering nearly 500 feet into the clouds, the splendidly designed masts support the antenna by a system of counterweights which allows for the expansion and contraction of the wires due to temperature change. The masts are of steel construction throughout.

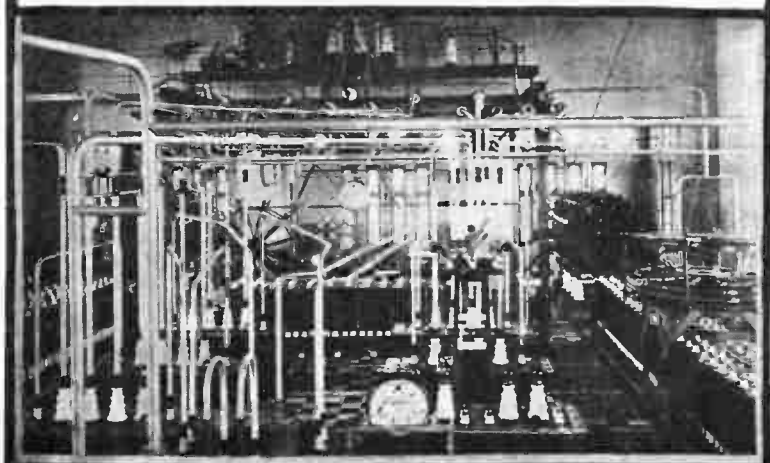


The receiving station which is located 28 miles from Buenos Aires employs the above gigantic loop antenna for trans-oceanic reception. Note the solidity of its construction.



Above: Showing the immense area of ground occupied by the antenna system which is rigidly guyed and carefully anchored to large concrete blocks, by strain insulators.

Below: Interior view of the central power station which supplies 1,000 k.w. at 12,500 volts potential to the transmitting circuit. Special water cooling systems keep the high frequency machines from over-heating.



The building which houses the extensive transmitting equipment. Monte Grande is a vital connecting link which will materially aid our commercial interests with South American countries.

The Radio Cheater

By JOHN LEMLEY

HOW an over-zealous young Alsatian medical student attempted to go a step further than to "cram" at the last moment before the final examination and use radio telephony to get by, is graphically shown by the accompanying drawing. Having previously stolen a copy of the examination paper which he gave to his girl chum, he assumed a nonchalant attitude and proceeded to write the answers as the girl slowly dictated them. She was established in a nearby apartment which was equipped with a complete short-wave radiophone transmitter, unknown to the authorities.

If we knew the truth, radio pocket sets played a greater rôle than we ever imagined in the World War. Pocket radio sets are being used by racetrack bookmakers and gambling houses.

SEWED inside the coat which he wore, was a loop antenna. In one of his pockets was a coil, two condensers and a crystal detector of the fixed variety. The set was semi-aperiodic, being exactly tuned to the wave-length of the transmitter. A very small phone which was easily concealed within his palm, brought him the much needed information. Everything was hidden, the phone cord being inside of his sleeve. His countenance was one of deep thought and it appeared as though he was engrossed in hard thinking.

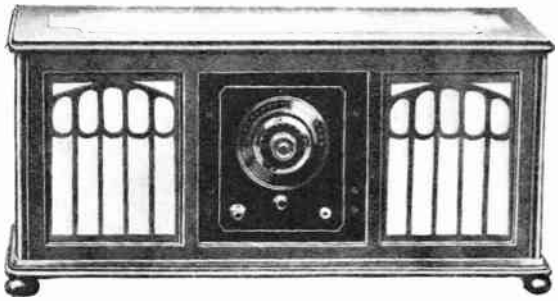
But, he was caught, exposed by a rival. Expulsion was the penalty. As for the girl, she was obliged to flee the city with him. Strasbourg, France, has a story which in time to come will oft be repeated, "The radio cheater."

Pocket radio sets can be made very compact and sensitive by using peanut audions with one or more stages of amplification.

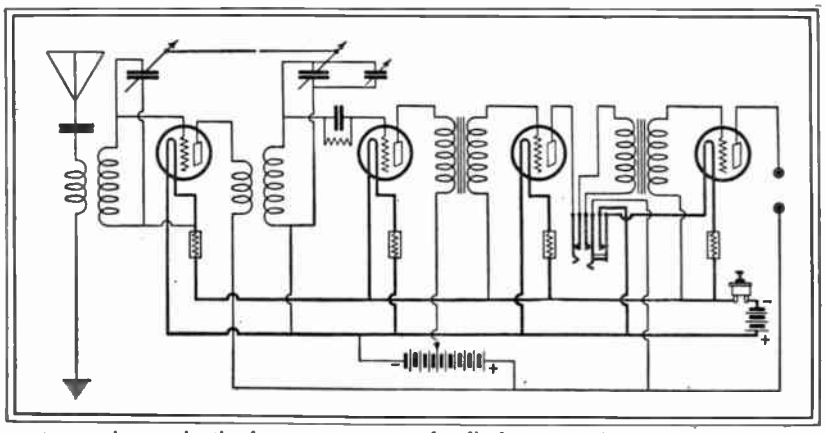
Single Control Receivers

PART 2

By LEON L. ADELMAN, A. M., I. R. E.

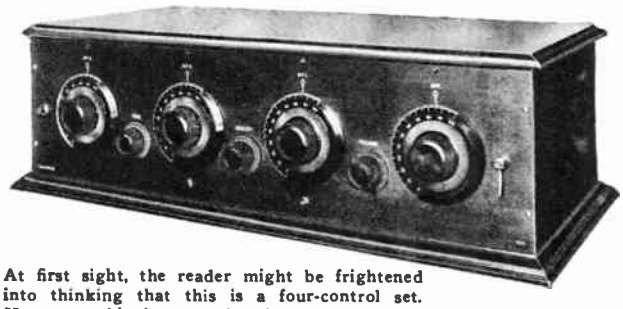


With the use of tuned radio frequency amplification constantly increasing, it was obvious that, if the set was to become a popular one with amateurs, the controls would have to be simplified. The latest development along this line is the use of gears for connecting the tuning condensers on the radio frequency amplifier stages with the detector circuit condenser, and working all of them from a common control. In the assembly of the set, the condensers and coils are matched as carefully as possible, so that the adjustment of the vernier will be reduced to a minimum. In order not to ground the circuit through the condensers, gears made of insulating material are used. In the set illustrated above, there is one main tuning dial which controls the two condeners by the use of gears, and directly under this main control is a small vernier to take care of any change in the circuit. On the lower left-hand corner is the filament switch which cuts out all tubes. In the lower right hand corner can be seen the filament control jack which eliminates one stage of audio frequency amplification.

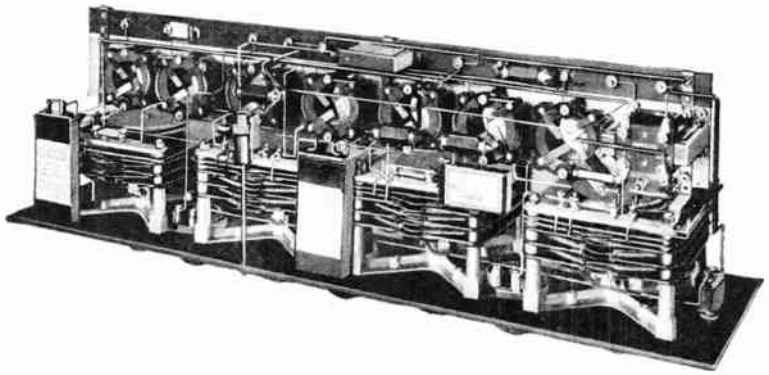


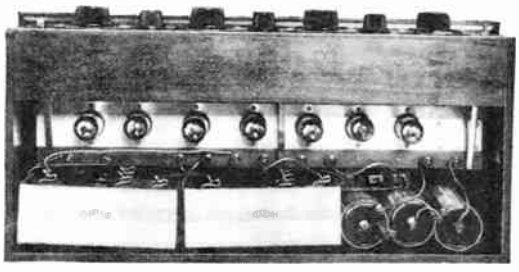
As may be seen by the d.agram, one stage of radio frequency, detec.or and two stages of audio frequency are used. The fixed condenser in series with the antenna is used to cut down the actual length of the flat-top, otherwise, the tuning of the set would be broad. Experiments have shown that the set can be built so as to obviate the use of separate filament controls for each tube. Use of automatic filament resistances provides for the necessary adjustment, without necessitating manual regulation. Removable automatic filament resistances allow the use of all types of tubes by replacing the resistances furnished with the set with correct resistances for the types of tubes preferred.

In order to prevent any back lash in the tuning control, small close tooth-gears are used. For proper operation of the set, tapped "B" batteries for the detector circuit are recommended. The simplicity of control and the results obtained from this set are very gratifying, even to the most skeptical user. Altogether, a design of this type is the forerunner of the chief developments in broadcast receivers to be brought out this coming year. Simplicity should be the pass-word.

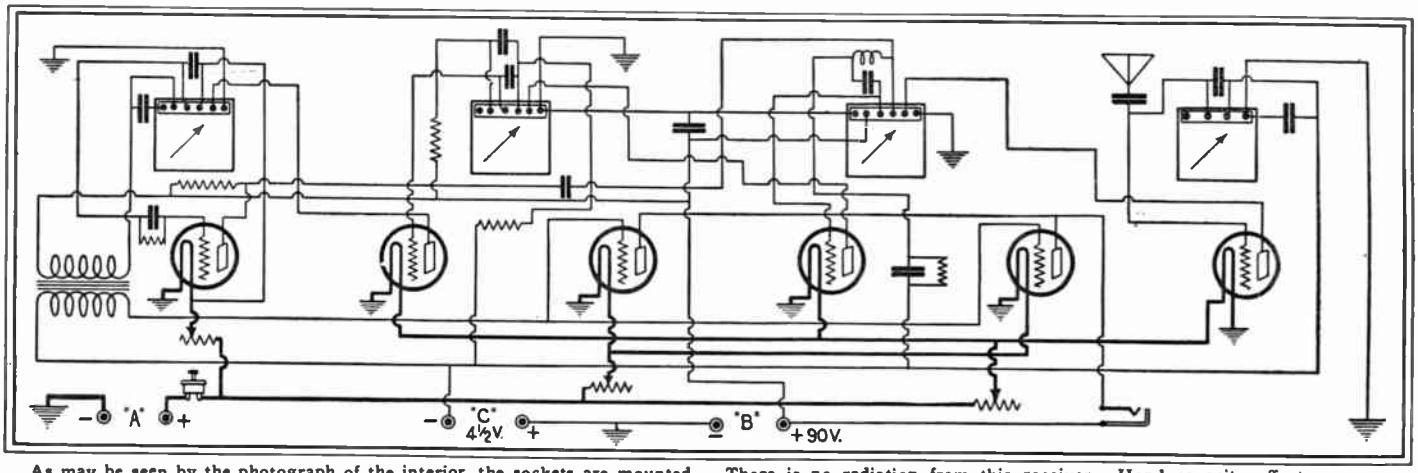


At first sight, the reader might be frightened into thinking that this is a four-control set. However, this is not what it appears to be. All four dials are operated simultaneously by any one of them, and each dial may be changed for final slight adjustment, if it should be found necessary. The system used in this circuit works on a new principle. The transformers consist of alternating rotor and stator leaves. The windings of the transformer are of special type and cannot be duplicated very readily by the experimenter. They are wound in a special form of "D" coil. No variable condensers are used because the tuning is done by varying the inductive relation of the stator and the rotor of the vario-transformers. The method of winding used in the make-up of the transformer does away with the stray fields that might otherwise lead to inductive feedback troubles.





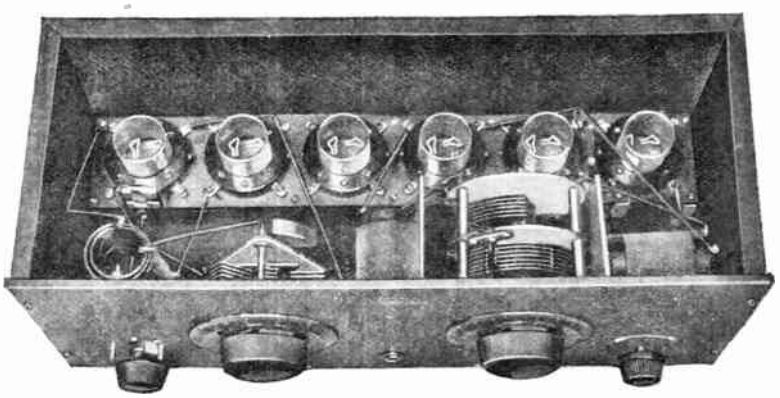
The receiver is so designed as to allow battery space in the rear of the cabinet. No tap or binding post is supplied to obtain plate voltage for the detector, the reason for this being that a resistance of 30,000 ohms is placed in the plate circuit of the detector, so as to get the proper voltage for its operation. A very important quality about the vario-transformer is that it is self-compensated, like a condenser. Each instrument has a primary and a secondary winding like any other kind of a transformer. Three stages of tuned radio frequency are provided for. This is done because it is essentially a dry cell tube outfit.



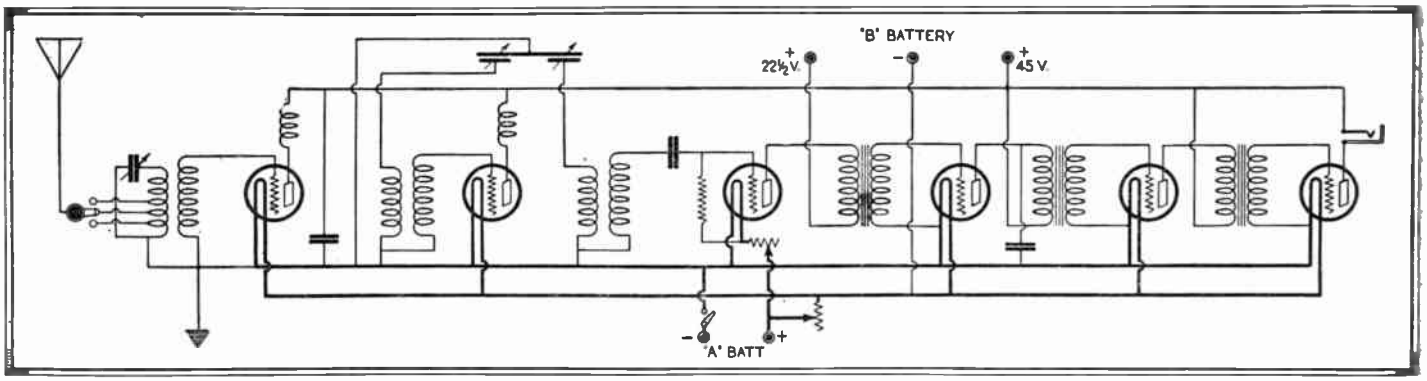
As may be seen by the photograph of the interior, the sockets are mounted on a metallic bed-plate. This simplifies wiring to a very great extent.

There is no radiation from this receiver. Hand capacity effects are entirely eliminated by grounding all metal parts of the receiver.

Although the set shown above is not virtually a single control receiver, the operation of it is very simple. The dial to the right controls two condensers mounted on the same shaft. This feature combines two controls in one. The large dial to the left tunes the antenna circuit which is not very critical in adjustment. The tuning of the other condenser, however, is very sharp and consequently the selectivity is high. One rheostat is used to control the amplifier tubes and another to regulate the detector filament temperature. In this receiver it is preferable to use a soft detector tube. Of course, in the construction of a set the best of materials should be used, otherwise, the results obtained will not be good.

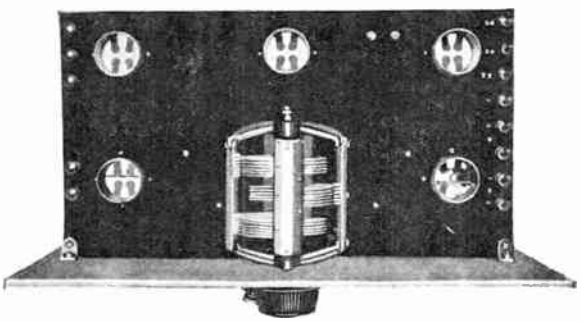


Note the interior of this well designed set. All parts are separated so as to eliminate to a greater extent the feed-back which would otherwise occur. The condenser to the right is a special type, and as can be seen, is well shielded. The audio frequency transformers are also shielded and placed under the tube rack toward the back of the cabinet. By the use of the best type of transformer, distortion in the audio circuit is eliminated.



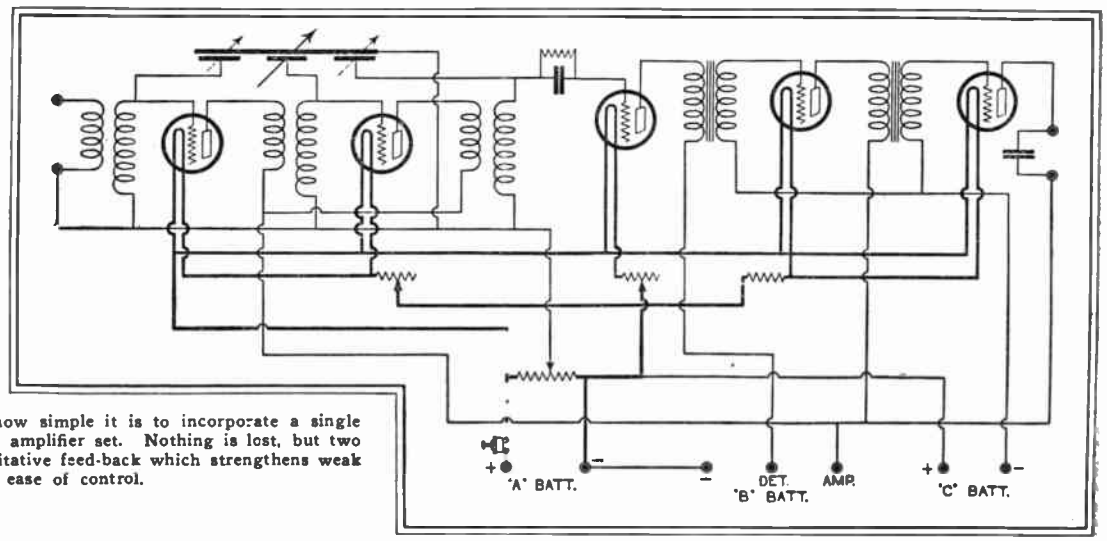
One might wonder at the above circuit diagram which shows two steps of radio frequency, detector and three steps of audio frequency amplification. In a few words, it was possible to add the third stage of audio because of the exceptionally good engineering design involved. Large by-pass condensers must of course, be employed in this circuit in order to readily by-pass the radio frequency currents.

Note particularly the tuning circuit which is much different from the ordinary tuned radio frequency receiver. An inductively coupled absorption circuit affords very sharp tuning. The inductance in the plate circuit are coupled to the tuning transformers. In mounting the transformers the filament end should always be toward the panel, to prevent any hand capacity effects.



The construction of this single control receiver is unique in the fact that it uses a condenser of special design. The stator is composed of three 11-plate units and the rotor consists of the same number of rotary units. All wiring is done beneath the sub-panel and therefore, makes a very neat job. All coils are carefully matched in order to have perfect condenser readings. The coils are also mounted underneath the sub-panel which allows the use of short leads to the R. F. stages. Two steps of radio, detector, and two steps of audio frequency amplification are employed.

Two rheostats, one for the detector, and one for the amplifiers are provided. A fixed automatic resistance is employed to regulate the filaments of the audio frequency amplifiers. A potentiometer prevents any tendency for the set to oscillate. It also allows a certain degree of regeneration to be introduced in the radio frequency circuits. This tends to make the receiver more sensitive. Oscillations are helpful to some extent in the tuning in of a distant station. After the station has been tuned in, adjust the potentiometer so as to stop oscillation.

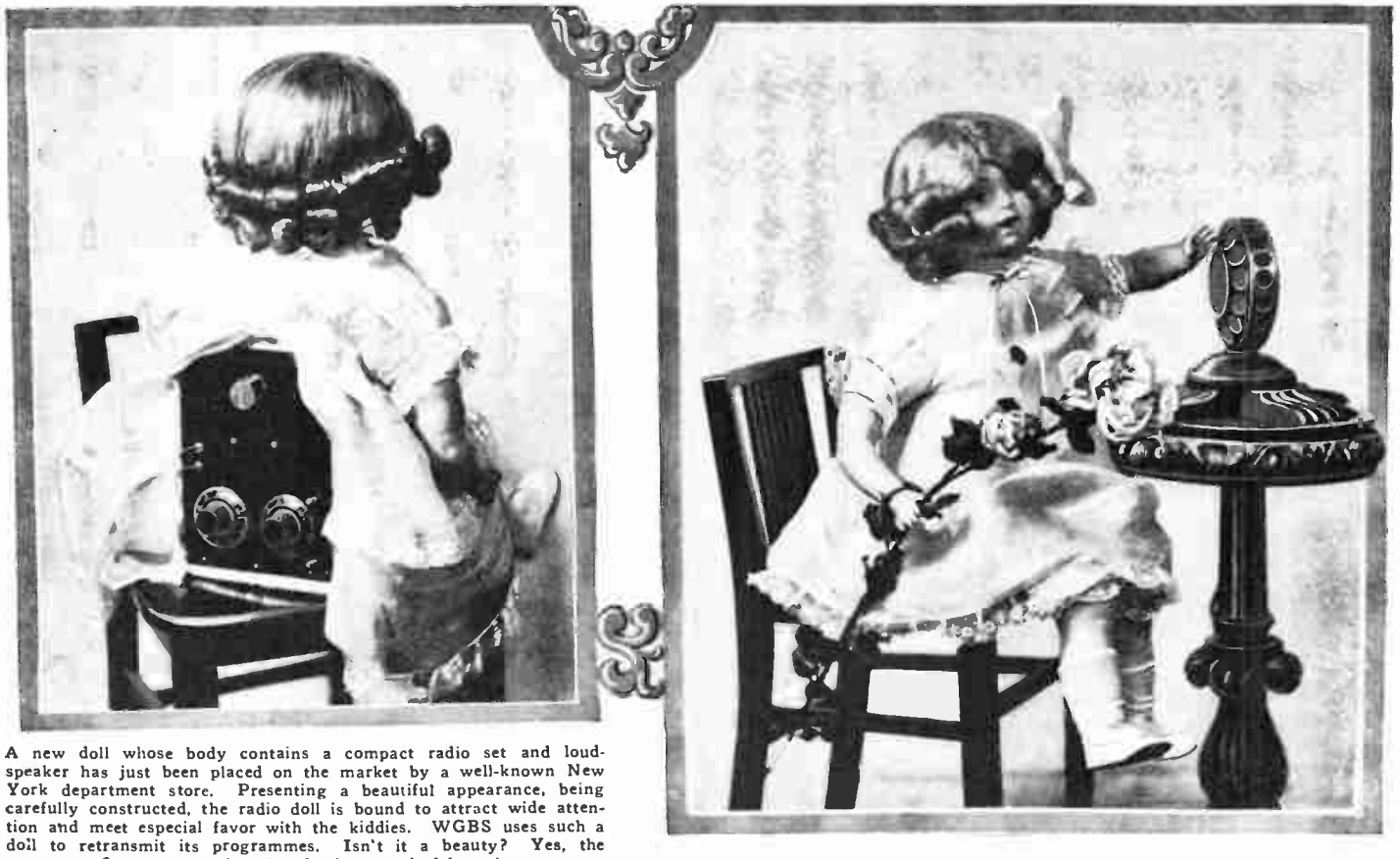


The diagram to the right shows how simple it is to incorporate a single tuning control in a radio frequency amplifier set. Nothing is lost, but two main advantages are gained—capacitative feed-back which strengthens weak signals and ease of control.

Names of manufacturers will be cheerfully given upon receipt of stamped envelope.

"Radio Rose" Makes Her Debut

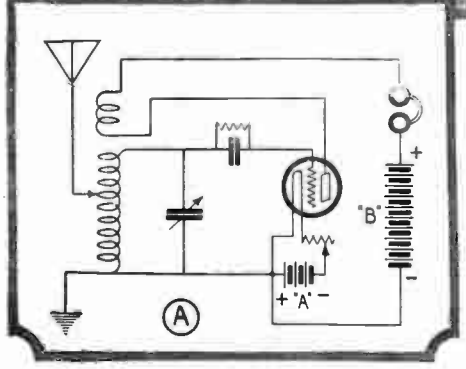
By MISS BESSIE STEINMETZ



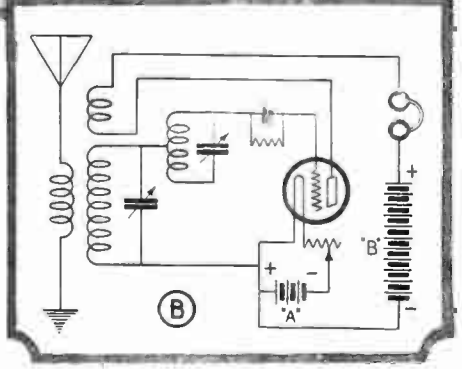
A new doll whose body contains a compact radio set and loud-speaker has just been placed on the market by a well-known New York department store. Presenting a beautiful appearance, being carefully constructed, the radio doll is bound to attract wide attention and meet especial favor with the kiddies. WGBS uses such a doll to retransmit its programmes. Isn't it a beauty? Yes, the flowers were given her for her wonderful work.

Does Your Set Radiate?

In recent tests conducted at Cleveland, several receiving sets of the single circuit variety were started oscillating, so that radiation from them occurred freely. By a previously arranged schedule, listeners distant more than 500 miles easily discerned the periodic signals which were transmitted by the radiating receivers.

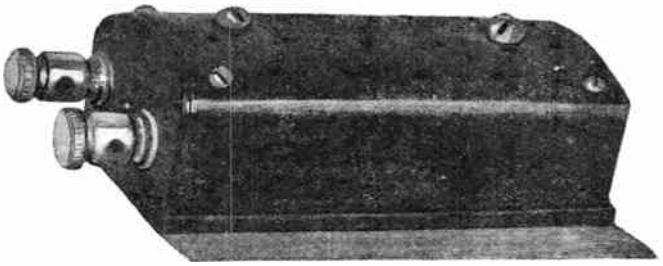


Practically every single-circuit set will radiate. It does so when the tube starts oscillating at radio frequency. When an audible squeal is generated in the phones, it does not necessarily mean that the set is radiating. An audio squeal cannot be transmitted without a radio frequency carrier. Squeals are the product of the difference in radio frequencies of the oscillating circuit and an incoming radio wave of some oscillating circuit. One hears the beat frequency. Fig. A depicts the single circuit regenerative set, while B shows how it may be altered so as to eliminate all possibility of radiation. The resistance of the antenna system, the degree of feed-back coupling and the power input to the tube control the radiating property of a set. B cannot radiate because no energy is fed back into the antenna circuit.

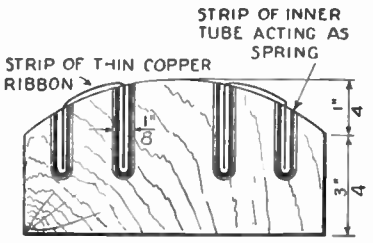


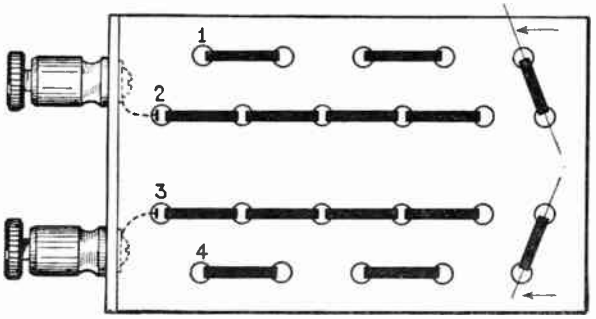
A Multiple Phone Block

By V. KREJCI

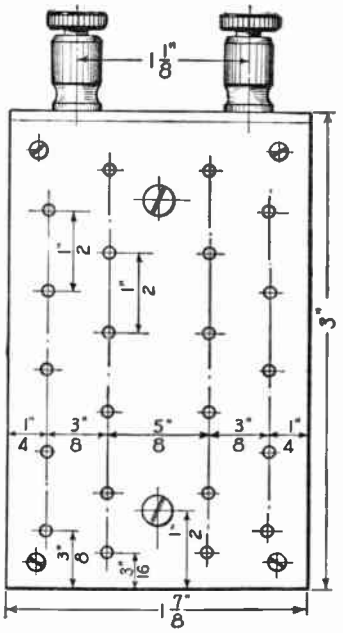


A miniature phone block which will accommodate 11 pair of phones, seven in series and four in parallel, is a very handy device which can easily be constructed upon the dimensions given in the diagram. A small block of wood is drilled and fitted with short lengths of thin copper strip. A piece of rubber tubing acts as a spring, effecting good contact. A fibre cover is screwed to the top, giving a pleasing appearance.



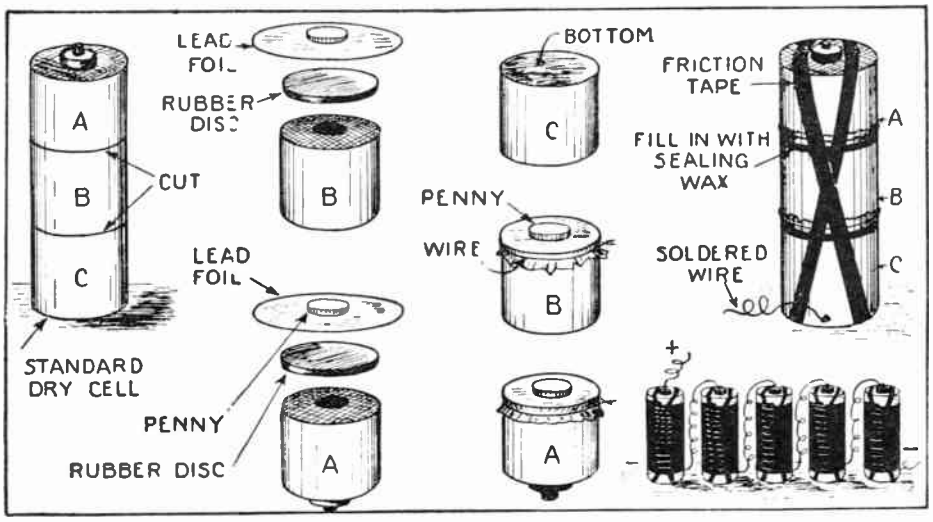


Between numbers two and three, five pair of phones can be connected in parallel. If desired, these phones can be connected in series, by simply plugging in the proper places. A 3/16ths inch drill is used to make all the necessary holes. The device will find a large use where many phones are used.



Heavy Duty "B" Battery

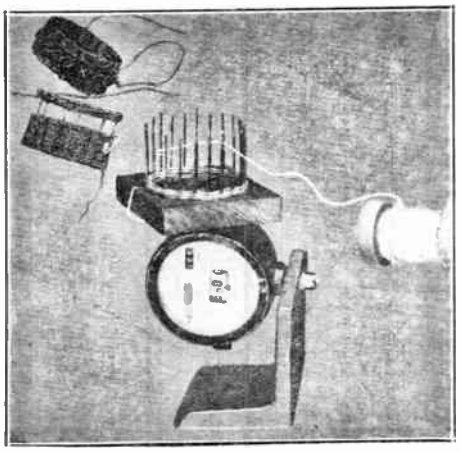
By EDMOND L. DeWICK



Five ordnary dry cells can be converted into a 22½-volt "B" battery which will last a long time and is much cheaper in the end, than a purchased one. The cardboard casing is first removed and the battery cut into three equal sections with a hack saw. The carbon rod is next insulated with a disk of sheet rubber, and a circular piece of tin foil is placed over this, wiring it in position. This converts the 1½-volt cell into a 4½-volt unit. The cells are bound together, after which the interstices are filled with sealing wax or pitch, in order to prevent short-circuit. The cells are then connected as usual, in series. Even worn out dry cells will be found worth while to experiment with. They still contain sufficient energy with which to operate a tube, although they may not be able to ring a bell. By the use of this form of construction for "B" batteries, much space can be saved. If directions are followed, several sets of these batteries should last indefinitely.

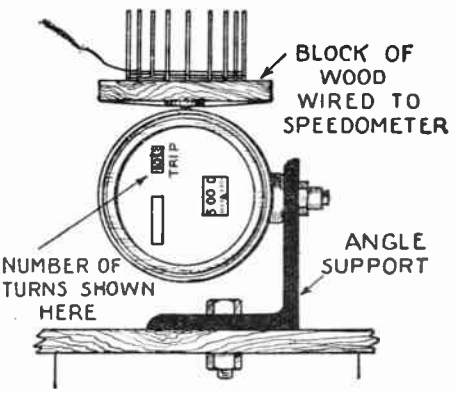
Turn Counter

By GEORGE B. HOSTETTER



How the apparatus looks when in use. Several types of low-loss coils may be wound with ease.

Ordinarily, it is quite difficult to keep track of the number of turns when winding low-loss coils. An old speedometer readily solves the problem. By mounting it on a piece of angle iron and fastening to its reset wheel a block of wood five or six inches square, which constitutes the coil-form, the result is a useful revolution-counter which avoids the necessity and bothersome task of continually recounting the number of turns. A most desirable feature, if the speedometer happens to be in good condition, is the mileage recorder which will indicate your speed in winding. (Note the 50 mile-per-hour reading at the time the photo was taken. Some speed!—Ed.) The device is really very handy to have around. It is handy to have a device on hand to help in the counting of the number of turns being wound on a coil. Everyone has experieced the delay when he has to stop every other minute or so to count the number of turns already wound on the coil.

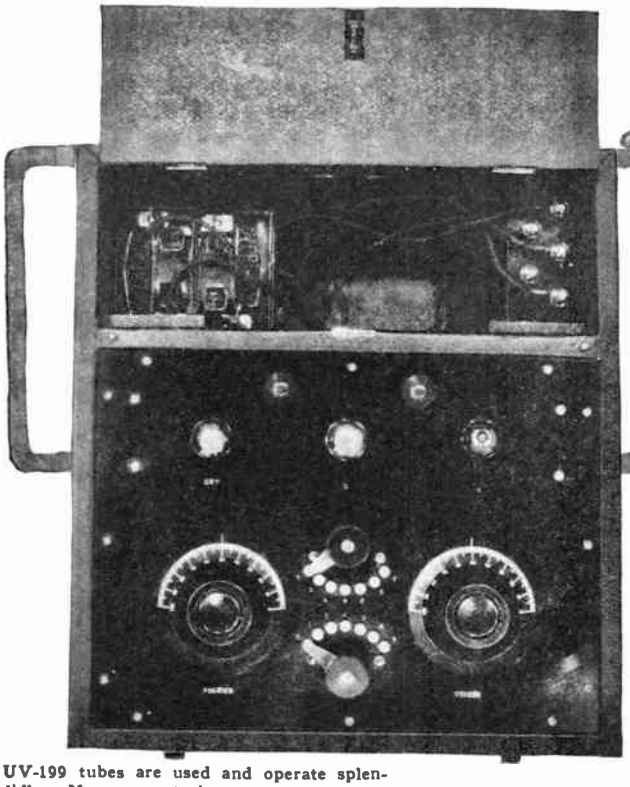


It is best to mount the recorder on the workbench in a convenient corner. Its simlicity is clearly indicated in the above drawing. Much faster work can be done with it than by merely counting.

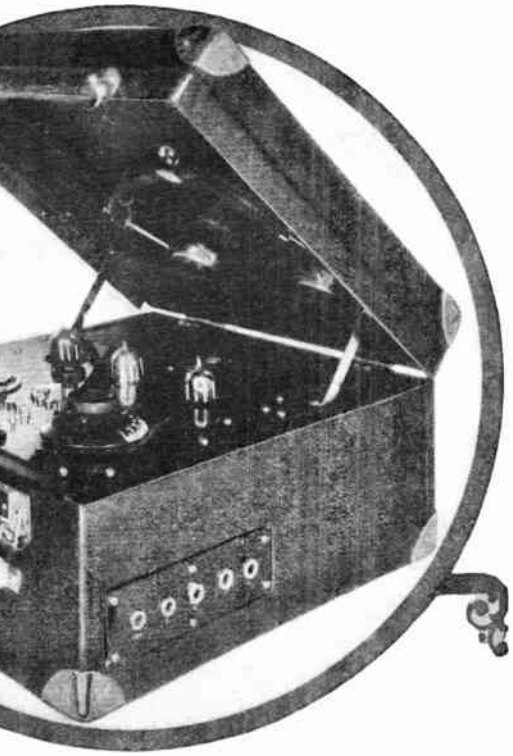
A Portable Set De Luxe

By LYNN MATTHIAS

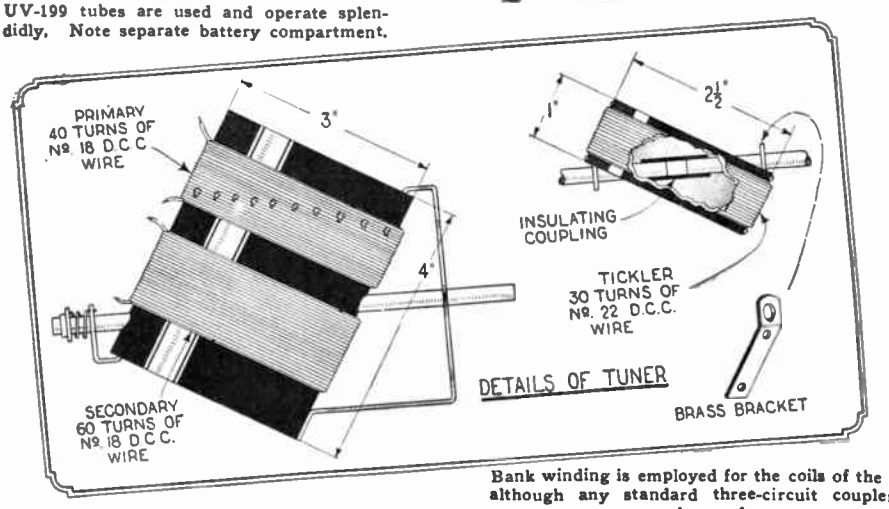
Construct Your Vacation Set Now



UV-199 tubes are used and operate splendidly. Note separate battery compartment.

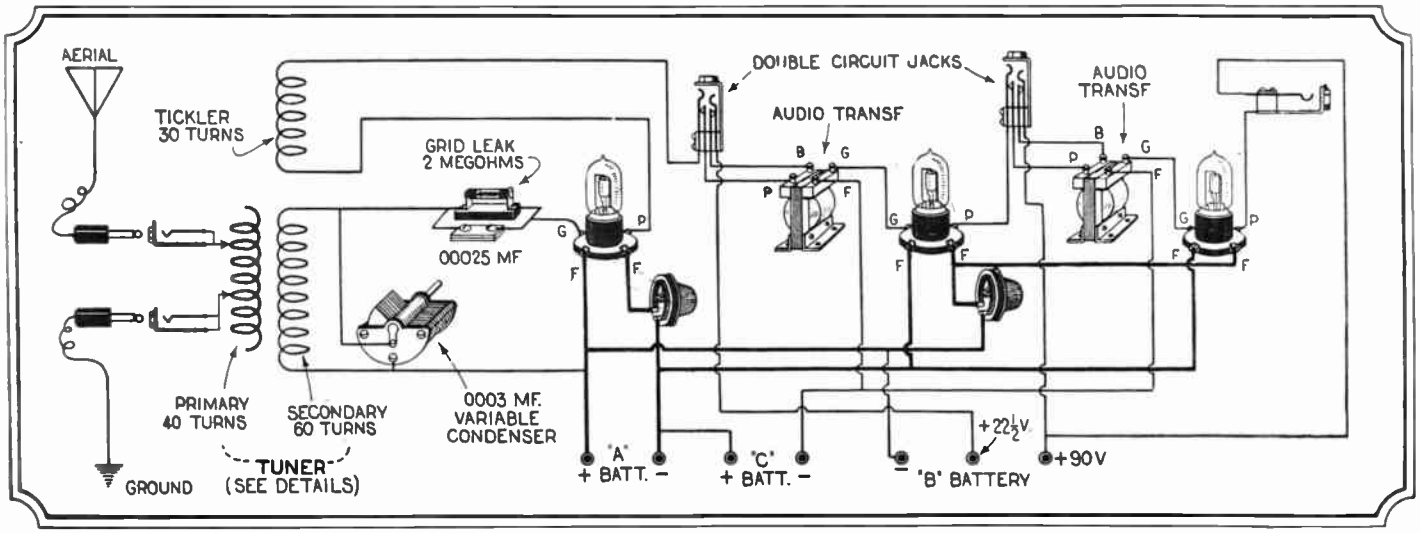


The portable receiver is finding more and more use as the art of radio steadfastly advances from the hobby of a few to an ultimate necessity of a nation. For the home and for travel, this ideal receiver incorporates all those good qualities necessary for bringing complete joy to its constructor and owner. Employing the standard regenerative circuit, and containing all the necessary batteries within a compact carrying case, very good results are obtained.



Bank winding is employed for the coils of the tuner, although any standard three-circuit coupler can be used.

WITH the approach of summer and the inevitable vacation which accompanies it, many of us would, literally, be "tickled silly" to have a real portable light-weight receiver to take along. If you begin the construction of the set now you will have no reason to fear that it will not be ready when your vacation comes around. Not only is it simple to construct but it fulfills all the requirements which make it worth the building. It is entirely self contained, simple in operation, sensitive and selective, rugged and attractive. Its extreme light weight, makes it all the more appealing. With all the hard knocks which must be sustained by such a set, it must be remembered that careful soldering is a requirement not to be overlooked. Note the pleasing appearance of the set.

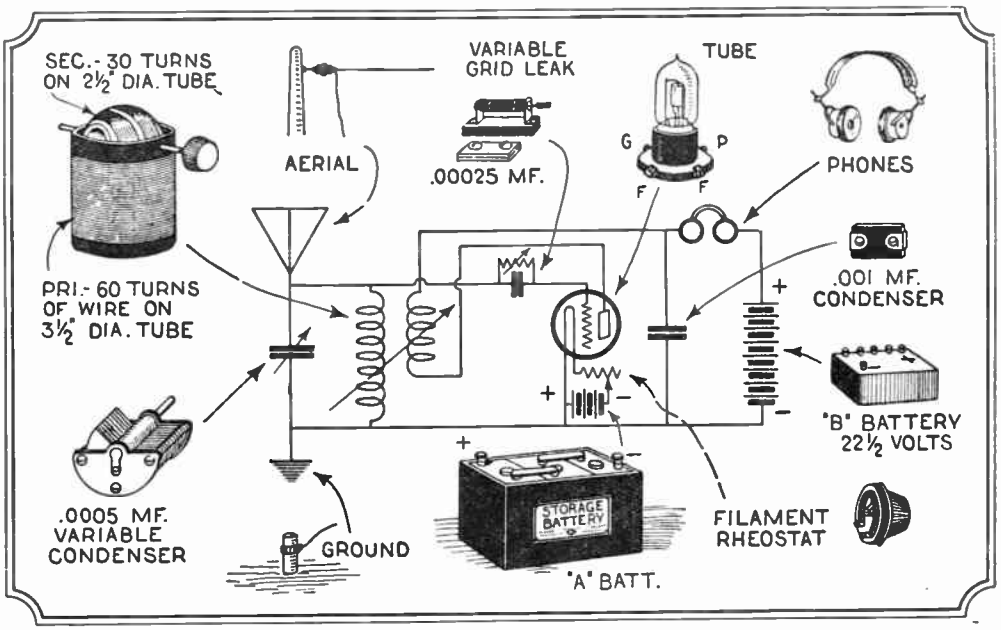


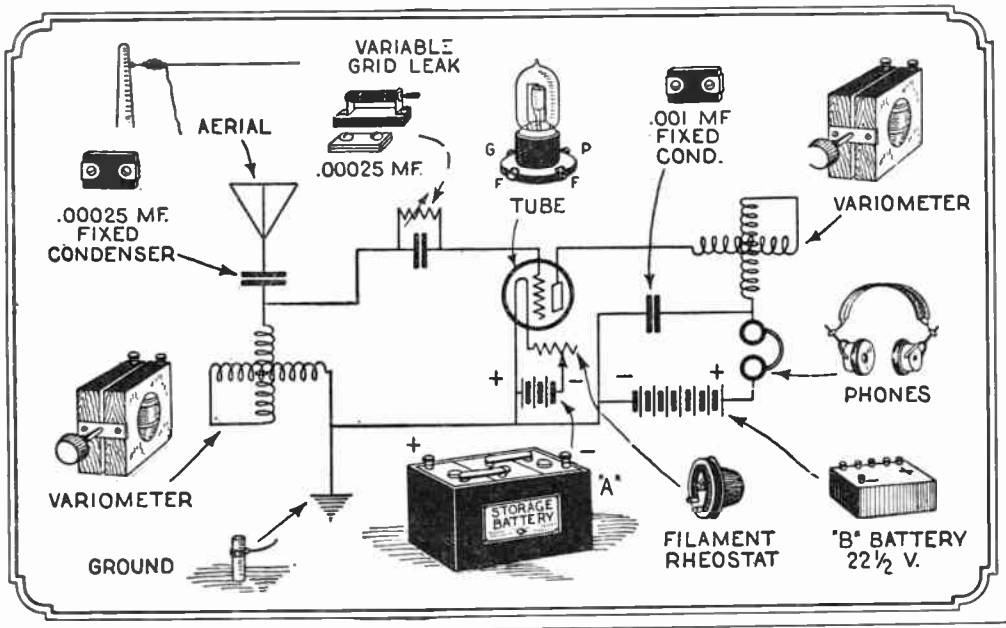
Five jacks, one each for the aerial and ground, detector and first and second stages of amplification afford very handy connection terminals. The antenna is a coil of bell wire 125 feet long which, when not in use, is placed in the battery box. Two 20-ohm rheostats are used to control the filament circuits. Two 3-cell flashlight batteries in parallel will last indefinitely for the filament supply. The set will operate a loud speaker on locals.

A Page for the Novice

PART IV

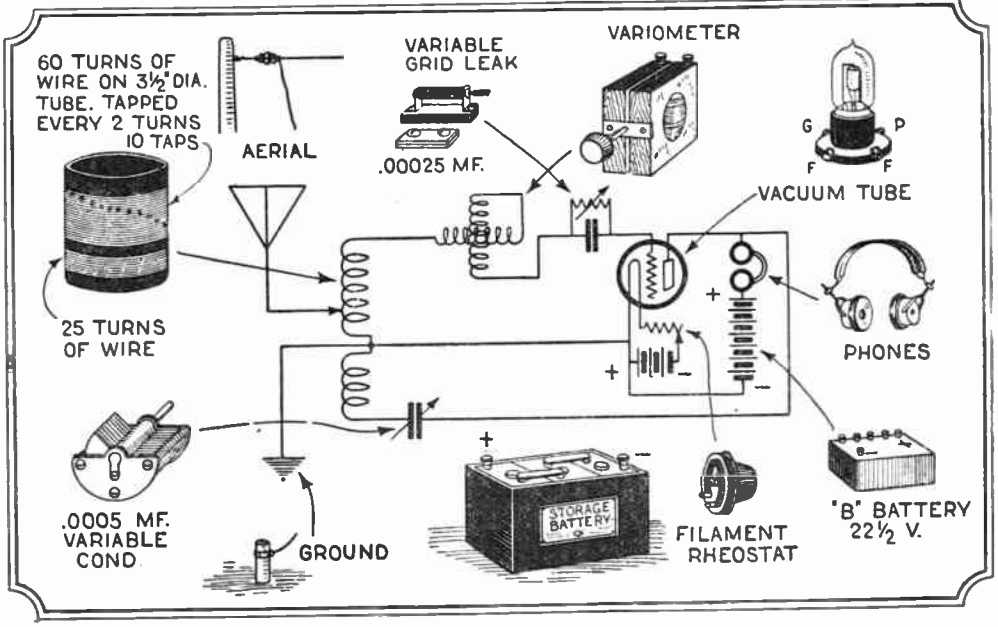
THE circuit diagrams on this page show how regeneration may be added to non-oscillating circuits. The only addition one has to make to the simplest form of non-oscillating circuit shown to the right is to add a tickler coil, which should be in inductive relation to the secondary. The variable condenser shunted across the secondary coil is used to vary the wave-length range of the receiver. An aerial of about 75 to 100 ft. in length is recommended. A good ground connection must, of course, be available. The addition of regeneration to this circuit will increase the range of the receiver. It is always best to have a variable grid leak in the circuit because of the difference in the characteristics of tubes. If trouble is experienced in obtaining regeneration, reverse the tickler connections. Sometimes it is desirable to cut down the number of turns in the tickler coil in order to obtain greater range of regeneration. Care should be taken in the operation of this receiver so that too much feed-back is not obtained, as this may cause outside interference. In the construction of the receiver the best of material should be used, as every little bit of energy counts.





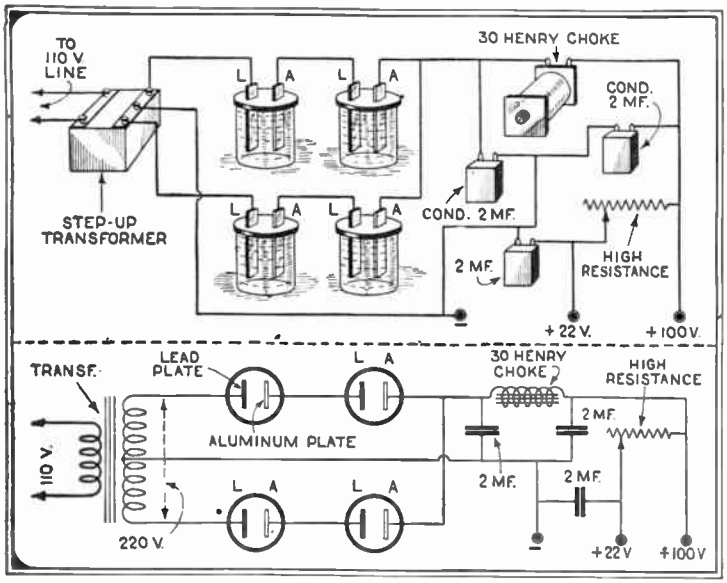
THE circuit to the left is a modification of the standard two variometer-variocoupler set. The variocoupler was left out in order to simplify the construction of the receiver. A series condenser may be seen situated in the aerial circuit. This is used to cut down the wave-length of an abnormally long aerial. In fact, it is desirable to use a long aerial in suburban localities and then to place a fixed condenser in series with the antenna to cut down its length. A long aerial collects more energy, but its use cannot always be adopted, especially in localities where interference is bound to result. By interference we mean the reception of more than one station at the same time without the power of tuning them apart. It is often desirable to place a fixed condenser across the phones and "B" batteries, as this may result in an increase in signal strength. In this circuit regeneration is obtained by the use of a variometer in the plate circuit of the tube. It works on the principle of a coil shunted by a condenser, or what is technically known as a tuned impedance. By varying the relation between the stator and the rotor sections of the variometer, regeneration can be introduced at will.

THE circuit shown to the right is a modified form of the Reinartz circuit. In this case regeneration is obtained by the use of a fixed tickler coil in series with a variable condenser. By varying the capacity of the condenser one may obtain any degree of regeneration he desires. As may be seen, a semi-fixed antenna connection is used. When very high selectivity is desired less turns should be used. Of course, this will cut down the signal strength, but sometimes it pays to sacrifice some signal strength for greater selectivity. A variometer instead of the usual variable condenser is used to tune the secondary circuit. When connecting the apparatus always ground the filament end of the coils. Also try always to place the rotor plates of the condensers to the ground circuit. This will help materially in the avoidance of hand capacity effects, which are experienced in some poorly designed home-made receivers. It is sometimes desirable to add a radio frequency choke coil of about 100 turns on a small diameter tube in series with the phones, to aid regeneration. If satisfactory results are not obtained at first, reverse the direction of the winding of the ticler coil.

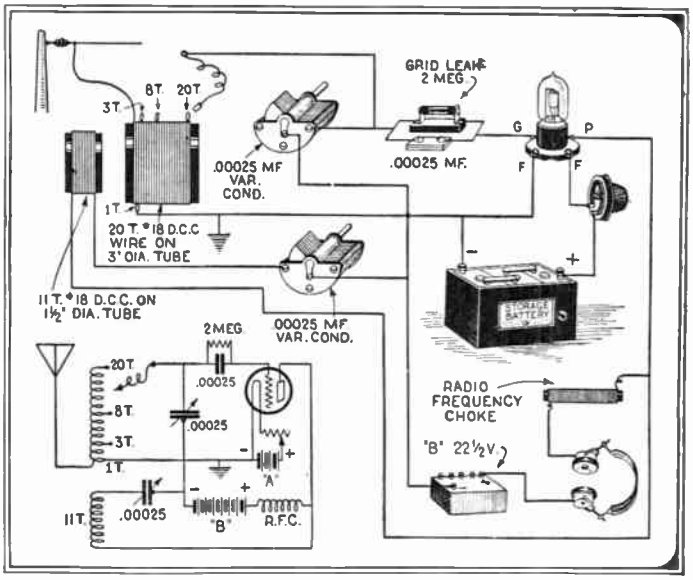


RADIO ORACLE

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 25c. is made for all questions where a personal answer is desired.



No modern set is complete unless a good "B" battery eliminator is used to supply the "B" voltage to the plates of the tubes. By the use of large condensers and correct size choke coils the AC ripple can be eliminated.



Short waves are rapidly coming into use for broadcasting purposes, on account of the greater carrying powers and less fading experienced on these waves. The circuit shown is the latest Reinartz type.

"B" BATTERY ELIMINATOR

(343) Q. 1. Joseph Rapaport asks for a circuit of a good "B" battery eliminator.

A. 1. The circuit of the "B" battery eliminator is given above; by following closely the constants given you will hear no hum in the receivers. To some people, the cost at first seems prohibitive, however, the equipment will pay for itself in a short while. For obtaining variable "B" battery current for the detector use a high value variable resistance.

CAPACITY

(344) Sol Kupferman, Coshockton, Ohio, asks:

Q. 1. Kindly explain as clearly as possible the action of the condenser in R.F. and D.C. circuits.

A. 1. In an arrangement known as an electrical condenser which consists of conductors and insulators, electrostatic energy may be stored up. The action is similar in analogy to that of a gas tank used for the purpose of storing gas. The amount or volume of gas which can be held by a tank is not fixed. Thus, if the pressure is doubled, twice the volume of gas can be contained within the tank. If the pressure is increased, more gas can be stored until eventually the tank bursts.

This is exactly what happens in a condenser. The amount of electrical charge given to a condenser depends on the potential difference or electric pressure, the charge being directly proportional to this potential difference. The capacity of the condenser is expressed by the constant ratio of charge to the potential difference, symbolized: Q divided by V equals C.

Besides depending upon the distance apart between its plates and the kind of dielectric between them, the capacity of the condenser varies according to the size of its plates. Radio frequency currents readily pass through condensers. As the frequency becomes lower, less and less current is allowed to go through until when a direct current is applied to its plates, no current whatsoever flows.

In resistance coupled amplifiers it is at once understood why blocking and by-pass condensers are used, the term by-pass being used when speaking of radio frequency currents and the term blocking condensers used when it is necessary to keep the plate voltage from directly affecting the grid circuit.

CHOKE COIL

(345) Q. 1. Harry Bertman, Dallas, Texas, desires to know the construction of a five-millihenry inductance.

A. 1. A five millihenry choke coil consists of about 250 turns No. 28 D.C.C. wire on a two-inch diameter tube.

SHORT WAVE RECEIVER

(346) Q. 1. A. Larsen, Denver, Colo. Please publish a good circuit for a short wave receiver.

A. 1. The diagram is given herewith. The winding is made in the popular basket weave form about three inches in diameter. Wind three turns, then tap, also placing taps at the eighth and twentieth turns. The tickler consists of a one and one-half-inch diameter coil placed about one inch below the filament end of the secondary. The secondary condenser is of .00025 mf. and the regenerative condenser is of .00025 or .0005 mf. capacity. These condensers must be of the latest design low-loss variety. The R.F. choke consists of about 100 turns of wire wound on a short length of wooden dowel. The wave-length range of the receiver described is from about 20 meters up to 150 meters. The tube must be removed from the base and leads soldered on the connecting wires so as to lower the capacity and also to make the tube non-microphonic.

GRID LEAK

(347) Q. 1. G. Reiser, West Hoboken, N. J., asks: What is a grid leak and what are its uses in a radio circuit?

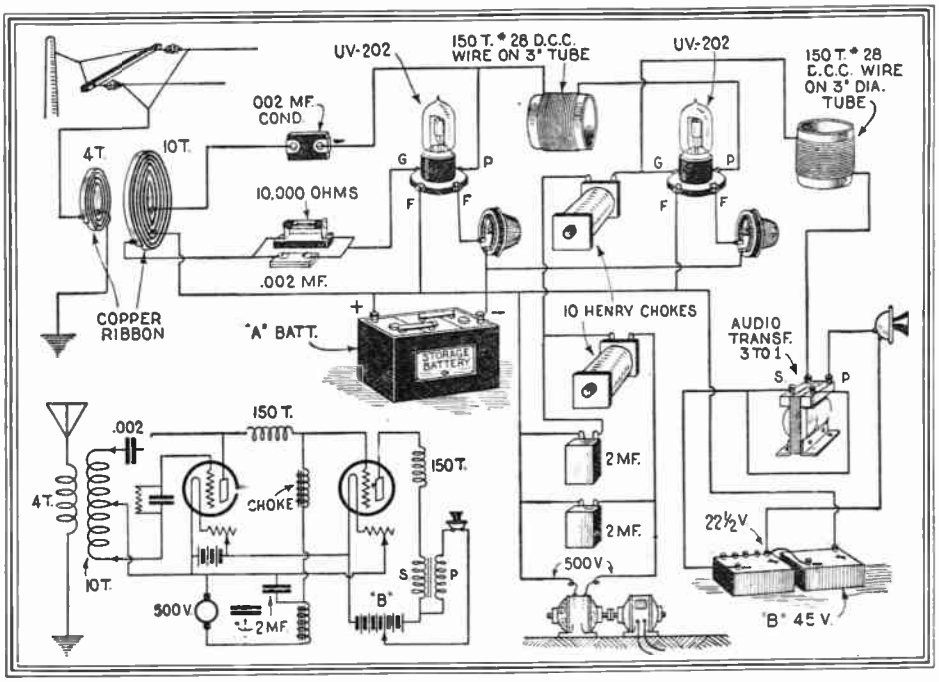
A. 1. A grid leak is used in a radio circuit to let the radio frequency currents leak off the grid. If these currents were allowed to accumulate they would render the vacuum tube inoperative until these charges leaked off in some manner.

Q. 2. Frequently the grid leak is placed between the grid and the filament and sometimes across the grid condenser, which is usually the best position?

A. 2. The most generally accepted method is to place the grid leak across the grid condenser, but with some tubes the other method works out better. We would recommend that you try both methods until best results are obtained.

WANTED!!! RADIO ARTICLES

WE want descriptions of new radio ideas which you have worked out in practice. Take photographs of the important parts and make pencil or pen and ink sketches of the hook-ups or mechanical details, et cetera. We are particularly desirous of obtaining new hook-ups and descriptions of single tube sets, reflex and other types which have proven satisfactory. We like articles on new single tube receptors. We will pay good prices for your ideas. —Editor.



The low power broadcasting set shown above can be used to communicate with stations about 10 to 15 miles apart. The modulation system is of the best and latest design.

BROADCASTING TRANSMITTER

(348) Q. 1. J. C. Coggill, Concord, N. H., please send me diagram and explanation for the construction of a small portable broadcasting set with a range of about 10 miles.

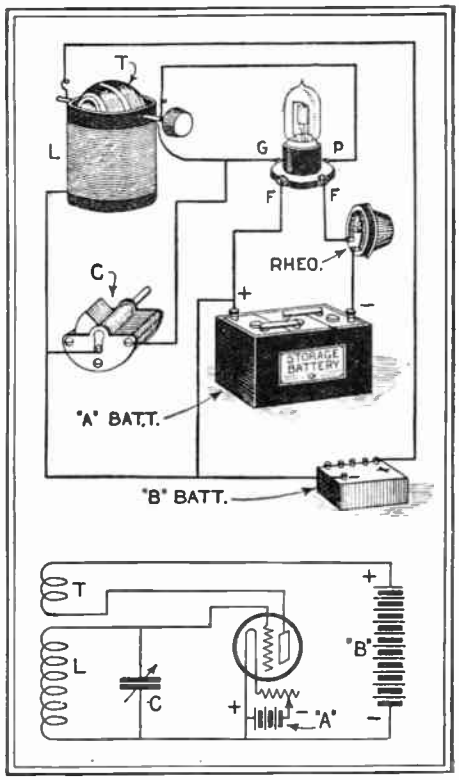
A. 1. First of all, you must be examined and have a license for broadcasting. The circuit for the set is given above. For the plate supply, we recommend that you couple a generator to the motor of the truck or vehicle you are going to house the transmitter on. The filaments can be supplied by the storage battery used for the starting system or ignition system of the truck. A good antenna must, of course, be available. The ground connection can be obtained by driving a six-foot copper or iron bar into the ground.

OSCILLATIONS

(349) Q. 1. R. Simpson, Chicago, Ill., please explain how oscillations are produced in the circuit I am sending you.

A. 1. The phenomenon of self-oscillation is rather remarkable and is usually explained as follows:

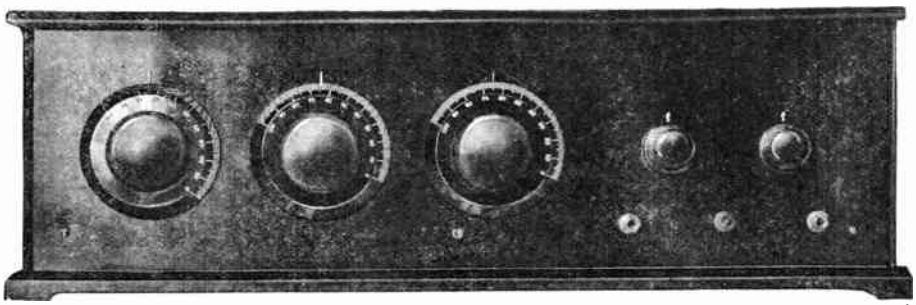
A momentary accidental E.M.F. on the grid may cause a sudden variation of the anode current. The circuit LC consequently tends to oscillate since the condenser C becomes charged and then discharged through L. These weak oscillations in LC induce similar oscillations in R, and are then communicated to the grid of the vacuum tube. The oscillations are magnified by the amplification action of the tube and thus reinforces the oscillations already existing in circuit LC, with which they are in phase. The magnified oscillations now induced in T are magnified by the tube and so the process goes on until the oscillations in R and L are self-supporting. This, of course, takes place in a fraction of a second. The frequency of oscillations thus produced may be varied by altering the value of the variable condenser C.



Herewith is shown a fundamental oscillatory circuit.

$100.00 In Prizes For Circuit Used In This Set

SCIENCE AND INVENTION leads again, something entirely new!! The Mystery Set, a five tube wonder. Submit its circuit and win prize.



This is not a freak set. The circuit used is a standard one. A wonderful distance getter. Come on, Radio Fans, do your stuff. Better than a crossword puzzle and more interesting to solve.

FOR the first time in the history of the radio art, a very novel contest such as has never been held before, is being sponsored by SCIENCE AND INVENTION. Opportunity is given to the readers of SCIENCE AND INVENTION to exercise their mental powers in guessing the correct circuit used in the wiring of the above five tube receiver. Look at it carefully, study minutely the front panel. Ponder a while, what may be behind the panel, the three large dials and the two smaller ones? The three large dials to the left operate—well, we will let the guess-work up to you—maybe they operate condensers or variometers. Probably it is a—well, we will let everything up to you. What are the two small dials for, can they be——? Or are they something else? The size of the panel is seven inches wide by twenty-six inches long. There is nothing hard about it. You may submit as many circuits as you desire. It is not necessary to state the constants of any of the parts, *i. e.*, the capacities, inductances, resistances, etc. All that is essential is a carefully drawn diagram, which should represent your idea as to what circuit is employed in the receiver.

$100.00 GOLD IN PRIZES

1st Prize	$50.00
2nd Prize	20.00
3rd Prize	15.00
4th Prize	10.00
5th Prize	5.00

RULES

1—Contestants may submit as many entries as they desire.

2—Circuits must be carefully and clearly drawn in ink on one side of a sheet of white paper. All symbols should be marked as to what they are supposed to represent.

3—The contest closes at noon on Saturday, July 2, 1925.

4—In case of a tie, duplicate prizes will be awarded to each contestant so tying.

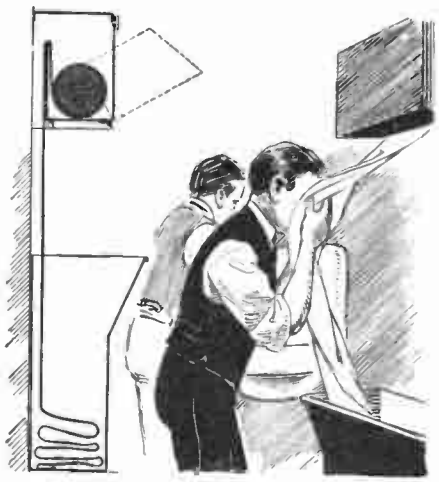
5—The correct circuit or the nearest to it will be awarded first prize.

6—All circuits must bear the contestant's name and address in the upper right hand corner. The date must also accompany the above.

7—The circuit and photo of the interior of the set will be published in the September or October issues.

LATEST PATENTS

Towel Cabinet



No. 1,514,400, issued to Frank M. Steiner, describes an improved type of towel holder for washrooms, wherein the same section of the toweling is used only once. A roll of absorbent cloth is kept in the hinged cabinet as illustrated above and when a clean section is desired, it is pulled down and the remainder allowed to collect as shown.

Oil Can

No. 1,520,829, issued to Gustave Lidseen, covers a type of oil can which cannot spill even though upset. Furthermore, a measuring device is incorporated which, if desired, allows only a certain amount of liquid to escape. Both the measuring and the sealing devices are actuated by a finger lever as indicated above.

Vacuum Cleaner

No. 1,596,231, issued to Frank W. Finkhousen, describes a novel type of portable vacuum cleaner which is entirely self-contained. Above at the right is shown a cross sectional view of this device. A small dust bag is incorporated in the handle. An electric motor operating from the house current turns a fan which in turn is belted to a small brush as shown.

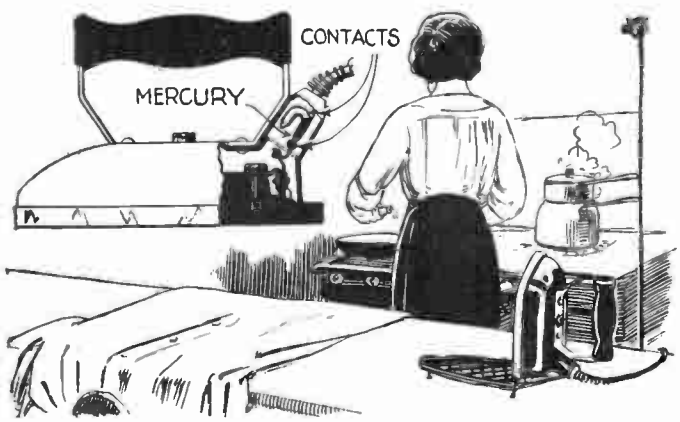
Locking Device

No. 1,518,119, issued to Warren C. Rees, covers the design of wood screw which is to be locked in position by means of a nail as illustrated above. It is impossible for a screw of this nature to loosen.

Ear Cushions

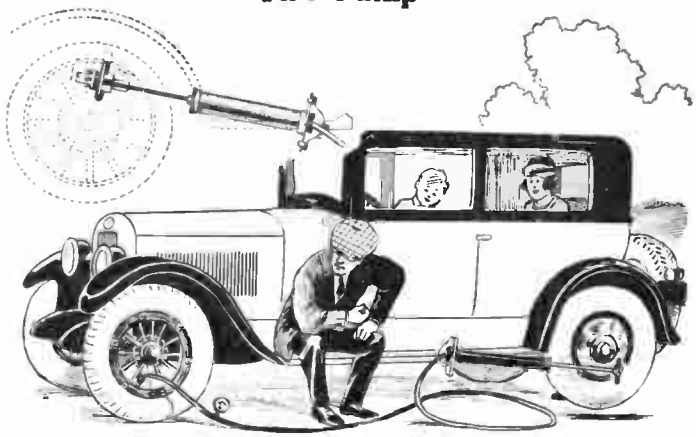
No. 1,514,152, issued to Hugo Gernsback, protects a soft pliable cushion of a highly resilient material designed to be placed over the cap of a radio or telephone receiver, making the same more comfortable in use.

Circuit Breaker



No. 1,511,382, issued to Dayton Ulrey and Daniel I. Mayne, covers several designs of fluid circuit breakers, the most basic of which is illustrated above. A conducting fluid, preferably mercury, completes the circuit when the electric iron is horizontal. The circuit is broken when the iron is tilted and so prevents overheating and waste of power.

Tire Pump



No. 1,520,249, issued to Elmer Kaufmann, provides protection for the type of tire pump clamps illustrated above. One end of the pump is secured on a swivel to the running board of the car, whereupon the handle is fastened by another swivel clamp to one of the rear wheels which is jacked up and turned by means of the motor.

Scientific Humor

NOT TRAINED FOR IT

"Our old friend Bill is dead," one man said to another.

"Why, I thought he took some scientist's advice and took something to prolong his life."

"He did, but a train ran over him."—*Edna May Bush.*

REDUCTIO AD ABSURDUM!

TEACHER: "Now hydrogen is a good reducing agent and—"

PUPIL: "Gee, I'll tell my mother. She has tried all the different kinds on the market and only gets fatter on them."—*Ned Guffe* , Reporter No. 6,042.

A NUTTY ONE!

ETHYL: "You must have had an electrical engineer decorate your cake."

BETHYL: "Why?"

ETHYL: "It has nuts alternating currents." *Everett Shepard.*

WRONG, HE'S AN EQUININE

"Harry, what is an adjective meaning like a dog?"

"Canine."

"Name corresponding adjectives for other animals."

"A cat's a feline, an ox is a bovine, a cow is a vaccine, and a horse is a quinine."—*Paul Slifer.*

MORE TRUTH, ETC.

NERVOUS OLD LADY: (expecting to take her first airplane ride): "Is this airplane perfectly safe?"

"Safest on earth, madam," answered the pilot.—*P. P. Udre.*

A LIGHT PAINT

NUT: "I have found out how to make luminous paint out of any kind of paint."

PRO.: "How?"

NUT: "Put an electric light in it."—*Joseph Wm. Schilling.*

AND YOU CAN STOP IT FROM TALKING

"Radio is certainly a wonderful thing."

"I should say it is. Why my wife will sit and let it do all the talking." —*Ned Guffey,* Reporter No. 6,042.

HOW WOULD A COP DO?

DUMB: "What's that?"

DORA: "A lightning arrester."

DUMB: "Oh, yes, and after it's arrested it becomes chained lightning."—*Harry Boyajian.*

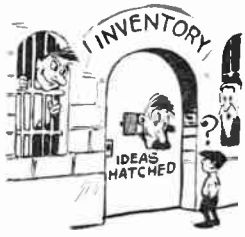
OHM, SWEET OHM

FATHER (calling to his son's room): "Bobbie, are you doing your homework now?"

BOBBIE (testing a pair of wireless headphones): "Yes, dad, I'm doing my ohm-work."—*T. B. Marsden, Jr.*

First Prize $3.00

THE PATENT OFFICE?



SON: "Pa, what is an inventory?"

PA: "A place to put crazy inventors I suppose."— *Malcolm D. Hartley.*

YOU DON'T GIVE A DIAMOND IF YOU WANT TO CUT HER

PROF: "A diamond will cut the hardest substances."

STUDE: "Yeh, it will even make an impression on a woman."—*Stan Symms.*

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

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

THE BOY DEVOLUTED

TOMMY: "Teacher, I'm beginning to believe more and more in the theory of evolution."

TEACHER: "In what way?"

TOMMY: "Well, Dad called me a monkey and I told him he shouldn't forget he's my father."—*Adelbert Body,* Reporter No. 18,360.

THE RIGHT SPIRIT

MAGICIAN in performance: "So, you see I merely dip these photos in the magic liquid, and behold! spirit photographs develop right before your eyes."

SKEPTIC in audience: "That's nothing, He's probably using spirits of ammonia."—*E. A. Daansen,* Reporter No. 17,657.

HE WOULD MEOW IF THEY WERE CATGUT

DOG: "Why do you meow and howl so much?"

CAT: "If you were as full of violin strings as I am you would howl too."—*Ned Guffey,* Reporter No. 6,042.

AGE, NOT EGGS

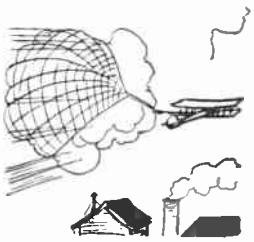
TEACHER: "What are the different ages of history?"

WILLIE: "The stone age, the bronze age, and the iron age."

TEACHER: "What age are we living in now?"

WILLIE: "The hard-boiled age."—*Ralph L. Garrett.*

AND GOLDEN HOURS!



LECTURER: "Science performs wonders. Aviators can now destroy clouds with electrical sand."

Amazed voice from the audience: "Gosh, that's wonderful. Now, if they only knew how to salvage the silver lining."—*Wm. A. Heitler,* Reporter No. 11,783.

THE ENGLISH PROFESSOR TAKES UP SLANG

1. Cease masticating the fabric.
2. Torrid canines.
3. It is the feline's facial hirsute adornments.
4. Atta young male of the species "homo sapiens."
5. I will announce to the third planetary satellite of the sun.
6. It is the small, succulent fruit.
7. Might I ask if it is not the veracity or conformity to facts?

MEANINGS

1—Quit chewing the rag.
2—Hot dog!
3—It's the cat's whiskers.
4—Atta boy.
5—I'll tell the world.
6—It's the berries.
7—Ain't it the truth?—*Edgar Welch,* Reporter No. 7,809.

BUT THE HYPO WILL DISSOLVE IT

A photographer's wife, hearing screams from her infant son, rushed into the dark room and found her husband dipping little Oswald up and down in a large tank.

"Heavens, Henry!" she exclaimed, "What are you doing?"

"Calm yourself, Lizzie," came the laconic response, "the child swallowed a quarter and I am giving him a hypo bath to remove the silver."—*Sam Y. Caldwell.*

PERHAPS, IN THIS CASE

PROFESSOR OF ASTRONOMY (Lecturing on the opposition of Mars): "And now, gentlemen, let us consider the relative positions of the celestial bodies concerned. Let this incandescent lamp represent the sun, this globe shall be the earth, and well, my hat here may represent Mars."

BRIGHT STUDENT: "Professor, is Mars inhabited?"—*L. C. Cartwright,* Reporter No. 9,656.

WE SECOND THE MOTION

MRS. B.: "I think your daughter recites very well. Don't you?"

MRS. A.: "All she needs is a short course in electrocution to finish her off, as you might say."—*I. Cady.*

THE ORACLE

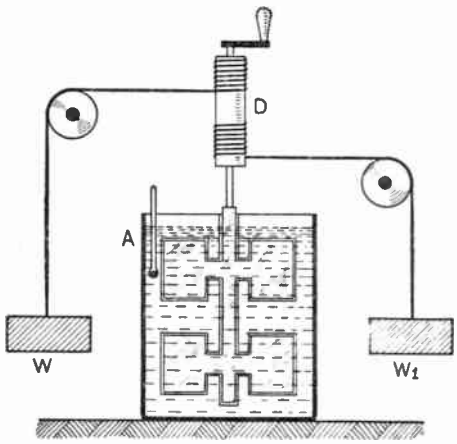
The "Oracle" is for the sole benefit of all scientific students. Questions will be answered here for the benefit of all but only matter of sufficient interest will be published. Rules under which questions will be answered:

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

HEAT

(1824) Q. 1. John Hopkins, of Rome, N. Y., wants to know what is meant by the mechanical equivalent of heat.

A. 1. The mechanical equivalent of heat is the energy required to produce a given amount of heat. The amount of heat is most conveniently measured in units of weight of water heated one



The simplest method for the determination of the mechanical equivalent of heat is shown above.

degree of a thermometric scale. The mechanical equivalent of heat used in this country and in England, generally, is the energy required to raise the temperature of a pound of water one degree Fahrenheit. It is called the British-Thermo-unit, abbreviated, B.T.U. The honor of the development of the equivalent of heat and energy goes to the famous scientist, James Prescott Joule, who originated the apparatus shown above. The weights are drawn to the top and on descending, paddles churn the water. The friction caused by this operation heats the water and the rise in temperature is indicated by the thermometer A, which is immersed in the water. The energy required to heat one kilogram of water one degree Centigrade is equal to the work done in raising a weight one kilogram to the height 427 meters, and 778 foot-pounds of work are required to raise the temperature of one pound of water one degree Fahrenheit.

EINSTEIN'S THEORY

(1825) Q. 1. Herbert Davis, West New York, N. J., desires more information concerning what are really the four dimensions.

A. 1. Time and again, we have discussed Einstein's theory of relativity in these columns. Every once in a while questions pop up about some hazy point which one has in his mind. These can readily be answered since it is not necessary to go into intricate mathematical considerations.

Start with any point "A," in pure mathematics, a position of no dimensions in space. Moving "A" in one direction, we produce "B," a finite line. If "B" is then moved its own length, we have a definite area, "C." The plane "C" can then he moved so as to create a three dimensional object, "D."

So far, starting from a position, we have length, breadth and depth. Of course, it is readily evident that these constitute our conception of the three dimensions in which we live. The fourth dimension is a mathematical conception used in calculations, especially in working on the Einstein theory.

There are many books on the subject and we shall be pleased to give the names of publishers to our readers who may be interested.

Q. 2. Kindly publish the dimensions and the distances of the planets from the sun.

A. 2. In the order of their size, the planets in round figures are as follows:

Mercury, 3,000 miles in diameter.
Mars, 4,200.
Venus, 7,600.
Earth, 8,000.
Uranus, 35,000.
Neptune, 35,000.
Saturn, 73,000.
Jupiter, 90,000.

It is interesting to note that Neptune has one moon, the Earth has one moon, and Mars two; Uranus, four; Jupiter, nine, and Saturn, four rings and ten moons. There is a possibility that the Earth has a second extremely small satellite.

A comparison between the largest known suns is very interesting. The diameter of the earth's sun is 864,000 miles, that of the sun Arcturus, 21,000,000, the sun Betelgeuse, 215,000,000 miles and that of Antares, 400,000,000.

The following is a table giving the distances of the planets from the sun:

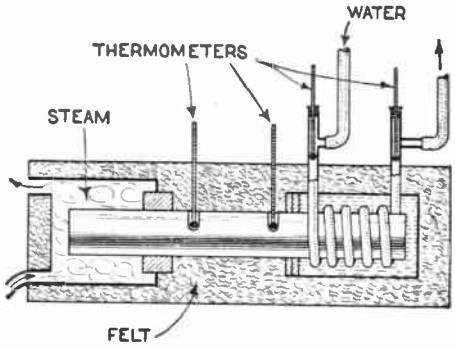
Mercury, 36,000,000 miles.
Venus, 67,000,000.
Earth, 93,000,000.
Mars, 142,000,000.
Jupiter, 483,000,000.
Saturn, 886,000,000.
Uranus, 1,800,000,000.
Neptune, 2,800,000,000.

There is no particular reason why there may not be a number of other undiscovered planets existing. We have been limited in our study of the heavens because of our telescopes. The largest telescope is the reflector at the Mount Wilson Observatory, California, which is 100 inches in diameter. It is hardly possible, with present-day methods, to build a larger reflector. Some time ago there was discussed the probability of using a pool of mercury rotated at high speed to serve the purpose of a reflector. The device was to have been built at the bottom of a mine shaft somewhere in South America. The work has never been done, nor do we believe that it has progressed any since.

What with the possibility of motion pictures by radio, there is a likelihood that it will be possible to build vacuum tubes which will have the property of amplifying the light coming from such distant sources.

CONDUCTANCE OF HEAT

(1826) Q. 1. W. B. Jones, of Memphis, Tenn. asks for information concerning the conductivity of metals for heat.



It is very easy to set up the apparatus for finding the conductance of a metal for heat. This experiment will be found very instructive.

A. 1. Searle's method of determining the conductivity of a metal for heat is as follows: A short bar, say one inch in diameter and six inches long, is heated at one end by steam while at the other end is kept cool by a stream of cold water which flows through a pipe closely wound around a bar in a helix, as shown in the figure. The whole assembly is thoroughly packed in hair felt, or asbestos, either of which is a very poor conductor of heat, so that heat cannot escape from the sides of the bar, but must flow from the hot toward the cold end, where it is absorbed by the stream of water. When a steady condition of flow is reached the heat passing through the length of the bar at any time will be equal to that removed by the stream of water. Thermometers are mounted at the ends of a helical tube, by which the temperature, as it flows through the helix, multiplied by the total weight of water that passes in any given time, gives the quantity of heat transmitted along the bar in that time. The temperatures at two points on the bar, such as t_1 and t_2, are measured by thermometers, the distance d between those points is measured, and also the cross-sectional area A of the bar. All the elements are then known for computing the conductivity from the formula $H = \frac{KA\,(t_1 - t_2)}{d}$,

K is a constant which depends upon the substance of which the metal is made, and is known as the co-efficient of conductivity.

DRYING PROCESS

(1827) Newell Anderson, Moose Lake, Minn., asks:

Q. 1. Can you give me a good drying process for lumber?

A. 1. Vacuum drying experiments for producing lumber of a good quality in a short time have been carried out in Sweden. The entire process is merely in an experimental state, and consequently any experiments which you conduct upon the system might be of value to you. Per-

haps we may make a suggestion along this particular line, inasmuch as the process is not yet patented in America.

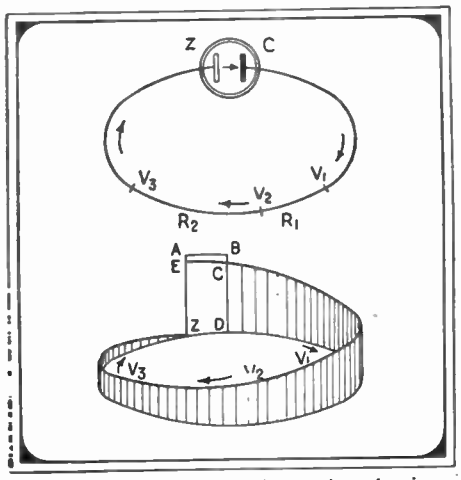
We would advise that you secure a small metal tank about six feet long, and three feet in diameter. If electricity is cheap, place several electric heaters within the tank, so that the temperature of the entire space may be raised at least 212° F. Then connect a vacuum pump to the tank. This may be made from a discarded gasoline engine, or a small vacuum pump can be purchased.

The entire system should now be put in operation and various experiments tried, with regard to both temperature changes and vacuum gauge readings. These should be carefully plotted and charts made of the systems, to determine the best results which can be obtained from regular trees. If the experiments are intended to be tried out on a still smaller scale, we would suggest a small water tank or a wooden box fitted with a tight cover, and lined inside with asbestos. Heat in the form of a steam coil is to be applied to the box, and small branches of trees should then be inserted in the box for treatment. A small bicycle pump, reversed, and connected to a motor will serve admirably for the production of the partial vacuum needed.

POTENTIAL

(1828) Q. 1. Robert Wormald, Brooklyn, N. Y., wishes to know what is meant by the fall of potential in an electric circuit.

A. 1. From the diagram, it can be seen that everywhere in the external circuit from C to Z the current flows from points of higher to those of lower potential, and is, therefore, expending energy. But there is a great rise in potential from the zinc to the acid at A; at this point the current, therefore, must receive energy from a chemical action which effects the face of the opposing difference of potential. From A to B there is a sudden drop of potential which shows that at that point also energy must be spent, but in this



The above is a graphic illustration showing the fall of potential in a dry cell.

case against the chemical forces which at this point exert a E.M.F. against the current. The only place where energy is absorbed by the current is at the surface of the zinc plate and, therefore, the energy of a chemical action at the zinc plate supplies that which is spent in all other parts of the circuit. This conclusion is based on the law of conservation of energy. At any point in the circuit where there is an electromotive force E, the energy taken in or given out per second is equal to IE, where I is the current strength. The energy is absorbed if the current is with the E.M.F., and is given out if the current is against it.

PRINTING INK

(1829) Q. 1. Jos. Reppaport, Los Angeles, Calif., asks about the composition of printing ink.

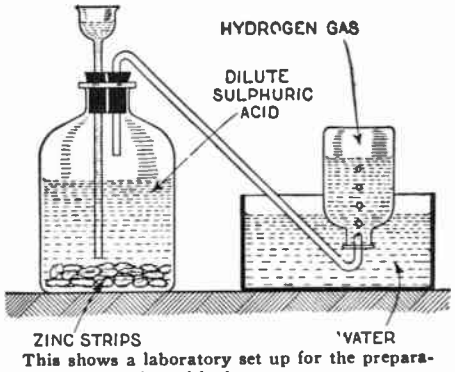
A. 1. Black printing inks owe their color to the finely divided carbon or lampblack, which latter may be made from resin oil, and other carbon containing substances according to the quality of the ink desired. There are, however, certain requirements for all printing inks. The ink must be a thick and homogeneous liquid. It must contain no other solid matter than finely divided carbon, and every drop when examined under a microscope must appear as a clear liquid containing black grains uniformly distributed. Many different materials for making it are given in recipes, so many, in fact, that it is often impossible to discover their true use in the ink. The following is a list of articles commonly in use for the manufacture of printing ink.

Boiled linseed oil, boiled without driers.
Resin oil from the dry distillation of resin.
Resin itself, especially American pine resin.
Soap, usually resin soap but occasionally ordinary soap.
Lamp black and other pigments.

HYDROGEN

(1830) Q. 1. M. Conta, Rome, Oregon, please tell me how I can produce hydrogen gas cheaply.

A. 1. A large flask or bottle is fitted with a two-hole rubber stopper. Through one of the holes is thrust a thistle tube, and through the



This shows a laboratory set up for the preparation of hydrogen gas.

other a right-angle piece of glass tubing. Water is put into the bottle to a height to immerse the lower end of the thistle tube. Pieces of zinc scrap are introduced taking care not to break the glass. It is now corked tightly with the stopper. Dilute sulphuric acid is poured in through the thistle tube, hydrogen gas comes off and can be collected by inverting a bottle full of water in a tank of water and bubbling the gas into it. The bubbles from the rubber tubing to which the gas generator is connected will displace the water in the bottle by what is known as downward displacement. The chemical reaction for this is as follows:

$$Zn + H_2SO_4 = H_2 + Zn\,SO_4$$

GERMICIDES

(1831) Q. 1. Harvey Brownstein, Philadelphia, Pa., asks: "What is the best known germicide which can be taken internally and leave one uninjured and "sterilized"?

A. 1. This timely question of great import brings to mind the recent discovery at Johns Hopkins University by Dr. Veader Leonard of the School of Hygiene and Public Health. It is well known that carbolic acid is the most powerful compound of germicidal value known to medical science. Keeping this in mind, Dr. Leonard made and tested a large number of compounds and has finally achieved success with one of them similar to carbolic acid. It is only too well known that the acid will kill any germs with which it comes into contact and will equally kill anyone who swallows it.

By slight changes in the structure of the molecule, the more or less familiar resorcinol, which is also poisonous, is obtained. It is from this compound that the final new product is evolved. There are a great number of uses to which the new substance may be put. In cleaning up long-standing infections of the kidneys and urinary tract, it is acknowledged to be the greatest discovery as yet made. By the name of hexylresorcinol, the new antiseptic is practically fifty times stronger than carbolic acid in its power to kill disease germs, yet it can be swallowed by anyone without causing the slightest injury

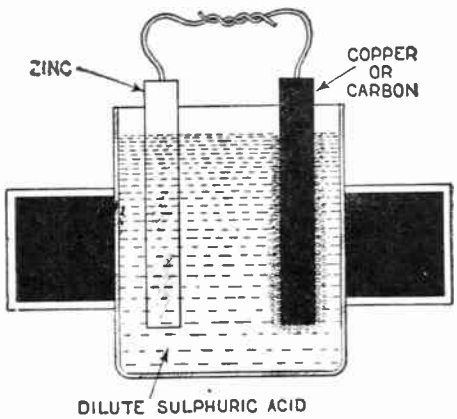
Ten years were required in which Dr. Leonard's associates finally perfected this new medicinal. Having tried the antiseptic on animals which later showed no ill effects, the Doctor swallowed some himself and was not harmed. Continued internal applications caused no noticeable injury and when applied to several cases of severe infection of the kidneys, they were cleared up in 48 hours, which is truly a remarkable record.

There are many who claim that the science of medicine has not advanced since the early days of the Egyptians. Especially is this true when time worn remedies are used and are found to effect a sure cure. However, as a whole, it must be admitted that our surgeons and physicians are doing some very wonderful work and due credit must be given them for it.

GALVANIC BATTERY

(1832) Q. 1. J. Anderson, Cheyenne, Wyo. Kindly explain the action of a galvanic battery.

A. 1. The action of a galvanic battery may be briefly put as follows: There are a number of chemical compounds, which may be salts or acids, which when put into water are in part decomposed, a small portion being converted into positive and negative ions. Thus sulphuric acid gives positive ions of hydrogen and negative ions of SO_4. It will be observed that there are no charges or electrons set free. The negative ion goes to the zinc plate and it combines therewith forming a zinc salt, in this case zinc sulphate. The hydrogen ions go to the carbon or copper plate but cannot combine therewith. In the formation of the zinc sulphate, charges of electricity in the shape of electrons are set free; at the carbon plate electrons of the opposite sign are set free and the effect of this is that a current of electricity goes through the wires connecting the two plates and the current is in a sense maintained through the solution of the battery by a passing along of the ions or an alternate action of each one upon its neighbor. If there is nothing at the carbon end for the hydrogen to combine with, the bubbles go off as a gas or some of them may stick to the plate and impede the action of the battery. Therefore, an oxidizing agent is introduced into the battery to get rid of this hydrogen. Potassium bichromate is very much used for this purpose and manganese binoxide is also used universally in dry batteries.



The simplest form of galvanic battery consists of a carbon or copper rod and a zinc plate immersed in dilute sulphuric acid.

FORCES

(1833) Q. 1. Nat. Greenspan, Sullivan County, N. Y., asks the definition of all known forces.

A. 1. A force is anything that tends to change the state of a body with respect to rest or motion. If a body is at rest, anything that tends to put it in motion is a force; if a body is in motion anything that tends to change either its direction or its rate of motion is a force. A force should always mean the pull, pressure, rub, attraction (or repulsion) of a body upon another, and always implies the existence of a simultaneous equal and opposite force exerted by that other body upon the first body, *i. e.*, the reaction. In no case should we call anything a force unless we can conceive of it as capable of measurement.

Forces may be divided into classes, extraneous, molecular and atomic; extraneous forces act on bodies from without; molecular forces are exerted between neighboring particles of bodies. Extraneous forces are of two kinds, pressures and motor forces; pressure simply tend to produce motion; motor forces actually produce motion. Thus, if gravity act on a fixed body, it creates pressure; if on a free body, it produces motion.

Molecular forces are of two kinds, attractive and repellent; attractive forces tend to bind the particles of a body together; repellent forces tend to thrust them asunder. Molecular forces are continually exerted between the molecules of bodies, and on the predominance of one or the other depends the physical state of a body as solid, liquid or gaseous. The reactions between electrons and nucleus or protons in the atom represent atomic forces.

Prizes of More Than $28000.00 Offered by Science and Invention Magazine

$11,000.00 is being offered by SCIENCE AND INVENTION magazine and Joseph F. Rinn for proof of spiritualism, and psychical phenomena. The conditions of Mr. Rinn's offer of $10,000.00 were explained in the August, 1923, issue of this publication. The details were again repeated in the October, 1924, issue of SCIENCE AND INVENTION magazine in the Readers Forum. Briefly, the award is divided up into the following. $1,000.00 to anybody who will read an open book placed behind his back. $1,000.00 to anyone who will produce a readable message on a ouija board, the letters of which have been transposed. $1,000.00 to anyone who will produce a message on slates. $1,000.00 to anyone who will prove telepathy. $1,000.00 to anyone who will describe in detail and in advance an event or calamity which eventually takes place over which he has no control and of which he has no previous knowledge, or will produce a picture on a negative placed in a locked safe. $5,000.00 to anyone who will produce ectoplasm. All effects must be devoid of fraud. To Mr. Rinn's awards, SCIENCE AND INVENTION adds another $1,000.00 to anyone who will produce any type of manifestation which cannot be duplicated by trickery.

This contest, which has been extended for another year, closes May 1, 1926. It is advisable that the reader refer to the rules of the contest, so that he may familiarize himself with the conditions of the test. In this challenge every medium is included.

$5,000.00 in prizes is awarded by SCIENCE AND INVENTION magazine for a perpetual motion machine. This publication does not believe that perpetual motion is possible. It brands as imposters all who have claimed to have developed a perpetual motion machine that would work, but who destroyed it because they were afraid that the idea would be stolen, or because they feared that they would get nothing for it, and could not protect the idea without a patent, for which they had no funds. This publication will pay to anyone demonstrating a working model of a perpetual motion machine $5,000.00 with which sum the expenses of applying for a patent can be met, leaving most of the sum as surplus. We are not interested in securing the rights to the invention. The conditions of the contest are that the device be brought or be shipped to the offices of SCIENCE AND INVENTION magazine, that we must be satisfied there is no trickery in making the mechanism work, and the device must work by gravity. Mechanisms operating by atmospheric pressure changes, temperature changes or humidity are not considered perpetual motion devices.

There are no hitches or strings tied to this offer, the details of which were published in the March, 1925, issue of SCIENCE AND INVENTION magazine. The contest is open to everyone and is aimed to guard against fraud. The date of expiration is March 1, 1926. See the issue referred to.

Pending Contests

$100.00 In Prizes for Circuit Diagram of the Mystery Set Announced in This Issue. Contest Closes July 2, 1925.

Thirty-five Combination Pen Pencils Awarded as Prizes for Uses of Inner Tubes for Automobile Tires, Announced in March, 1925, Issue. Contest Closes May 1.

$1000.00 Monthly Contest Awards

FIRST PRIZE $100.00

The Lost World, by Edwin Schallert 14-15-16

SECOND PRIZE $75.00

Predicting the Sex of the Unborn, by Dr. Isaac Fried, M. D. 20

TWO PRIZES OF $50.00 EACH

Transmutation—Is It Possible? by Charles T. Dahama, Ph.D. 39
Model Demonstrates Eclipses, by Dr. Ernest Bade 48-49

THREE PRIZES OF $35.00 EACH

The Mystery of Atomic Energy, by Donald H. Menzel, Ph.D. 21
X-Raying Big Guns, by S. R. Winters 22
Scientific Puzzles and Oddities, by Leslie R. Jones 42

FIVE PRIZES OF $25.00 EACH

Filming "Peter Pan," by Edwin Schallert 12
What Are Spiral Nebulae? by Charles T. Dahama, Ph.D. 23
Unique Bicycles, by Maj. Chas. G. Percival 35
Useful Cements and Their Uses, by Ismar Ginsberg, B. Sc. 47
A Portable Set De Luxe, by Lynn Matthias 64

FIVE PRIZES OF $20.00 EACH

An Oscillating Propeller, by Richard Neumann 34
Timing the Swiftest of Vibrations, by Dr. Harold Richards, Ph.D. 37
What Comes Out of An Auto Exhaust, by O. Ivan Lee, B. Sc. 38
Anaglyphic Vision, by Dr. Alfred Gradenwitz 50
Making Toy Balloons, by R. R. Henderson 52

TEN PRIZES OF $15.00 EACH

Has the Earth Two Moons? by Don Home 24
Roller Shoes, by Dr. Alfred Gradenwitz 41
Moving Effect in Stereoscope, by C. Brust 50
Home-Made Stereoscope, by Dr. Ernest Bade 51
Filter Stereoscope, by C. E. Payne 51
Radio From Cellar to Garret (author please send address) 56
Dangerous Static, by Henry N. Deneen, Rep. No. 17,129 57
Aerial Guide for Night Fliers (author please send address) 57
Monte Grande in Argentina, by Dr. Albert Neuburger 58
Multiple Phone Block, by V. Krejci 63

FIFTEEN PRIZES OF $10.00 EACH

Advertising Lamp, Holmes Feature Service 40
Reminder, by K. B. Murray 53
Barometer, by S. L. Bastin 53
Test Tube Heater, by Robert Rogers, Rep. No. 11,229 53
Zinc Cuts, by George J. Gould 53
Trouble Lamp, by William Nicholson 54
Parts Rack, by F. J. Wilhelm 54
Aluminum Oxide, by Arthur A. Blumenfeld 54
Flasks, by G. M. Blackford 54
String Filter, by Arthur A. Blumenfeld 54
Heavy Duty "B" Battery, by Edmond L. DeWick 63
Turn Counter, by George B. Hostetter 63
Rear Mounted Dial, by J. Liebowitz, Rep. No. 2939 91
Loop Aerial Mounting, by C. G. Switzer 92
Vernier Condenser, by C. S. Martin 94

TEN PRIZES OF $5.00 EACH

Smoke Rings (author please send address) 5-
Condenser, by William F. Pond 54
Paint Brushes, by F. J. Wilhelm 54
Glass Threads, by Arthur A. Blumenfeld 5-
Rack, by F. J. W. 5-
Variable Condenser, by V. Wardinhausen 9
A Solder Mould, by C. F. Felstead 9-
Stand Off Insulator, by A. Hornsby, Rep. No. 17,352 9-
Initial Bezel, by C. H. Ostermeir 9-
Carbon Removal, by M. Mather 90

(No Further Entries)

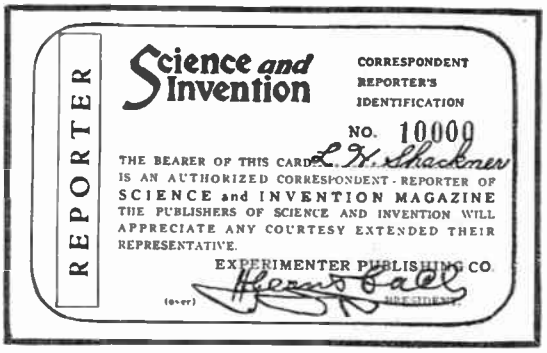
$12,000.00 in Prizes for Articles

82 monthly prizes will be given as follows:

FIRST PRIZE		$100.00	
SECOND PRIZE		$75.00	
2	PRIZES OF	$50.00	each
3	" "	35.00	"
5	" "	25.00	"
5	" "	20.00	"
10	" "	15.00	"
15	" "	10.00	"
10	" "	5.00	"
15	" "	2.00	"
15	" "	1.00	"

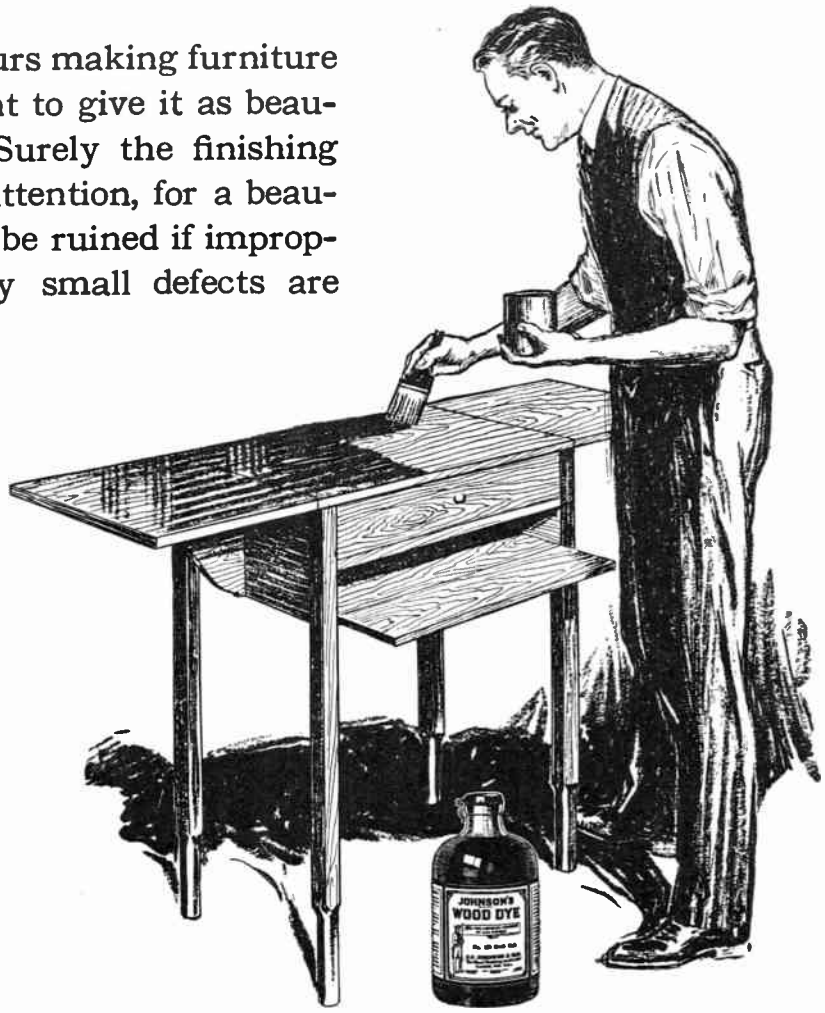
Last year SCIENCE AND INVENTION Magazine paid for articles $13,320.00 to 1,112 prize winners. Hundreds of SCIENCE AND INVENTION reporters won prizes, and up to the time of going to press there were more than 20,000 reporters in the field.

Every month this publication pays $1,000.00 or more in prizes, exclusive of money paid to those authors who are on contract, and who receive their own rates. At the left the list of prizes issued monthly is itemized, and above are the names of the prize winners for this issue. In order to assist our reporter correspondents in securing available material for publication, we issue without charge the reporter's card, a sample of which is illustrated at the right. Send a postal card for one. It will act as an open sesame in securing news. Address Field Editor, SCIENCE AND INVENTION, 53 Park Place, New York City.



How to Give Home-Made Furniture that Finished "Professional" Look

After spending precious hours making furniture by hand, you naturally want to give it as beautiful a finish as possible. Surely the finishing should receive its share of attention, for a beautiful piece of furniture may be ruined if improperly finished, whereas any small defects are minimized if well finished.



The Johnson Book on Wood Finishing gives complete instructions for finishing new and refinishing old wood—soft or hard. It tells how to stain wood artistically—how to remove old paint and varnish—how to secure a beautiful enamel finish, etc. This book is the work of experts—profusely illustrated in color. It includes color charts—gives covering capacities, etc. It is full of valuable, authoritative information on Artistic Wood Finishing. The coupon below tells how to get a FREE copy of this authoritative manual on a fascinating subject.

JOHNSON'S WOOD DYE

Johnson's Wood Dye is for the artistic coloring of all wood. It is very easy to apply—dries in four hours and will not rub off or smudge—penetrates deeply, bringing out the beauty of the grain.

Johnson's Wood Dye is a *dye* in every sense of the word. It contains no finish whatsoever. Like most first class products it answers one purpose only—it *dyes* the wood. A finish must be applied over it—we recommend Johnson's Varnishes or Johnson's Polishing Wax.

Johnson's Wood Dye is made in seventeen beautiful shades, among the most popular of which are:

123—Dark Oak	*131—Walnut*
129—Dark Mahogany	*126—Light Oak*
127—Brown Mahogany	*124—Golden Oak*

All shades may be easily lightened, darkened or intermixed. Full directions on every label. Select the shade of Johnson's Wood Dye that you want and order it from your dealer by name and number.

FREE—25c BOOK ON WOOD FINISHING

Ask for a FREE copy of the Johnson 25c Book on Wood Finishing at stores displaying the sign shown at right. These stores carry Johnson's Artistic Wood Finishes and will be glad to show you wood panels—and answer questions on how to properly finish wood. If no store in your locality can supply the Johnson Book — mail this coupon for a copy —Free and Postpaid.

YOUR DEALER'S NAME .....

Your Name .....

Your Address .....

City and State .....

S. C. JOHNSON & SON, Dept.S.I.5, RACINE, WIS.

Doctor Hackensaw's Secrets

By CLEMENT FEZANDIE

(*Continued from page* 31)

just jump into the 'plane again and I will take you to the Desert of Sahara and show you what I have accomplished there by means of this same atomic energy. You will begin to realize the value of my invention when you see how it enables me to make every portion of our planet habitable by man.

CHAPTER III—A CANAL THROUGH DESERT OF SAHARA

"Here we are at Tunis, Pep, and here you will see the beginning of my canal through the Desert of Sahara. The canal extends all the way across the desert to Timbuctoo—some job let me tell you, to dig this ditch through hundreds of miles of desert, and let in the waters of the Mediterranean. Even with the aid of atomic energy it was no light task.

"You see, in this case it was *explosive energy* and not mere *heat* that I needed; and there were two drawbacks to using the explosive force of grains of sand. The first was that the explosions would destroy the insulators, and thus the disintegration would spread unchecked to the whole desert; and the second was that each explosion would throw the neighboring grains of sand to a distance and so stop the work until a new start could be made. By using my sand in a very fine powder I was able to guard against the first danger, for while the powder disintegrated readily it did not produce energy enough to start disintegration in an ordinary grain of sand. I thus need not bother about insulators. All I needed to do was to reduce the explosion to such a degree that I could use a suitable instrument carried in an automobile and by means of a hose feed the dust slowly in a stream of inert gas, the dust exploding as it touched the ground. This was slow work, but the only alternative was to change the energy into heat and utilize the heat to run a dredging machine to dig the canal. This would have been even slower yet.

"Now we shall fly along the banks of the canal to Timbuctoo. You can already see for yourself the advantages of this new stream in the desert, for all along its course there are Arab encampments, and at the places where I have created small lakes, whole villages have sprung up."

"But," objected Pep, "I thought the water of the Mediterranean was salt."

"So it is, but by distillation it can easily be rendered fit for drinking purposes. In fact driven wells will furnish enough fresh water. This salt water is all right for irrigation, as the salt can be filtered out as the water percolates through the soil."

Doctor Hackensaw's joy was great to perceive that several vessels were already in the canal making their preliminary trip. "It won't be long," said he, "before a railroad, too, follows the line of the canal."

Timbuctoo was reached in the course of about four hours of flying and the night was spent there.

"And now," said Doctor Hackensaw to the young girl, "I am going to show you another of the conquests which the mastery of atomic energy has permitted. You saw at the South Pole how easy it will be to reclaim the Arctic regions. Here you see how I can reclaim this immense desert, larger in area than the whole United States. Next I shall show you how I can conquer the ocean itself, a transcendental discovery, because the surface of the earth contains several times as great an area of water as of land. We are now about to start for what will soon be a new continent, for in the very midst of the Pacific Ocean I have started creating a new land!"

"PACIFIC CONTINENT"—A NEW LAND

"What!"

"Yes, Pep. There will soon be a new Pacific continent to add to the map. You are probably aware that at intervals in the past, new lands have emerged and all continents have been submerged through the agency of earthquakes. The idea occurred to me that I might create an artificial earthquake by means of atomic energy, and so produce a new continent for my own use. Columbus discovered America, but I shall go him one better; I shall *create* my Pacific continent!

"I have already started work. I chose an elevated portion of the sea-bottom—probably a spot where a continent existed at some remote age, and after long planning, by means of special submarine boats, adapted to descend to great depths, I started releasing atomic energy under the bed of the ocean so as to upheave it quietly as it is sometimes upheaved slowly by natural causes. To save work, I have upheaved this land in a circle so that my island is really a ring with a central lagoon. Then I can elevate the centre and so complete my island. Up to date I have only raised one small island as an experiment. To this I shall add others and finally join them all together into one land."

To Pep the airplane trip to the new island was very tedious, though she relieved the monotony of the journey somewhat by taking an occasional trick at the steering wheel. And when they did at last sight the island, it was a disappointment, being nothing but a kind of mudbank with no vegetation except some dead and offensive sea-weeds and fish and marine monsters in various stages of decomposition.

"Oh, don't let's land here," she cried. "The place is too horrible!"

"All right," assented Doctor Hackensaw, whose nostrils, too, were offended. "I'll wait till it's been cleared off and planted, and I'll wager that then you'll be delighted to come with me. And mark my words, it won't be long before I have a whole large continent here. Then I shall build an isthmus to connect it to China on the one hand and to the United States on the other so that we can have a trans-Pacific Railroad

BOTTLED LIGHT, HEAT AND POWER

"And on my new continent I shall manufacture atomic energy and sell it in the form of light, heat and power to all the nations of the world, to run their boats, their trains, their factories and all their machinery!

"And now for home!"

CHAPTER IV
A RIVAL INVENTOR

"Say, Pop," cried Pep Perkins, "you're not the only man who has invented 'Atomic Energy.' Here's another one!" And with the words she handed the doctor a newspaper and pointed to an advertisement in the personal columns:

"ATOMIC ENERGY

The undersigned hereby informs the governments of the whole world that he has discovered the secret of atomic en-

(*Continued on page* 76)

TROPADYNE SUPERADIO OUTFIT

THIS Superadio 6 Tube Set brings in Station KFKX (Hastings, Nebraska), 1200 miles, in New York City, clearly on a loud speaker, using only the small loop which comes with the outfit.

The outfit advertised here is complete, as listed below, everything needed is included, down to the last screw. The charts, blueprints, directions and photos furnished are so complete and explicit that anyone can build this set and have it working within a few hours. There is nothing additional to buy except the necessary batteries and tubes. Price includes mahoganite cabinet and folding loop aerial.

You can pay $150 or more for an outfit, or $200 or more for a set, but you cannot possibly buy a better set than this one.

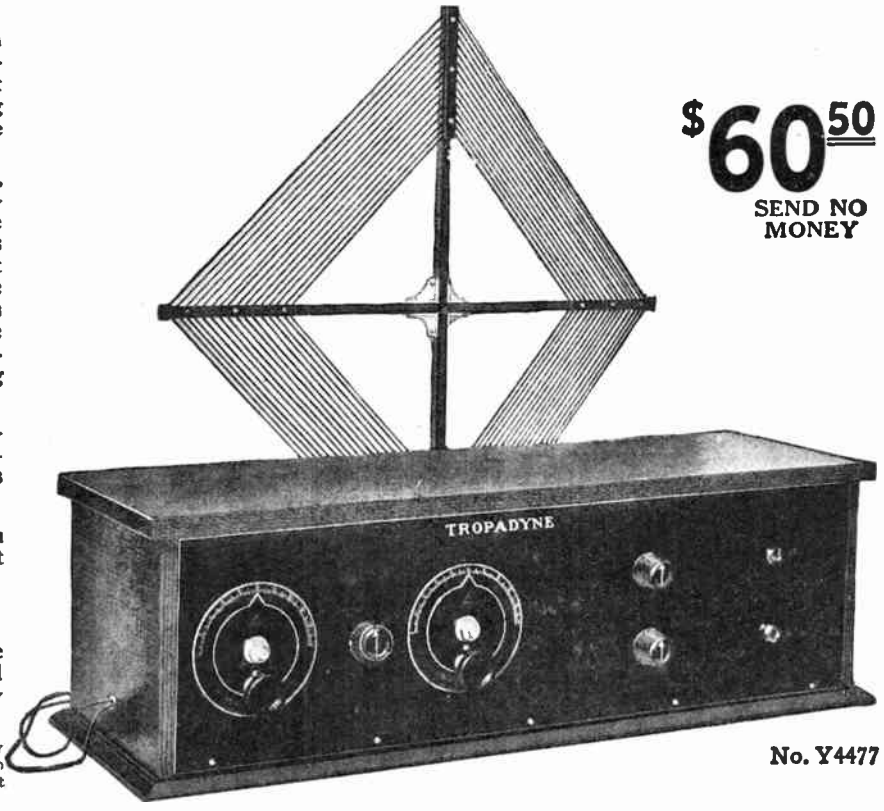
READ THIS

Utmost sharpness—Cuts thru locals bringing in long distant stations as if they were locals.

Ease of Tuning—Only two dials.

Tuned Intermediate Transformers; the only real BALANCED set of its kind made. Once transformers are tuned they need not be touched again.

Your Money Refunded if this set does not satisfy you in all respects—if after 5 days' fair trial you do not proclaim the TROPADYNE the best radio set you ever listened to.



$60.50

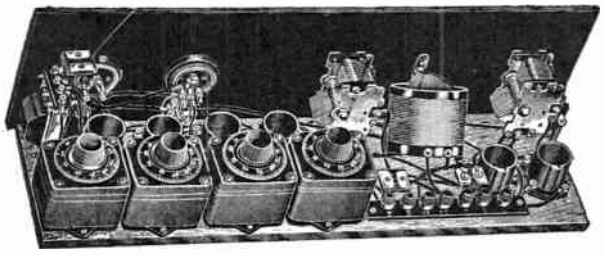
SEND NO MONEY

No. Y4477

A GREAT ADVANCE IN RADIO SET BUILDING

By using our new NO-SOD-ER connectors, any one, by means of a screw driver and a pair of pliers, can put this set together. No bus bar, no heat, no flame, no solder, no soldering iron (*only an expert can solder right*), no fuss, no trouble. By means of our insulated, double eyeletted, flexible connectors, perfect connections are made, not only mechanically, but electrically as well. Short circuits impossible. Read all about this new advance on page 2038, May issue of RADIO NEWS.

REAR VIEW OF TROPADYNE



Set uses 201A or UV-199 Tubes.

Note These Important Features:

DISTANCE, VOLUME AND TONE QUALITY equal to any 8 tube set sold anywhere at any price.

LOOP RECEPTION—Outside aerial not required with this set—the complete loop is included in outfit.

PERMANENT LOGGING OF STATIONS—Follow chart furnished; there are only two tuning controls and you will always find the same station at the same spots on the dials. Our log chart shows you at what point to find any station.

MICROMETER VERNIER DIALS giving you the full advantage of the exceptionally sharp tuning.

OUTFIT IS ABSOLUTELY COMPLETE—Drilled panel, Mahoganite Cabinet and everything else needed, except tubes and batteries.

ECONOMY and SIMPLICITY—This is not a reflex, yet six tubes do the work for which other sets require eight to ten.

The Editor of Radio News

In the August 1924 issue, said this about the Tropadyne: "Here is a remarkable receiver which we warmly recommend to our readers. It has several new and unusual features. In the first place only 6 tubes are used giving as much volume as the average 8 tube Heterodyne. The selectivity of this set is unusual. Unequalities of the intermediate transformers have now been done away with by tuning each transformer. After the transformer has been tuned, it can be left this way, no further tuning being necessary.

"This system makes for maximum sharpness and maximum volume. Another outstanding point of superiority of the Tropadyne circuit is that it practically does not radiate, thereby not interfering with other nearby receiving stations. A saving of two tubes as well as an increase of selectivity is obtained with this new circuit."

Complete List of Parts:

4 *RICO* Tropaformers; 1 Standard Variocoupler; 2 *Certified* Low Loss 23-plate Condensers; 1 *Calibrated* Transformer; 2 Jacks; 3 Fixed Condensers; 6 Bakelite Sockets; 2 Vernier Dials; 1 Rheostat; 1 Potentiometer; 1 7x24 Panel; 1 7x24 Mahoganite Cabinet and Baseboard; Supply of "No-Sod-er" Connectors; 1 Folding Loop Aerial; 1 Grid Leak and Mounting; Binding Posts; Flexible Wire; 1 Bakelite Binding Post Strip; 4 doz. Screws; Full Directions.

We ship in 24 hours

RADIO SPECIALTY COMPANY, 100 PARK PLACE, NEW YORK

New "Rasco" Catalog NO. 12

CONTAINS 75 VACUUM TUBE HOOK-UPS. 300 ILLUSTRATIONS. 500 ARTICLES. NOW 100 PAGES

All Armstrong Circuits are explained clearly, all values having been given, leaving out nothing to puzzle you.

Just to name a few of the Vacuum Tube circuits: The V.T. as detector and one-step amplifier; one-step radio frequency amplifier and detector; three stage audio frequency amplifier; short wave regenerative circuits; 4-stage radio frequency amplifiers; radio and audio frequency amplifier; inductively coupled amplifier; all Reflex circuits.

FREE

A POSTAL CARD BRINGS IT

SEE OUR 2-PAGE AD ON PAGES 2038 and 2039 RADIO NEWS

S.I. 5

SEND NO MONEY

RADIO SPECIALTY CO., 100 Park Place, New York, N. Y.

Please send at once one complete Tropadyne Superadio Outfit as advertised in May "Radio News." I will pay postman or expressman $60.50 upon arrival.

NAME .....

STREET or R.F.D. .....

CITY ..... STATE .....

Doctor Hackensaw's Secrets

(*Continued from page 74*)

ergy and the means of utilizing it. In other words, he has discovered a force which will enable any nation to easily annihilate its enemies.

I offer my secret to the government that makes the highest bid, all bids to be made in this personal column.

As a sample of the power of this atomic energy I shall on Saturday next at five P. M. blow up the land on which the carousel in Central Park now stands. The authorities are asked to take proper precautions to prevent the loss of life.

I. N. VENTOR.

Doctor Hackensaw read the announcement with a frown. Philanthropist as he was, it was a blow to his pride to think that another inventor had stolen a march on him. Then an idea struck him, and with a roar he jumped for the safe where he had stored some of his prepared tapes. For convenience and safety in handling his explosive he had prepared long rolls of tape similar to that used for telegraphing stock quotations. On this roll the finely pulverized dust he obtained by crushing grains of sand was glued with certain chemical substances between the particles. In this way he was able to control the atomic energy released.

"Pep!" he cried, half joyfully, half sorrowfully, "that fellow is a villain! He hasn't invented anything! He has only stolen a lot of my prepared tapes! And yes—he has stolen one of my radio machines to start the disintegration! I must look into this at once, because there is no knowing what damage the fellow will do, handling this stuff that he doesn't know anything about!"

CHAPTER V

Saturday had come and the neighborhood of the carousel in Central Park was thronged with spectators eager to see what was going to happen.

At a quarter to five a small boy wormed his way through the crowd and handed the head of police a slip of paper bearing these words:

"On account of the crowd, I shall blow up the rocks on the ball-ground instead of the carousel. I. N. Ventor."

A loud speaker had been installed for the occasion and through this the chief of police made the announcement of the change in programme. All eyes now turned toward these rocks, well known to every New Yorker. Generations of children had slidden down those rocks, and if you had asked what caused the polished surface of the rock, the large majority would have answered that it was caused by the seats of the trousers of the boys who had slid down. As a matter of fact, this polish was hundreds of thousands of years old, and like the scratches on the surface of the rock were due to glacial action at the time when the ice was digging the chain of Great Lakes and the smaller lakes that honeycomb the states of Maine and New York.

At the stroke of five there was a perceptible tremor of the earth. This gradually increased and a number of people were thrown down. Then the enormous mass of rocks at the southern extremity of the ballfield was seen to slowly rise in the air.

There were a series of loud cracking sounds, as the huge rock broke into fragments, and then with one terrific explosion large masses were hurled in all directions! For five minutes the disturbance continued, though what was happening could not be seen because of the cloud of dust that enveloped everything and covered the spectators themselves. The performance was over!

CHAPTER VI

"It's all right, Pep," cried Doctor Hackensaw, the next day. "The rogue has met with his deserts, and the country is saved!"

"How did it happen? Was he blown up in the explosion?"

"No, he met a more prosaic end. He had come to the park in an automobile. In this way his radio apparatus for starting the explosion could be completely concealed. But he was in such a hurry to get away that he collided with another auto, and as luck would have it, he was killed instantaneously. I read of the account in the papers, and the description of the radio apparatus and the rolls of purple tape found in the damaged auto told me the tale at once. The police imagine it was just an every-day auto accident, so I had no trouble in getting possession of my tapes again. And in future I shall keep these powerful engines of destruction safely stored in the strongest vaults of some safe deposit company. They are too dangerous to leave exposed to ordinary sneak-thieves.

"As a matter of fact I begin to fear that I may have to give up all my schemes for the utilization of this atomic energy. I am beginning to see the wisdom of a well known English king, I think is was Alfred the Great. A chemist came to him one day and explained that he had discovered a new explosive far more powerful than gunpowder. King Alfred rewarded him generously, but on the express condition that he would keep his discovery secret as men already possessed sufficient means of destroying each other.

"It is the same to-day, Pep. The world is not far enough advanced yet to make proper use of Atomic Energy. Our wars and our strikes would become far more destructive than they are at present, and humanity in its foolishness might wipe itself completely from the face of the earth!"

Sun Gives Normal Heat Again

THE Smithsonian Institution has just published a paper by Assistant Secretary C. G. Abbot, giving daily value of the sun's heat since 1920. Results show that for more than two years the solar heat has been below normal, but that now it is just reaching normal again. Comparisons with the number of sun spots furnishes the reason. When there are few sun spots, as in 1923 and 1924, the sun burns low, like a fire that is not stirred, explains the scientist. The time for many sun spots is now approaching, and, like a fire when the fresh coals are raked forward, the sun soon will send out more heat.

"Two observatories under the Smithsonian Institution are carrying on this work," it is explained. "One station is in the nitrate desert of Chile on a mountain 9,500 feet high. It never rains there, so that all food and water have to be hauled twelve miles. The ground there is as bare of life as an asphalt roof. The other station is on a mountain in the Arizona desert, where it seldom rains.

"Daily telegrams bring results from both stations to the Institution. Some promising experimental forecasts of weather conditions have been attempted by H. H. Clayton, based on these results. These will be reported on later. Measurements like these hold out great promise of usefulness.

Patent Advice

Edited By A. P. PECK

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain patent phases. Regular inquiries addressed to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are published here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

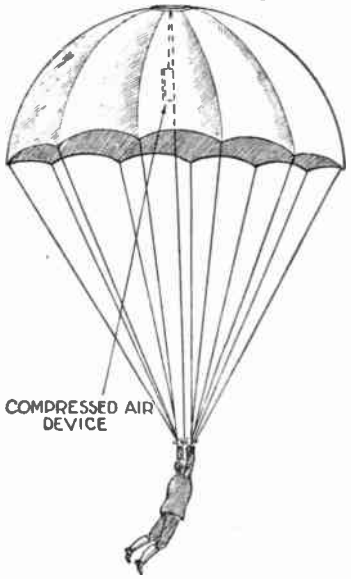
Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

NOTE:—Before mailing your letter to this department, see to it that your name and address are upon the letter and envelope as well. Many letters are returned to us because either the name of the inquirer or his address is incorrectly given.

PARACHUTE

(885) Alfred Furry, Ovid, Mich., has conceived an idea of a safety device for the use of aviators which incorporates a compressed air system for forcing a parachute open. The idea is that the parachute will then become effective even at very low altitudes. He asks our advice.

A. 1. The device you propose for forcing parachutes open is not new. It has been proposed and tried before, but found wanting. The system



Parachute opening devices are not new and often fail in operation.

is not positive in action, as it very often fails due to failure of the compressed air device.

However, we cannot comment any further upon your compressed air device, as you did not give any details of the same.

SELLING A PATENT

(886) H. Rider, Portland, Ore., states that he has made his final payment on a United States patent and desires to know whether or not he can proceed with attempting to sell his invention.

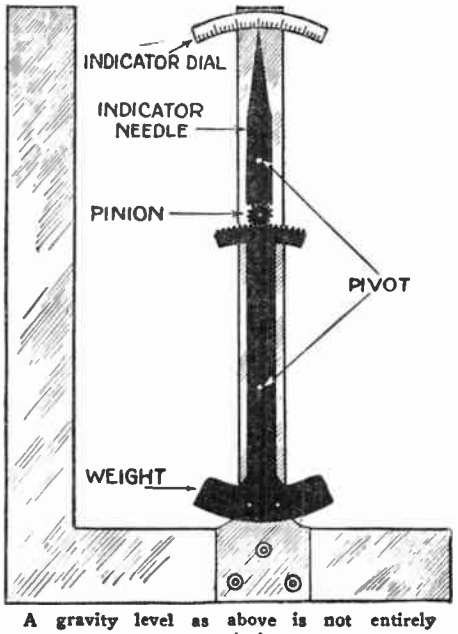
A. 1. Inasmuch as your final payment has been made, we believe that you can go right ahead and send out blueprints and specifications of your patent, the application of which is now pending at the Patent Office. You should not meet with any difficulty.

LEVEL

(887) E. E. Nelson, Dayton, Ohio, suggests a design for a gravity level to be used in connection with a carpenter square. The idea is illustrated herewith. He asks our opinion upon the subject.

A. 1. The gravity square level which you have designed is not very new, and in our opinion, not extremely practical.

We do not believe that a patent upon this tool would benefit you materially, and would not suggest that you apply for the same.



A gravity level as above is not entirely practical.

PERPETUAL MOTION

(888) Samuel Tatter, Hoboken, N. J., refers to the February, 1924, issue of this magazine, wherein was illustrated a series of supposedly perpetual motion machines. He asks whether or not any of these devices have been made to operate.

A. 1. Not one of the perpetual motion machines which were illustrated in this magazine have been made to work. We offer $5,000 to anyone who will make up a model of one of these machines and make it work according to our satisfaction, or we offer a similar amount to anyone who will make a working model of any other type of perpetual motion machine. All models to be eligible for this prize must be brought to the offices of this magazine, and thoroughly and satisfactorily demonstrated. Plans and written descriptions will not be considered.

(*Continued on page* 80)

Patent Advice

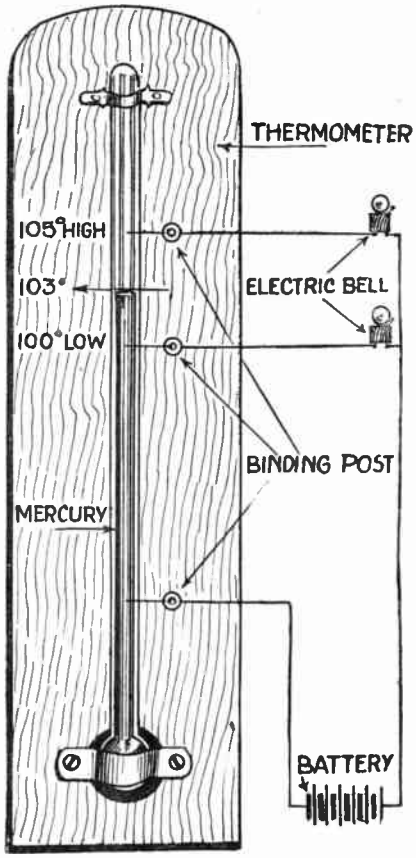
(*Continued from page 78*)

HEATING ALARM

(889) C. Slator, Llano, Texas, suggests a heat indicating device such as illustrated herewith which will ring a bell when a certain high temperature is reached, and which will cause another bell to ring when a certain low temperature is reached.

A. 1. With regard to your alarm, we would advise that there is nothing new in this system. Thermometers of this nature are on the market at the present time, and the metallic thermostats which can be built much cheaper, even surpass these thermometers with regard to practicability, serviceability and adjustability.

We do not believe that you can secure a patent upon your idea.



Heating alarms of the type illustrated above are by no means new and furthermore are not as efficient or as cheap to manufacture as thermostats. It is therefore not advisable to patent a device of this nature.

ELECTRIC LAWN MOWER

(890) Ralph H. Smiley, Indiana, submits a design of a lawn mower to be operated by an electric motor, the current being supplied to the latter through a flexible wire. He asks our opinion.

A. 1. Although the lawn mower which you have designed is practical to a limited degree, it is by no means as popular in appeal as those lawn mowers incorporating in their construction a small gasoline motor. The latter can be used anywhere and do not require cables or certain types of current in order to operate them. There is a possibility of patenting your system and also a possibility of a sale. On the other hand, there is a similar degree of uncertainty in the system, particularly with regard to its being accepted. Patenting this device is a gambling feature and you yourself alone know whether or not you can afford to gamble.

RADIO LOG

(891) Adolph Franzmann, Stillwater, Minn., describes a radio set logging device in which the call letter of the station, wave-length, dial settings, and remarks are to be written by the user. He asks our advise on the same.

A. 1. We do not consider your proposed radio set log to be worthy of a patent. There is one other device of this nature patented and on the market today which we consider to be far simpler and far superior to your proposed style. We would advise you to drop the idea entirely.

Readers Forum

(*Continued from page 55*)

This same author would have us believe that a great amount of expansion alone is the reason a glass breaks when filled with hot water. If the same hot water were put in the glass slowly, the glass would not break, and still there would be as much expansion as when the water was poured in quickly. The fact is that when water is poured into the glass quickly, the inside of the glass expands much faster than the outside. This causes the glass to break. If the glass is allowed to expand evenly on the inside and on the outside by pouring the water in slowly, it will not break. In this way the whole inner surface does not expand before the outer one starts its respective expansion. So it is not expansion alone that breaks glassware, but expansion and the lack of expansion. If the author of that article is correct, I can record two new laws in physics.

Please do not misunderstand me as sarcastically criticizing your work in a destructive way, for I believe your contributors are doing a great deal toward the advancement of science in America.

THEO. A. HUBER, Ada, Ohio.

(You are entirely wrong in your statement concerning the conductivity of water. Water is a very poor conductor of heat. If a vessel containing water be heated on one side, the water will be found to boil on that side, whereas the other is quite cool or even cold. This is particularly true of a pan-like vessel containing the water, and if the heat is concentrated over a small area, preventing the heating up of the entire pan, the effect will be well marked. Of course, water is not as poor a conductor of heat as asbestos or other heat resisting products, but it is by no means as good a conductor as the various metals. If you think that this is a new principle in physics, then it must stand. Any book on physics will not only present the facts here outlined, but will also demonstrate the experiments required for laboratory proof of these statements.

With reference to the expansion proposition, we would advise that your explanation as well as that given in the magazine is correct. You have merely gone into the question a little more thoroughly than the magazine article. It is not necessary that the water be poured into the glass slowly in order to prevent the glass from breaking. There are many other methods which can be used which will work equally well. As for cooking food under a flame, this is a regular practice. It is the best way of broiling and is used for making toast.—EDITOR.)

PRAISES SCIENCE AND INVENTION

Editor, SCIENCE AND INVENTION:

As a reader of your splendid magazine, I wish to add a word of praise. You certainly present the "goods" in a manner that is most interesting. The descriptions you give show that science and invention are the forces that keep us moving onward.

I am quite interested in the many new theories that are put forth, and while not able to understand them as given by the big scientists, I am able to grasp them very easily from your illustrations and text. This only goes to show how popular your illustrations are, and how the layman can grasp from them the meaning of very difficult scientific theories. This idea of illustrating articles is particularly fine.

Your fiction is good and I especially enjoy "Dr. Hackensaw's Secrets" and also the stories that deal with other worlds. The radio articles are good, and I keep all the data presented by your publication for future information, even though new circuits given monthly seem to supersede outfits a month or two older. The wrinkles, how-to-make-it, and latest articles on patents and inventions are instructive. The scientifically or otherwise inclined man can always find something of interest to him in the pages of your publication.

Your covers are always up to date, and in fact it was a cover on one of the issues that attracted me to your magazine and made me pick it from a group of others on the newsstand. Since that time I have become a regular purchaser. There is only one fault that I can find, and that is I always lose some extra sleep on the day the magazine first comes out each month, as I read it through from end to end. I keep the magazines and enjoy the old copies again and again every time I go over them.

EARLE S. DECKER, Middletown, N. Y.

(We are very glad that you like the humble efforts of the editors and those of our reporters in giving you the type of magazine you like. Unfortunately we cannot place a curfew in the publication and make you go to sleep on time, but as long as the subject matter of SCIENCE AND INVENTION *keeps you awake, we know that you are interested in the magazine. It is when you throw the book away in disgust that the paper fails to be what we desire. We thank you for your kind letter and trust that you will continue to enjoy this journal for a great many years to come.*—EDITOR.)

The Living Death

By JOHN MARTIN LEAHY

(*Continued from page 27*)

"But why isn't there? Something queer about that cave, Bond. It is a fact well known that great caverns *breathe*. Take the Mammoth Cave, for instance. In summer the cave *exhales*, the air moving with the force of a gale at the Iron Gate, about three hundred feet from the mouth. But, when the temperature of the outside air falls below that of the cavern, the mean of which is 54°, then it *inhales*.

"However," he added, "there can be no doubt that temperature alone is not, in every instance, an adequate explanation. In other words, sometimes some of the phenomena presented by the respiration of caverns are inexplicable."

"Well," I told him, "I am not going to lose any sleep trying to figure out why that zephyr at the mouth of the cave isn't a typhoon. Certainly I am not going to try to explain the respiration of a cavern (of which I know nothing whatever) when scientists (who know all about everything) can't explain that simple phenomenon, an ice-cave—one of those caves in which there is a lot of ice in summer, but in which not a single particle is to be found in winter."*

"Perhaps," he smiled, "we'll find something in there tomorrow for the explanation of which you would be glad to give a whole year of your life."

In my secret soul, I groaned aloud.

"Then our exploration of that labyrinth of Erebus is not yet ended?"

"'Tis my hope," he made answer, "that we shall see much more than we have."

Which meant that I couldn't hope (though wishing mighty hard) that we shouldn't.

Nine o'clock the next morning found us at the entrance once more. We had one of the sled-meters with us, so that there would be no guess-work about the distances traversed. We passed the monster and the door, then the spool and entered that maze of grottoes. We saw to it this time, you may be sure, that we did not get lost. On we went through that wonderful place. No pen could describe the beauties that we saw there. We were in fairyland. The formations took a thousand-thousand shapes, some of them indescribably fantastic, others terrible as spectral figures lurking about tombstones.

There were columns slender and fluted, as beautiful as those of a Grecian temple. We saw ribbons, festoons, curtains, flowers (oulopholites), trees, animals, birds, fountains, waterfalls, angels, demons, Gorgons, serpents, gnomes, dragons.

Some of the sinter was translucent; and at last we found some columns that were as transparent as glass!

Whilst the others were standing there examining and admiring the first of these, I moved forward—to be brought up by a sight so strange and horrible that, for a few moments, I could scarcely believe the testimony of my senses.

My exclamation brought the others to the spot instanter.

Pointing to the column before me, I cried: "I don't know whether it is a dream or a picture by Doré; but—isn't that a human head?"

*"One of the largest of these natural icehouses is in the Carpathian Mountains, near the village of Selitze, and is resorted to, in mid-summer, to supply the wants of the villagers. At that season the roof is covered with immense icicles, and the drops falling on the sandy floor are instantly congealed. On the approach of winter the icy mass begins to dissolve; and, by Christmas, it is gone, leaving the cavern dry and warm till spring returns!"—Hovey.

CHAPTER XXVI

THAT FORTUNE HAS WARNED US

Yes, that was what we saw; as I am a living and honorable man, there was a human head in that pillar of sinter-glass!

We gazed in upon the object in indescribable amazement and in horror. The skin, the color of which was a dirty brownish-yellow, was drawn tight to the bones, the whole head having a dry and withered look; there could be no doubt, however, that this strangest relic of mortality upon which the eye of man ever lighted was that of a white man.

"And look at that!" exclaimed Frontenac, pointing to the next column. "There is another one!"

The moment succeeding Nunatak ejaculated:

"And there's the third!"

"Another!" said Hansen.

"And two more there!" Loomis added.

A few minutes, and still another was found, making seven altogether of these strange, grisly objects.

As for the physical agencies which had brought about this singular phenomenon, the rationale was a simple one: the heads had been placed upon the stalagmites, and the drip of the acidulated water had done the rest; the deposit of crystal sinter had incased them. And there they were like insects preserved in amber.

But why had those old Antarticans done so strange a thing?

"If the whole body," said Frontenac, "had been placed under the drip, there would have been no mystery at all about it. But why only the head?"

"Maybe, boss," observed Louis Louisiana, "the Fiend hisself might be able to answer that question. What horrible things human bein's really are—a lot of them 'tany rate! Probably, now, this is just the pleasant little joke of some robber or priest or tyrant."

"Probably," I suggested, "Sleeping Beauty will be able to throw light upon the matter."

"'Tis not impossible," Frontenac said. "But these objects must have been old even in her day. The heads were, of course, placed upon the stalagmites, yet not a one of them is in a stalagmite now; sufficient time elapsed for the formations to meet and form these pillars. In her time they must have been even as they are today, for, on the falling of the Great Cold, the drip ceased."

"Still," I proffered, "there might not have been much space, when the heads were placed there, between stalactite and stalagmite."

"That is, of course, true. Still I think that they must, when she was born, have been here for a long time. I think it unlikely that Sleeping Beauty ever saw them. Perhaps, indeed, she never even heard of them."

"We shall see."

"Unless," he said, "the girl is, after all, a corpse."

"I don't know, muttered Nunatak, "that they would be any the more wonderful if we knowed why the thing was done."

We found nothing more in that place, which we called the Hall of the Heads.

Our sled-meter showed four and one-half miles at this spot. We figured that we were about three miles from the entrance in a bee-line.

On we went. For a half mile or so, the going was very difficult. The floor was strewn in all directions with fallen stalactites. In some places, even columns had fallen.

(*Continued on page 84*)

The Living Death

(*Continued from page 82*)

Our hypothesis was that an earthquake had produced this havoc. The meter was useless here, and so Nunatak, who had been trailing the instrument, slung it onto his back. Two hands were none too many for the negotiation of this scene of confusion and ruin.

On issuing from it, we entered a low, wide gallery, the walls and the roof of which were almost as smooth and regular as though fashioned by the hand of man. There was not a vestige of sinter anywhere; there had been no water-drip here.

"I should not be surprised, though," I said, "to find the formation of dripstone still taking place. We know that there is water somewhere in this cavern."

"Perhaps," Loomis suggested, "a river flowing from the Gardens of Paradise."

"It is not impossible. But my idea was that there probably are fissures in which the warm air of the cave meets the ice and melts it."

"But there would be no dripstone formed," Frontenac said, "because the water would not be acidulated."

"By George, I forgot about that!"

"Do you know," I asked him some moments afterward, "what I was thinking?"

"Nothing awful, I trust."

"I have been thinking, for some time now—I can't keep the confounded idea out of my head! But I have been thinking what a beautiful fix we would be in if something were to happen to our lights."

"Nothing can happen to our lanterns," Darwin Frontenac answered lightly.

"You speak as though an accident were simply a thing impossible. And, besides, last night I had a dream—"

"That, I suppose," he put in, "you would have me believe was not all a dream, that Fortune has warned us. For Heaven's sake, no oneirocritics, Bond! Spare us that!"

"Oh, well," said I, "'tis the same old story: a prophet is ever without honor in his own country."

That gallery was exactly one mile and a quarter in length. It opened into a great chamber, almost a perfect circle and with a diameter of fully one thousand five hundred feet. The formations here were beautiful beyond anything that we had heretofore seen.

And here it was that the first turn of fortune came.

High up in one wall, with grotesque stalactites hanging about it, was a curious hole, which Nunatak must needs peek into. Goodness only knows why that particular opening should have intrigued him in a manner so remarkable. But thus it was. And so up he went, climbing carefully, for the ascent was a rather difficult one, whilst we sat on a fallen stalactite and watched him.

He had reached the very top and had just straightened up to look in when it happened. Something gave way beneath him; he clutched at a stalactite to regain his equilibrium; the stalactite dropped from the roof, smashing three more loose as it fell, and down came stalactites and a mass of fragments with our poor musher in the midst of them all.

We cried out in horror—I noticed with a sinking of the heart that no sound had broken from the victim—and rushed forward. Poor Nunatak! Our poor comrade was dead!

As we fetched up, however, he reared his tall form from out the débris, shook the dust from his clothes and calmly remarked that he had come down much faster than he had gone up!

Whilst we were rejoicing in his escape, a sudden thought came to me:

"The lantern! Where is the lantern?"

At last we found it—or, rather, what had been it. For the thing which we found, under one of the stalactites, looked about as much like a lantern as a pile of ashes in the grate resembles the stately tree that was consumed there.

I looked at Frontenac with that exultation which the true prophet feels when the dire calamity predicted has at last fallen upon the sinful and (above all) heedless people.

As for Frontenac, a barely discernible smile touched his lean face, and he quoted these words of Byron's:

"Of all the horrid, hideous notes of woe,
Sadder than owl-songs on the midnight blast,
Is that portentous phrase, 'I told you so.'"

"Well," said I, "I *did!*"

"Be an optimist, Bond," Frontenac laughed. "It won't happen again."

"As though *that* is the only thing which can happen!"

"Curse the curiosity," exclaimed Nunatak, "that took me up to that confounded hole! I do actually believe 'twas an evil spirit that led me to do it.

"And yet," he added, "I wisht that I had got a peek!"

Frontenac smiled a little.

"We won't risk *this* light, Louis," he said.

I wondered if this loss of one of our lights would mean (as I sincerely wished it would) that here was the end of our advance. We had, of course, only one light now—and if something were to happen to that?

However, not the slightest hesitation was evinced by our leader, whilst none of the others showed any disposition whatever to even suggest that it might be expedient to turn back now. Nor, alas, did I! How often have I bitterly regretted that I suffered my false pride to keep me silent! 'Tis true, it might not have done any good; but, on the other hand, had I spoken, I might have prevented that horror which even now makes my blood run cold.

But I did not!

And so at last we quitted that great chamber, my soul oppressed by vague but none the less terrible fancies and fears—as if, indeed, I had, in some unaccountable manner, sad prescience that some horrible tragedy was imminent.

CHAPTER XXVII

WHAT HAPPENED

It was not long in coming.

A quarter of an hour passed, and then it was that we stepped out into the fatal chamber.

It was as though we had entered a grotto in the heart of a great jewel, so beautiful were the formations that everywhere met the eye.

We had scarcely entered the place when Frontenac drew up with an exclamation for silence.

A faint musical tinkling was heard.

"What is it?" someone whispered, the voice, I thought, evincing a superstitious, some nameless dread.

"Listen!" said Frontenac.

At this moment I became aware of another sound.

"Drip, drop!" it went. "Drop, drip!"

"Over there!" Frontenac said.

He started. We followed. Loomis was beside him, carrying the light.

(*Continued on page 86*)

The Living Death

(*Continued from page* 84)

What was that mysterious tinkling, at every moment now becoming more distinct?

Then suddenly the explanation flashed into my stupid brain, even as Nunatak exclaimed:

"Water!"

"Of course," was Frontenac's answer. "What did you think that it was?"

"For a few moments," the musher said, "I sure half thought that 'twas fairies or spirits or somethin'."

"Bad spirits?" Frontenac queried.

"Yes, boss; schemin' devils."

"Spectral sirens, as it were."

"Regular spirit witches, boss."

And thus they had their little joke at the expense of those eerie fancies which the mysterious sounds had conjured up. Little did a man of us dream what a horrible thing this discovery was to prove.

"There she is!" said Frontenac.

And there it was—a tiny stream of water issuing from a point high up in the wall and falling, with that curious metallic, musical tinkle, into a large semi-circular basin, whence it escaped in a gentle flow to disappear on the instant into an orifice in the cavern floor.

"Wonder," said Nunatak, "if 'twas here that that poor devil of an Antarctic feller got his water."

Not a sign was found, however, to show that any human being had ever visited the pool.

We had turned to quit the spot when a remark from Nunatak caused Frontenac and me (we were just behind Loomis, who, it will be remembered, was carrying the light) to stop and look back. It was to this fortuitous circumstance, there cannot be the slightest doubt, that we—Frontenac and I at any rate—owed our lives.

Loomis paused for a moment, then moved forward.

Came a cry, a sudden rending, crackling—utter blackness!

A shriek, despairing, horrible, arose, as though from the depths of a pit.

Came a horrible rumble, silence, and then a sound as though produced by a great mass plunging into water at an appalling depth.

"Great God!"

The voice, which I recognized as Hansen's, was aquiver with horror.

"What was it?" I cried.

"Don't move!"

The words were Frontenac's, and they cut through the blackness like a knife.

"As you value your lives, don't move an inch!"

"What was it?" I asked.

"The floor!" said Frontenac.

"It give way!" cried Nunatak. "I saw it goin'—then everything was black."

"The light!" I cried. "The light! The lantern is gone!"

"Yes," the musher said. "The lantern is gone. And poor Loomis is gone. We can never get out to the mouth of the cave in this darkness. And, before the end comes, we'll wisht to God that our bones was down there with poor Loomis's."

I shuddered with horror as I thought of the fate that awaited us in this fearful place. It was not of Loomis that I was thinking—though I *did* think of him, poor fellow—but of the loss of the lantern. And, before you set me down as a selfish, heartless brute, remember that I was not thinking of a simple little fabrication of glass and metal, worth at most but a few dimes and pennies, but of the lives of six human beings.

For to even dream of ever reaching the entrance without a light—why, it were the wildest madness. We were doomed men—doomed to the horrible fate (if not to a worse one) which had befallen that poor being from Paradise.

Came a sharp scratching sound; a sudden light burst out—the feeble light of a match in the hand of Frontenac. And I noticed that that hand did not show the slightest tremor.

"Look!" he exclaimed.

But there was no need to tell us to do that; we were looking—at that hole in the floor, yawning, dark, frightful as must be the deepest pit in hell's blackest corner.

I shrank back, for I was within two yards of the edge.

The opening was roughly elliptical in shape, the major axis probably fifteen feet, the minor ten or twelve. As the light was growing dim, a mass on the opposite side, one weighing perhaps two hundred pounds, broke off and disappeared. The next instant we were in darkness once more. Frontenac was counting. He had reached six when the sound came up from those fearful depths.

"Great Heaven!" he exclaimed. "Four hundred feet!"

He struck another light, then stretched out on the floor, flat on his stomach, and looked over the edge.

"For God's sake, Darwin," I cried, "be careful! That may be undermined, too!"

He called out Loomis's name, but the only answer heard was the mocking echoes of his own voice.

He called again and again—many times, the mournful echoes metamorphosed by my horror-chilled senses into exultant, demoniacal laughter.

"There can be no hope," I said. "Poor Loomis was dead before ever he struck."

"Lucky feller!" came the voice of Nunatak, the words sounding in my ears like the croaking of some sinister specter.

Frontenac raised his head and turned his look upon the musher's pale visage. But he said nothing. As he was thus looking back, the match burned to thumb and finger, and he dropped it into the pit.

Pitchy blackness rushed in upon us again.

"Yes," came the voice of Frontenac from the darkness, and it was as though he was speaking to himself, "the lantern is gone!"

CHAPTER XXVIII

ANOTHER HORROR—MAD

Frontenac struck another light, as did Hansen.

"There is no danger in this spot," Frontenac assured us; "the floor isn't undermined here."

"Too bad 'twasn't!" Nunatak muttered.

"So," Darwin said, "our minds may rest easy on that score at any rate."

"Wretched consolation, that," I told him.

"Who would have dreamed," he went on, "that this tinkling, innocent-looking little stream had hollowed so fearful a pit, only a mere shell of floor remaining to conceal the horror underfoot? Probably, though, when it began its work, the stream was a large one. And, of course, the work was done before ever the Great Cold fell. For then the supply of carbonic acid ceased, and it is the acid and not the mechanical action of the water—though the latter does play a part—that destroys the rock."

"What does it matter how it was done?" queried Nunatak bitterly. "It has dragged down as fine a man as ever went out on a trail, and it has entombed us all here in

the heart of Sleepin' Beauty's Cavern! Why think about formin' theories?"

We were again in darkness.

"No man," I said, "must ever have set foot upon that spot in those ancient times."

"Who can say?" returned Frontenac. "A more probable inference, it seems to me, is that the floor over the pit was firmer then."

"Why," came the voice of Watson, "couldn't we tell that the place was hollow? Why, for instance, didn't we hear the sound of the falling water?"

"Hear it?" Frontenac ejaculated. "Why, it is spray, mist long before it reaches the bottom."

"And why," came the voice of Louis Louisiana, "didn't we bring along one of the dogs. If we only had one of them dogs! He would lead us out if the darkness was ten times as black as it is."

"Yes!" said Frontenac bitterly. "But we didn't bring a dog."

I asked:

"Darwin, what's to be done now?"

"Start for the entrance, Bond."

"Start or stay," came the voice of Nunatak, "what difference does it make? 'Tis human nature, though, to keep on goin' to the very end, and so I say:

"Mush!"

"Same here," said Addison.

"Ditto," came the voice of Watson.

"Them's my sentiments," Hansen said.

There was a brief silence.

"There's the water,' suggested Frontenac. "We'll renew our supply, and we'd better each take a good pull at that spring."

We did.

"All ready ,boys?" Frontenac sang out at last.

"Ready!"

"Then here we go!"

He struck a light and started. Only a few steps had been taken, however, when he stopped and, looking back at us, said:

"Really we ought to make a few tests before leaving this hole—"

"Tests!" I exclaimed.

"With the object," said he, "of securing as close an approximation as possible—for the result, of course, could be nothing more than an approximation—of the depth of that pit."

"The pit! Cursed be the moment," I cried, "that we entered this hellish grot!"

"Amen!" said Nunatak.

"Oh, well," Addison philosophized, "it might have been worse."

"If it had," the musher growled, "it would have been the worst."

"You croaking bird of ill-omen, Louis!" Frontenac said, a faint glimmer of a smile on his face.

Scarcely had he uttered the last word when he clapped a hand to his head fiercely and cried out. But that was not all: the next instant our leader—he the self-contained, the man of iron nerves—was laughing and dancing, his tall form and lean features presenting a strange, eerie, maniacal appearance in the expiring light of the match.

"Great Heaven, Darwin," I cried in amazement and distress, "what is it?"

Suddenly the light went out.

But I had seen enough to send an icy chill to my heart. The one horror that my tortured brain had never conceived—that was this fearful thing which had fallen:

Frontenac was mad.

CHAPTER XXIX
"WHO WILL BE THE NEXT?"

I heard a muttering in the darkness, and my blood ran cold at the sound.

Suddenly he burst out:

"Blockhead, oaf, dolt, fool! Oh, fool—imbecile and idiot of inconceivable asininity! Thick-skulled, double-domed, triple-damned lunatic!"

I cudgeled such brains as I had left in hopes they would conceive some remark that might mitigate this sudden, fearful madness which had seized upon poor Frontenac, and with this result:

"There, there, Darwin! You mustn't take on this way—really you mustn't, old fellow. Our case may be a desperate one, but, after all, it is not hopeless."

My words were succeeded by the most intense silence I ever had experienced in all my life. Horrible thoughts writhed and coiled in my skull, writhed and coiled like a tangled mass of vipers. This terrible silence—what did it mean? What was to follow? What effect had my words produced upon the brain of the madman?

A laugh was the answer—a laugh, long, loud, pealing, merry.

"Really, Bond, I believe you thought that I had gone clean off my head—completely, utterly and absolutely off my noodle!"

"Off your noodle! Good Heaven, is it any wonder if I did? You called yourself a double-domed, triple-damned lunatic—whatever that is! I don't know, but I certainly do know that you certainly acted like one. What on earth did you carry on like that for?"

His merry laugh rang out again.

"Old *tillicum*" (partner), said he, checking himself, "this is the delightfulest thing I have known in many a long day, I do assure you! I wouldn't have missed it for the world!"

And off he went again.

"Explain the little matter, boss," came the voice of Nunatak, "so's the rest of us can enjoy the little joke, too."

A flush burned my cheeks, a flush of fierce, insensate anger—anger at Frontenac because of his actions of a lunatic and at myself for having suffered my senses to distort and magnify in so absurd a manner what I had seen and heard.

"Well," said I, somewhat testily, I regret to have to admit, "elucidate!"

"We're saved!" Frontenac said.

"Saved? What are you talking about?"

"That's what we are."

"What on earth do you mean?"

"Just what I said. Why, there is our reserve supply of oil—right here in this can in my pocket!"

"What good is that," I wailed, "when the lantern is gone?"

"Bond, Bond! I see I wasn't the only lunatic, after all, in this bright and intelligent audience."

"Hooray!" roared Nunatak. "All we need now is a wick!"

"Of course," Darwin said. "And to manufacture a wick will be no formidable matter. Then a hole in the stopper, and presto! a real, regular, genuine lamp to light our way back to the entrance!"

It was magical—our swift rush from the black depths of despair to these iridescent heights of hope, exultation.

Blockheads, dolts! Why had none of us thought of that before?

In the light of a piece of woolen stuff that had been dipped into the oil, Frontenac made a hole in the stopper, whilst Nunatak, with a speed and deftness for which I should not have given him credit, fashioned the wick. A few minutes, and there it was—a light, feeble though it was, that shone bright and beautiful as Hope's own lamp.

Regarding the matter soberly, however, 'twas a far cry indeed from the bright lanterns with which we had entered, to this primitive flame, and terrible were those galleries and chambers through which we had to make our way. Indeed, had it not been for the marks left and the careful notes made during our advance, the outlook, even now, would have been a black one.

We moved over to the edge and stood looking into the blackness of the pit.

"Poor fellow!" said Darwin Frontenac. "'Tis a horrible tomb—but, then, so is a tomb of marble.

"Let us start. No, we will see how deep this pit is."

"How," Nunatak asked, "are you goin' to do that, boss? We ain't got no line to sound it."

"'Tis easy, Louis, though we can't claim any great accuracy for the result."

Frontenac stretched himself out on the floor, looking over the edge, his chronometer watch in his hand. I took a similar position beside him, holding a fragment of rock over the abyss.

"Good Lord," burst out Louis, "maybe that rock'll hit poor Loomis!"

"I think it unlikely," Frontenac returned. "The sounds told us that the pool down there is a deep one. The depth of it may be hundreds of feet. Anyway, it won't hurt the poor fellow any if it does hit him.

"Ready, Bond?"

"Ready."

"Now!"

"Six," said he when the sound came up.

A dozen trials were made, and they gave a mean of exactly six seconds. In that time a body would fall five hundred and seventy-nine feet *in vacuo*. But this abyss was not a vacuum. Also, there was the time it took the sound-waves to ascend. After allowing for the resistance of the air and the fraction of a second required for the sound to reach us—quantities, of course, that could not be known with precision—the result obtained by Frontenac was a depth of "just about four hundred feet."

We lost no time in quitting that fearful place. Slowly and carefully we made our way back. Several times we were brought up in uncertainty, but in every instance our careful notes put us right again. At length there was the spool; we were indeed safe now. There would have been no difficulty whatever in reaching the entrance, from this point, in utter darkness, thanks to the string. Not that there was any likelihood of our being compelled to do so; the flame of the lamp was as bright as ever. At the harpy and the door we stopped and for a time stood gazing upon those strange, mysterious objects, which we were probably beholding for the last time. The halt, however, was a brief one, for by this we were pretty well satiated with marvels and mysteries. It was six o'clock when we stood once more at the entrance, having been in that terrible, but certainly most wonderful, underground world for nine hours.

That night the ghost of poor Loomis came to me—in my dreams. Three times it came. In every instance the horror of the thing awoke me. And every time the figure asked the same question:

"Who will be the next? Why won't you tell me who will be the next?"

Morning found it blizzing fiercely. One could not see a dozen feet. All day the blizzard raged, all night and all the day following. On the morning of the third day, however—this was the 18th of October—the weather was clear and calm, and we got under way at an early hour, Frontenac driving Loomis's team.

Of the ninety dogs with which we had pulled out from Summer Haven, we had lost eight. One had been pitched upon by his comrades, killed and eaten upon the spot. On another occasion, Skookum (the first dog resuscitated) would have met the same fate had we not flown to the rescue. The end, however, was virtually the same; the poor creature was so badly slashed and torn that his sufferings were ended by a blow with an ax. He was then fed to his cannibalistic brethren. Two had deserted; these we never heard of again. Three had almost literally died in harness. The deaths of these animals were a mystery upon which the post mortem,

performed by Frontenac, shed no light whatever. The eighth had sickened and received the mercy of a bullet in the brain.

That day we made but eight miles. However, after due consideration, I have decided not to enter into a detailed description of the days that now followed, interesting though some of them certainly were. Our journey from Sleeping Beauty's Cavern to the valley of the palm trees was much like those made by other Antarctic travelers, and I am anxious to get on to the Gardens—where our experiences were such as are to be found in the wild pages of a romanticist or in a spirit-shaking nightmare rather than those of the world of reality, strange though that world may sometimes be.

CHAPTER XXX

PARADISE

With regard to things meteorological, we had, up to this time, a phenomenal run of luck. But now we encountered adverse conditions. It was no unusual thing to find the thermometer down in the minus forties. Winds blew, fierce and bitter, bitter and fierce as the passions of mankind and for a whole week blizzard followed blizzard with a regularity that was amazing and certainly was most maddening. What with these vicissitudes of fortune, we did not reach those mountains that barred the way to the southward until the 1st of November. Our camp that night was in latitude 86° 9'. From this point the way led to the eastward, towards that great defile which would take us through the mountains to the Gardens of Paradise.

The next day I had a very close call. Suddenly the snow sank beneath my feet, dropped, and there I was with my skiis bridging the fearful profundity of a crevasse.

All the others, their dogs and sleds, my own too, had crossed this very spot, and here it had broken on my gliding onto it, and I was by no means the heavyweight of the party. The situation was an appalling one. I have never heard of a man being in one precisely analogous. I durst not move a foot, and the blue depths over which I stood turned me giddy and sick. In front the skiis were supported by a mere crust of snow and ice, and, for all I knew, things were even worse behind. All I could do was cry out. This, it is scarcely necessary to say, I lost no time in doing. Even this threatened to destroy my equilibrium. They heard me and turned, and back they all came flying, Frontenac and Addison in the lead.

"Steady, Bond, steady!" Darwin cried as he came up. "We'll have you safe in an instant!"

"Be careful!" I warned. "The edge there is only a crust!"

They were careful.

"Make her safe, boys!" sang out Nunatak. "We'll tail onto you two, so's if he slips or somethin', you won't have to let go or all go down together."

This was done. Then Frontenac reached out a hand and grasped my right, Addison my left; there was a pull, and I shot across to safety.

Frontenac gave a deep respiration.

"I thought, Bond, that you were a goner that time."

As for Nunatak, that worthy grinned from ear to ear and remarked:

"A feller sure must be stuck on acrobatics, I'd say, when he'll straddle a crevasse in that-away fashion."

That day, what with the terrible surface encountered, we made only five and one-half miles. The next, the 3rd, we did better, we made ten miles, which brought us to the base of the mountains. It was hereabouts that Captain Livingstone saw the skua gulls. But not a vestige of life had we discovered. It was on his march to this spot,

too, that Livingstone's dogs began that mysterious sniffing. We had the same phenomenon, though in our case there was, of course, no mystery at all about it.*

At this camp was left Frontenac's sled. Four thousand feet above us, six thousand above the level of the sea, was the entrance to that way riven through the very heart of the mountains. Captain Livingstone was less than a day in reaching that spot; how he did it has always been a mystery to me. We were almost a day and a half in reaching the entrance. It was in this spot, it probably will be remembered, that they killed that strange bird, that bird like the one seen by Shackleton's men, brown of color and with a white line under each wing.

We gazed up at those black-ice-burdened cliffs, but there was no creature up there to launch itself down upon *us*.

Our camp that night was deep in the defile, lofty, awful masses towering high above us.

Noon of the next day, the 6th of November, we were at the highest point, about eight thousand four hundred feet above the level of the sea.

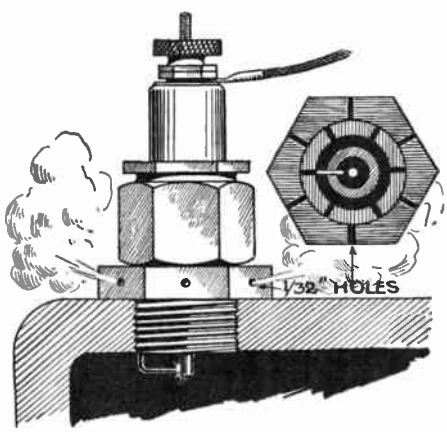
That afternoon we descended a little over two thousand feet. The wonderful valley was very near now; but it was getting late, and haze and fog obscured our surroundings. and so we decided to camp. A good rest, and then into the fog and on to Paradise!

Morning found us enveloped in a fog so dense that objects were sometimes invisible at a distance of only twenty feet. No use staying for it to lift, however. So we started. It was mighty unpleasant traveling like this—groping our way through this gray obscurity. But grope we did, and on and on—with thoughts of crevasses and other possibilities to keep us pleasant company.

On and on, slowly, steadily. Hours passed. Then suddenly, as Captain Livingstone had done, we stepped, one after another, out of the fog as through a curtain, and there were the Gardens of Paradise!

(To be concluded in next issue)

Carbon Removal



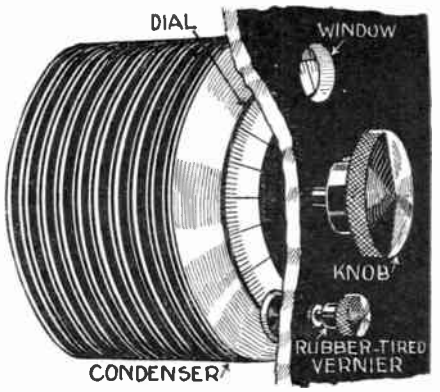
If holes are drilled in the shell of a spark plug as well as in a nut which fits the shank of the plug, carbon may be quickly removed from the porcelain by turning the nut so that the holes line up and running the engine for a few minutes. When in ordinary use the holes must be turned out of line. —M. Mather.

*" 'What on earth is Uroa scenting?' It was Bjaaland who made this remark, on one of these last days, when I was going by the side of his sledge and talking to him. 'And the strange thing is that he's scenting to the south. It can never be—' Mylius, Ring and Suggen showed the same interest in the southerly direction; it was quite extraordinary to see how they raised their heads, with every sign of curiosity, put their noses in the air, and sniffed due south. One would really have thought there was something remarkable to be found there."—Amundsen: *The South Pole*.

RADIO WRINKLES

UNDER this heading we are going to publish items of interest to everyone who likes to build radio instruments. In order to continue this department it is necessary for our readers to tell us about their latest experiments. Write us a short description of some time- or money-saving kink you have discovered and send it to us along with a few sketches. Our regular prizes will be paid for this material. Be brief and try to put everything in the drawing. Don't be too elaborate. Address "RADIO WRINKLES" editor, care of Science and Invention.

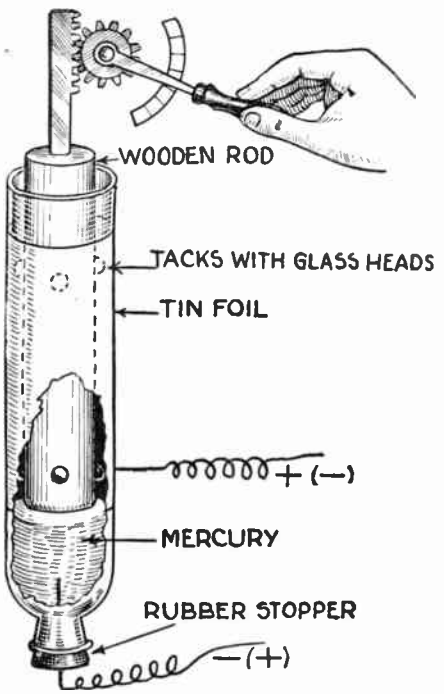
Rear-Mounted Dial



A novel effect is obtained when a dial is mounted in back of a panel. The dial numbers are viewed through a "window" drilled through the panel.

—J. Liebowitz, Reporter No. 2939.

Variable Condenser



Take the bottom off a long, narrow bottle. Cork the bottle up tightly and force a stout copper wire through the cork. Coat the outside of the bottle with tin-foil. Pour mercury almost up to the height of the tin-foil. The device is operated by a handle which presses the plunger down and thereby raises the mercury in the bottle.

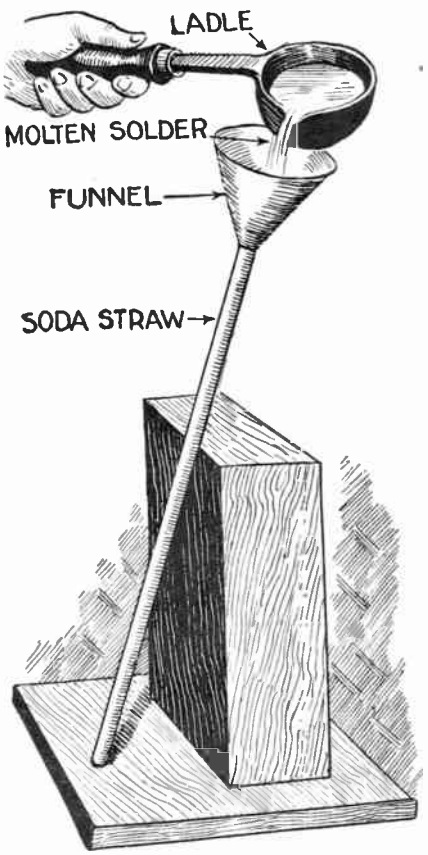
—V. Wardinhausen.

NEW CAMERA

Takes and Finishes Pictures Inside The Camera in One Minute

The marvelous new Crown Minute Camera takes and finishes pictures inside the camera in one minute. No films—no plates—no dark rooms. Load cards in daylight. Pictures 2½ x3½ inches. Size of camera 5¼x5¾x7 inches. Universal lens takes pictures at all distances. Simple instructions sent with each camera; no experience necessary. Send no money. We will send the camera on 10 days' free trial. If satisfied you simply send 50 cents weekly until our special introductory price of $10 is paid. Crown Minute Camera Co., Dept. 508, Norwalk, Conn.—Adv.

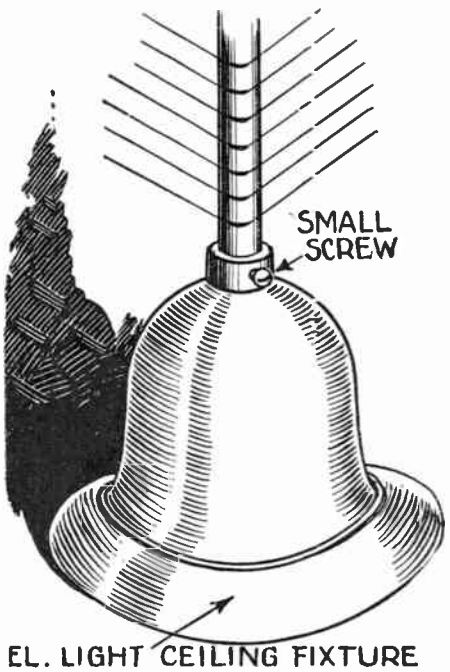
A Solder Mould



Usually after wiring up a set there is a considerable amount of solder left over. Melt the solder in a ladle and pour the molten solder into a soda fountain straw. By removing the straw after the solder has solidified or "set" a handy length will result.

—C. F. Felstead.

Loop Aerial Mounting



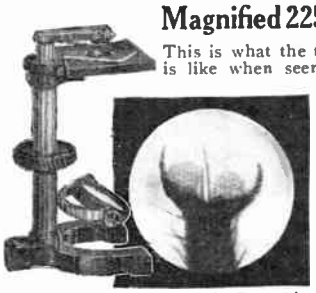
EL. LIGHT CEILING FIXTURE

An electric light ceiling fixture makes an excellent mounting for a loop aerial. The base of the loop is inserted into the fixture as shown, and is held in place by the screw.

—C. G. Switzer.

Magnified 225 Diameters

This is what the tip of a fly's leg is like when seen thru the



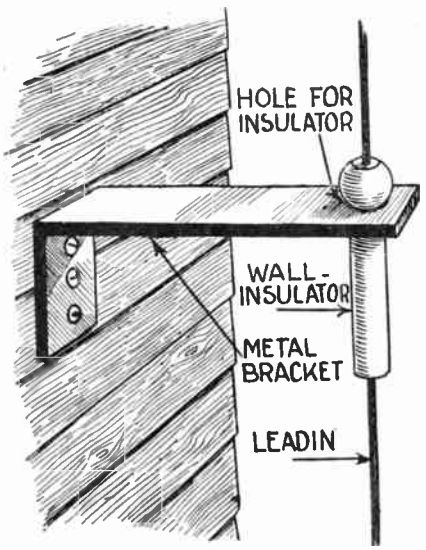
ULTRALENS MICROSCOPE

Any amateur can immediately start using his Ultralens to examine the edge of a razor, the mesh of a cotton shirt, the bacteria in dirty water. No technical training required, yet hundreds of scientists and teachers are using this instrument. Gives enormous magnification and perfect definition. Send $7.50 for complete outfit. Send for descriptive literature.

$7.50 for Complete Outfit Prepaid.

Scientific Apparatus Corp., Dept. 203, Milton, Pa.

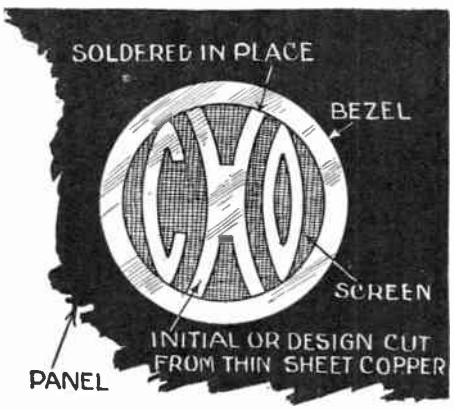
Stand-Off Insulator



A handy stand-off insulator may be made by setting a wall insulator in the end of a metal bracket.

—A. Hornsby, Reporter No. 17352.

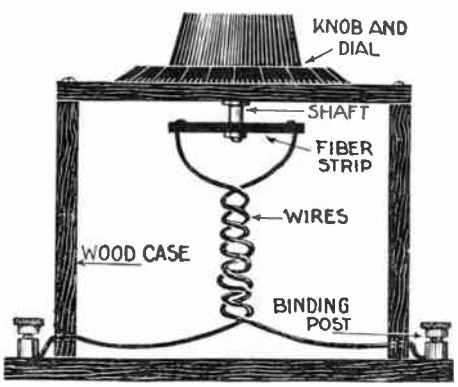
Initial Bezel



A design of the radio owner's initials cut from thin sheet copper and attached in the bezel in the receiving set, lends individuality to an otherwise common-place set.

–C. H. Ostermeier.

Vernier Condenser



The device shown is an effective vernier condenser. Two wires, preferably twisted lamp-cord, are connected to binding posts on the base and are twisted together by a fibre strip mounted on the shaft of the dial. The wire should be about four to six inches long. By turning the knob, the wires are twisted together, thereby changing the capacity.

—C. S. Martin.

Answers to Scientific Puzzles

(*Continued from page 42*)

LOCOMOTIVE WHISTLE

It is a demonstration of Doppler's principle. As the train is approaching the ear more sound waves, or vibrations, reach the ear per second than when the train is stationary. As the train is going away from the ear the number of waves per second decreases. (Pitch depends upon the number of waves, or vibrations, per second reaching the ear.)

PLUMB BOBS

No, they would not. The bob, in each case, would be attracted toward the center of the earth, due to the force of gravity. This would cause the two lines to converge toward the common center of attraction.

DISTANCE OF STORM

If sound traveled as fast as electricity the clap of thunder would be heard simultaneously with the flash of lightning. But, as sound only travels about 1,080 feet per second, as against 186,300 miles per second for the light from the flash, which is the same speed as the electricity which, of course, is the cause of the flash, sound in five seconds will only travel a little over a mile. Hence the storm is about a mile away.

PERIMENTERS

For a given perimeter, a circle will have the greatest area. The proof of this is to be found in plane geometry. The figures shown illustrate this principle.

RADIO AND SPECTATOR

The man listening-in on a radio set. Electricity travels nearly 1,000,000 times as fast as sound. Therefore, while the sound waves were going 100 feet the electrical broadcast wave would travel about 100,000,000 feet, or nearly 19,000 miles. This means that a radio wave would travel about three-quarters the distance around the world while sound was going only 100 feet

COLD KETTLE

The energy necessary to keep the water boiling is taken from the bottom of the kettle. As long as there is enough heat in the bottom of the kettle to maintain the water at its boiling point practically no heat will be induced into your hand. But as soon as the water stops boiling the heat in the water is conducted back into the kettle bottom, thus causing it to become very hot again.

RIFLE SILENCER

By preventing the air from rushing back into the rifle barrel to fill the vacuum made by the instantaneous departure of the bullet from the barrel. It is the air rushing back into the barrel to fill this vacuum that causes the loud report when a gun is fired.

COLD EGG PROBLEM

Upon removing the egg from the water it is, of course, wet. This water upon the shell of the egg keeps the shell cool by process of evaporation. However, as soon as the shell becomes dry the cooling process is no longer continued. Thus the egg will again become much warmer on the outside shell.

EGG IN BOTTLE

First soak the egg in strong vinegar for several hours. This will cause the shell to become soft. Now carefully force the egg into the opening of the bottle into which it is desired to put the egg. Carefully rinse out the vinegar from the egg shell and allow the egg shell to again harden. Your friends will wonder how you accomplished this.

(*Continued on page 97*)

Complete List of Titles in the E. I. Co. Books

All About Radio Parts

Everyone who constructs a radio set should know the simple fundamentals of the various parts of his set. The E. I. Company has set these forth in a compact little book that is valuable at all times.

Book No. 8—Price 25c

History and Operation of the Vacuum Tube

The Vacuum Tube is a marvelous piece of apparatus. A short study of it as given in this book gives you the principle on which every Vacuum Tube Radio Receiver operates.

Book No. 9—Price 25c

The Neutrodyne—All About It

Everybody knows the famous Neutrodyne hookup. One of the finest Radio Receivers in use today. This 51-page E. I. Company book gives an explanation of every detail of the Neutrodyne and how it all works.

Book No. 10—Price 25c

How Radio is Received

The simplest and yet most complete Radio Guide Book for any amateur broadcast listener. In print only two weeks, fresh from the press.

Book No. 11—Price 25c

How to Locate Troubles in Your Radio Set

Anyone with this handy book as a guide can repair and keep in order his own radio set. Covers every detail of the modern radio sets and tells how to locate and repair any trouble.

Book No. 12—Price 25c

Radio Reflex Receivers

Just off the press. Hookups galore on the finest and most up-to-date reflex circuits in use today. Diagrams and descriptions on every modern reflex.

Book No. 13—Price 25c

Tips for the Radio Amateur Constructor

Many men fail in building their Radio sets because of some trivial error that could easily have been corrected before it was too late. The E. I. Company has compiled a book that will help you avoid all the common pitfalls while building your Radio sets.

Book No. 1—Price 25c

How to Make PRACTICAL Radio Receiving Sets

The man who wants to build only those PRACTICAL Radio Sets that are guaranteed to give good results when properly constructed will need this book. Gives the principal successful hookups of practical Radio Construction.

Book No. 2—Price 25c

Radio Questions Answered

Question No. 1—What is Radio? This is the nature of the questions that this book answers. Then it answers questions on all the principal parts of a Radio Receiver. It is a handy book to keep in your Radio File.

Book No. 3—Price 25c

Radio Frequency Amplification

Distance lends enchantment—and it's the Radio Frequency Amplification that brings in the distance on your Radio Receiver. If you contemplate adding any Radio Frequency to your set you will want this book at your side.

Book No. 4—Price 25c

How to Tune Your Radio Set

Don't struggle in the dark, looking for stations—here is an inexpensive book that gives you detailed instructions on just how to handle your Radio set. You will be surprised at the increased results that can be obtained through proper tuning.

Book No. 6—Price 25c

100 Radio Hookups

No better book for your work bench. Gives diagrams, hook-ups and details on Radio Hook-ups galore. One of the most complete hook-up books published. Authentic and up-to-date in every respect. Third edition now ready.

Book No. 7—Price 25c

E. I. Co. Books

are sold throughout the country by all Radio and News Dealers

If Your Dealer Cannot Supply You, Write Direct

Any radio receiver will give better results if you learn more about it

ANY radio receiver gives better results in the hands of an experienced radio man. The reason for this lies not in their intimate knowledge of radio parts but rather in their fundamental knowledge of how the receiver operates.

The radio books of the E. I. Company are written with this sole object in view to give the average broadcast listener the fundamental knowledge that will enable him to understand the care and operation of the receiver he buys or builds.

Some of the E. I. books cover only the care and operation of general radio receivers, others cover the construction and operation of specific types of receivers, while a third class cover that intimate, general knowledge of radio transmitting and receiving that everyone should know.

Glance over the titles of the books listed on this page. They are sold everywhere. Or, if you wish you can obtain them direct from us.

All E. I. Co. Books are 25c. Each

Published by

E. I. Company, Inc.

The Consrad Co., Inc., *Sole Distributors*

233 Fulton Street **New York, N. Y.**

Answers to Scientific Puzzles

(*Continued from page 95*)

TIRE WEAR

The rear right-hand one (from the back of the car). Of course, the rear tires wear faster than the front ones because they are driving the car. But the right-hand back tire is more or less in the dirt edge of the road and continually running against the rough edges of the cement and macadam roads and, perhaps, against the curb. This causes unusual wear and is much more pronounced than the wear on the other rear tire.

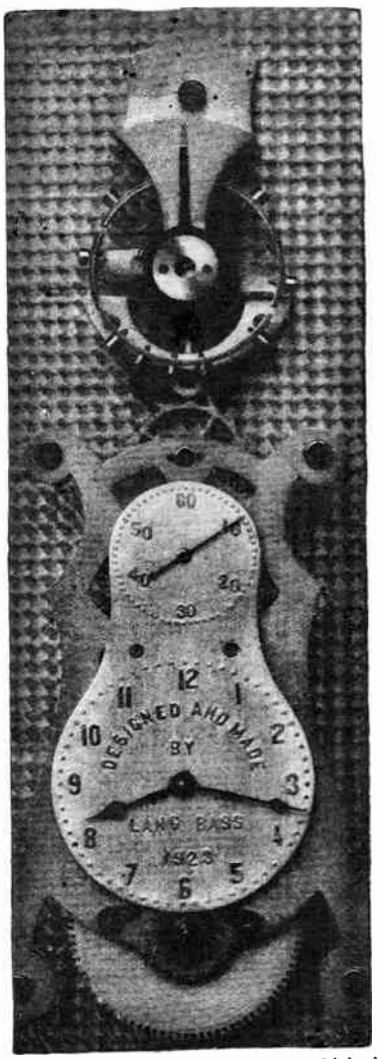
VOICE TO SUN

Light travels 186,300 miles per second, while sound only travels about 1,080 feet per second. It will take sound about 4.87 seconds to travel one mile, or 45,291,000,000 seconds to go 93,000,000 miles; 45,291,000,000 seconds equals 754,850,000 minutes, or 12,580,833.33 hours, which will equal the time required.

SOLDERING CAST IRON

Give the cast iron a good coating of copper sulphate solution (blue vitriol solution). If the surface is rough the solder will stick to this fairly well, depending upon the amount of copper deposited upon the iron by the copper sulphate solution.

Clock with Watch Movement

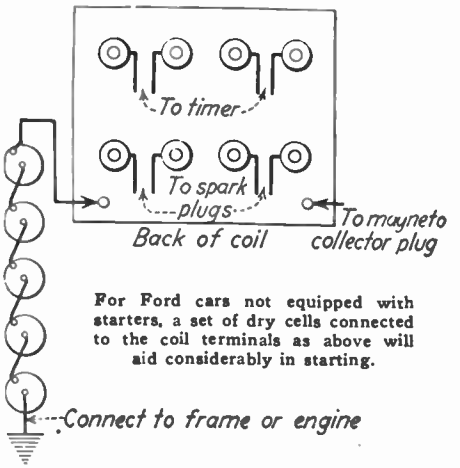


The clock here illustrated measures 8½ inches high, and except for the main spring and hold jewels, was designed and constructed entirely by hand by the author. The hair spring is made of piano wire and the metals of the balance are fused together instead of being soft soldered. It loses less than 30 seconds during a week. —W. L. Bass.

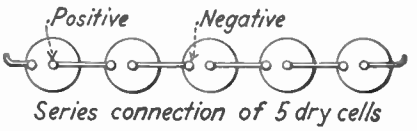
Motor Hints

By TOM C. PLUMRIDGE

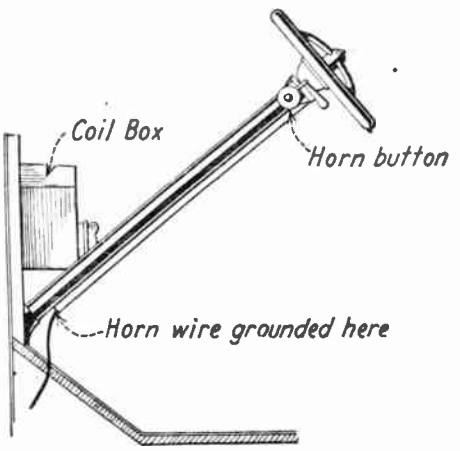
FORD ELECTRICAL TROUBLES



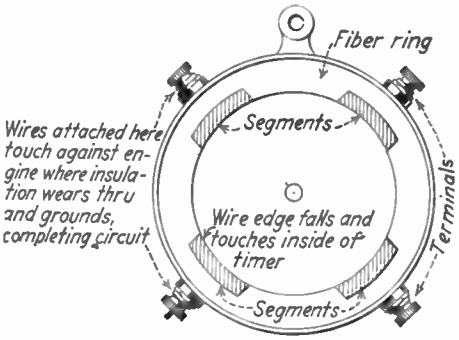
For Ford cars not equipped with starters, a set of dry cells connected to the coil terminals as above will aid considerably in starting.



The correct connections for a series of five dry cells are illustrated above.

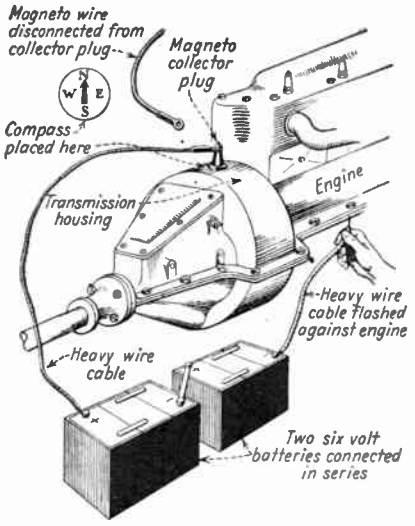


When Ford ignition troubles arise, they are often very difficult to locate. Short circuits occur frequently in unsuspected places. One of the most unusual places for a short circuit to occur, is illustrated above. The insulation on one of the horn wires may wear off at a point where it emerges from its protecting tube, whereupon a short circuit will occur and the engine stop.

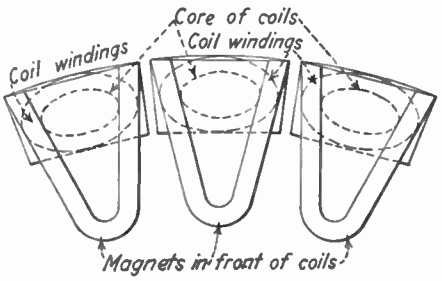


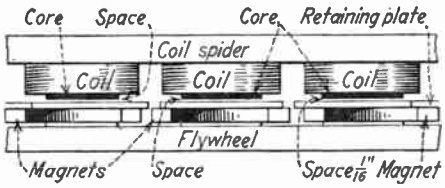
Other ignition troubles often occur at the commutator illustrated above. The wires connected to the terminal may become frayed and so short circuit to the commutator housing or the engine frame. Also the segment may become badly worn, whereupon a new timer should be installed.

Insure your copy reaching you each month. Subscribe to SCIENCE & INVENTION—$2.50 a year. Experimenter Publishing Co., 53 Park Pl., N. Y. C.

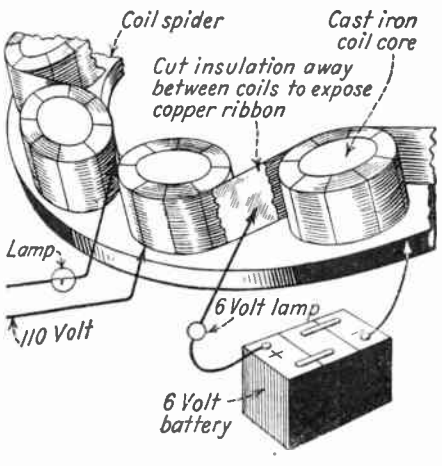


Often a Ford engine will not start quickly or run smoothly because of the fact that the magneto is weak. To remedy, place a compass to the left and slightly to the rear of the magneto collector plug after disconnecting the magneto wire. Very slowly crank the engine until a point is found where the compass needle points toward the radiator. Connect two storage batteries in series and one terminal to the magneto plug. Flash the end of the other connection against the engine frame 15 or 20 times, never maintaining more than a momentary contact. The magneto magnets will then be remagnetized.





Above: Side and end views of the magneto magnets and winding.



When testing magneto coils as above, if lamp lights, the coil is grounded. Replace with another one. Such trouble is indicated by consistent missing of the engine, not traceable to other causes.

Opportunity Ad-lets

YOU will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms, dealers and amateurs from all over the country. No matter what you may be seeking, whether supplies, automobile accessories, the opportunity to make money, or anything else, you will find listed here the best and most attractive specials of the month.

Advertisements in this section twelve cents a word for each insertion. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency. No advertisement for less than 10 words accepted.

Ten per cent. discount for 6 issues, 20 per cent. discount for 12 issues. Objectionable or misleading advertisements not accepted. Advertisements for the July issue must reach us not later than May 10th.

The Circulation of Science and Invention is over 175,000 and climbing every month

EXPERIMENTER PUBLISHING CO., INC., 53 Park Place, New York City, N. Y.

Agents Wanted

Agents—Best seller; Jem Rubber Repair for tires and tubes; supersedes vulcanization at a saving of over 800 per cent; put it on cold. It vulcanizes itself in two minutes and is guaranteed to last the life of the tire or tube; sells to every auto owner and accessory dealer. For particulars how to make big money and free sample, address Amazon Rubber Co., Dept. 601, Philadelphia, Pa.

Agents—Write for Free Samples. Sell Madison "Better-Made" Shirts for large Manufacturer direct to wearer. No capital or experience required. Many earn $100 weekly and bonus. Madison Mfgrs., 511 Broadway, New York.

Big money and fast sales. Every owner buys gold initials for his auto. You charge $1.50; make $1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co. Dept. 71, East Orange, N. J.

Only one sale a day means $200 per month. Five sales, $1,000 per month. Marvelous new adding machine. Retails $15. Work equals $350 machine. Adds, subtracts, multiplies, divides automatically. Speedy, accurate, durable, handsome. Five-year guarantee. Offices, stores, factories, garages buy one to dozen. A fortune for live agents. Write quick for protected territory and free trial offer. Lightning Calculator Co., Dept. W., Grand Rapids, Mich.

Earn big money fast applying gold initials to autos. Every owner buys—$1.35 profit on $1.50 sale—particulars and samples free. Write quick. Lithogram Co., Dept. 19, East Orange, N. J.

Earn $10 daily silvering mirrors, plating and refinishing metalware, chandeliers, bedsteads, headlights. Outfits furnished. N. Decie Laboratories, 1133 Broadway, New York.

$60—$200 a week. Genuine Gold Letters for store windows. Easily applied. Free samples. Liberal offer to general agents. Metallic Letter Co., 441 B., North Clark, Chicago.

Write and learn how to start profitable business without capital or experience. Silvering mirrors, refinishing auto headlights, tableware plating. Outfit furnished. International Laboratories, Dept. 25, 309 Fifth Ave., New York.

Agents—Be independent, make big profit with our soap, toilet articles and household necessities. Get free sample case offer. Ho-Ro-Co., 2719 Dodier, St. Louis, Mo.

Make $17 Day.—Finest extracts, food products, toilet preparations, household necessities. Credit; sample case free. Write for amazing offer. Perkins Products, B-30, Hastings, Nebr.

Wonderful invention eliminates needles for phonographs. Preserves records. Abolishes scratching. Day's supply in pocket. $20 daily. Sample on approval if requested. Everplay, Desk H5, McClurg Bldg., Chicago.

$4 cash with every sale of Capt. Burke's Fire-Foe, only pistol-type extinguisher on market; operates with one hand; used on U. S. airplanes; undersells all competition; stops bandits as quick as it puts out fires; factories and institutions buy in quantity; $20 a day easy; write for sales plans. Burke Fire-Foe Sales Co., Desk G, Cincinnati.

Agents Wanted Full or Part Time to Sell on liberal commission new Thermostatic Automatic Carburetor control Attachment for Ford cars. Increases mileage 100%. No holes to drill. Attached in 2 minutes. Does automatically exactly what Ford Manual instructs driver do by hand. Cadillac now using Thermostatic Carburetor Control under Blancke license. Write at once. A. C. Blancke & Co., Dept. 152-E, 602 W. Lake St., Chicago.

Robt. H. Ingersoll of $1 Watch fame wants good men to sell his Dollar Stropping outfit, an ingenious invention for sharpening all makes of safety razor blades. Great economic value. Meeting with nationwide approval. Easy to sell. Big repeat business. Agents having remarkable success. Full particulars. Robt. H. Ingersoll, 476H Broadway, New York City.

Free Book. Start your own little mail order business. Pier, 911 Cortland St., N. Y.

Rummage Sales Make $50 Daily. Offer wonderful values. We start you. Wholesale Distributors, Dept. 171, 609 Division St., Chicago.

Big Money and fast sales; every owner buys gold initials for his auto. You charge $1.50, make $1.44 profit. 10 orders daily easy. Samples and information free. World Monogram Co., Dept. 32, Newark, N. J.

Agents—Signs for stores and offices. Entirely new. $50 week easily made. World Signs, T166 W. Washington, Chicago.

Make-Sell Your Own Goods—Formulas. Processes. Trade-Secrets. Modern master methods. Catalog free. D. Thaxly Co., Washington D. C.

Agents Wanted (Continued)

Man wanted for this territory to sell wonderful value Men's, Women's, Children's shoes direct, saving wearer over 40%. Experience unnecessary. Samples supplied. Big weekly permanent income. Write today. Tanners Mfg. Co., 902-3 C St., Boston, Mass.

Build splendid business making chipped glass number and name plates. Particulars free. Simplex Co., Dept. 93, 1133 Broadway, New York.

Start Mail Order Business: Watch yourself grow. Cost 5c. Sell by Mail for $1. Make $15 to $30 daily. Information free. Desk B. Surety Service Company, 551 Harvard St., Rochester, N. Y.

Easiest money ever earned applying gold initials and monograms on automobiles. Instantly transferred from paper, anyone can do it. Cost 5c. Get $1.50. Samples free. Raico, 325 Harrison, Boston, Mass.

$3.00 Value for 30c. Everybody buys Pitkins New Process non-alcoholic food flavors and saves $2.70. Present sales force making big money. Some valuable territory still open. Send for free sample and prices. A big opportunity to establish a big business. No capital necessary. J. M. Pitkin & Co., 730 Pitkin Bldg., Newark, New York.

Agents—Salesmen—Dealers—Crew Managers—Make $75 to $100 a week. New Invention—Sensation of 1925, just out. Every car owner buys on sight. "Fixit" Rubber Repair for tires and tubes. Vulcanizes without heat or tools. Seals punctures and blowouts. Saves tire repair bills, increases mileage on casings. Sample free. Marquette Rubber Company, 2323—2327 Wolfram St., Dept. 20, Chicago, Ill.

Marvelous New Invention 400% Profit Liquid Quick Mend for hosiery and fabrics. Tremendous demand. Over hundred other fast sellers. Local and General Agents. J. E. Johnson & Co., Dept. 829, 321 W. Chicago Ave., Chicago.

I want 100 men and women quick to take orders for anti-moth, air-tight Ced-O-Bags. Make $10 to $12 daily. Cooper's profit $1 in 60 minutes. Beck orders 17 in one day. Meserol makes $6 in half hour. Protects furs, suits, clothes, blankets. Every family needs one to three. Fastest seller going. Experience unnecessary. No delivering or collecting. Write today for full details and amazing sample offer. Comer Mfg. Co., Dept. U-31, Dayton, Ohio.

Make $25 to $50 week representing Clows' Famous Philadelphia Hosiery, direct from mill—for men, women, children. Every pair guaranteed. Prices that win. Free book "How to Start" tells the story. George Clows Company, Desk 27, Philadelphia, Pa.

Sell Ford Owners Most efficient timer on market. Agents everywhere coining money—$50 to $75 weekly. Haines sold forty first week. Wonderful side line. Write Dept. 33, Auto Sun Products Co., 855 West 6th St., Cincinnati, Ohio.

Agents—Steady income. Large manufacturer of soaps, perfumes, toilet articles and pure food products, etc., wishes representatives in each locality. Manufacturer direct to consumer. Big profits. Honest goods. Whole or spare time. Cash or credit. Send at once for particulars. American Products Co., 2363 American Bldg., Cincinnati, Ohio.

Agents Monogram Automobiles. 15 million prospects. $1.40 profit every $1.50 sale. Wilbar made $29.50 first day. Free samples. Worcester Monogram Co., M12, Worcester, Mass.

American Made Toys

Opportunity to start Manufacturing Metal Toys and Novelties. No experience necessary. Enormous demand exceeds supply. We furnish, at cost, casting forms for production and buy entire output, also place yearly contract orders. Casting forms made to order. Catalog, advice and information free. Metal Cast Products Co., 1696 Boston Road, New York.

Battle Photos and War Relics

For Dens: Relics Collected from Europe's Battlefields. Firearms, medals, helmets, etc. Illustrated catalogue and sample War photographs 25c. Lieut. Welch, 2117 Regent Place, Brooklyn, N. Y.

Books

Ideophonic Primers. $1.94: Chinese, French, Spanish, Languages, 8 West 40th, New York.

Free—Upon request will send you my literature illustrating the following books. Astrology, Character, Clairvoyance, Concentration, Healing, Hypnotism, Magnetism, Mediumship, Personal Magnetism, Personality, Physiognomy, Salesmanship, Seership, Success, Sex, Will, Yogi Philosophy, Gazing Crystals, etc. A. W. Martens, E. E. 6, Burlington, Iowa.

Business Opportunities

Dollars yearly in your backyard. No mushroom dope. Particulars free. Metz, 313 East 89th, New York.

You can have a business-profession of your own and earn big income in service fees. A new system of foot correction; readily learned by anyone at home in a few weeks. Easy terms for training, openings everywhere with all the trade you can attend to. No capital required or goods to buy, no agency or soliciting. Address Stephenson Laboratory, 18 Back Bay, Boston, Mass.

Stop Plodding! Be Successful. Operate a Tire Repair Shop. Make big profits in any locality. We teach you and furnish complete equipments $100 up. Book of Opportunity free. Haywood's, 1312 South Oakley Avenue, Chicago.

Get Money in your mail. "Lambert's Mail Order Secrets" contains successful methods never before published. Particulars free. Leon Lambert, 670-D Kaufman Bldg., Wichita, Kansas.

Earn $25 weekly, spare time, writing for newspapers, magazines. Experience unnecessary. Copyright book free. Press Syndicate, 987, St. Louis, Mo.

Free Booklet. How to become Successful in Real Estate. Macdonald Cooperative Realty, San Diego, California.

This means you. Read Surety Service Company's Proposition!!! "Agents Wanted" Classification.

You want a big money making business of your own, a sure winner, write for information on how to make beautiful marble, Onyx, Agate and Turquois from common cement. Spencer Laboratories, 4201 South Main, Los Angeles, California.

Chemistry

Learn Chemistry at Home. Dr. T. O'Conor Sloane noted educator and scientific authority, will teach you. Our home study correspondence course fits you to take a position as chemist. See our ad on page 7 of this issue. Chemical Institute of New York, 66 W. Broadway, New York City.

Correspondence Courses

Used correspondence courses of all schools sold, rented and exchanged. List free. (Courses bought.) Lee Mountain, East Chattanooga, Tenn.

Correspondence Courses bought and sold. Hanfling, 799-a Broadway, New York.

Educational

Correspondence Courses. All Schools. Lowest prices. Terms. Catalog free. Mention subject. Economy Educator Service, 440-H Sansome, San Francisco.

Electric Motors

Motors $2.98. Good. Practical, twentieth horsepower, 115 volt alternating direct current. Order Now. Pay postman, Perry Trading Co., Dept. 14, 815 Lake, Racine, Wis.

For Advertisers

24 words—355 Rural Weeklies $14.20. Ad-Meyer, 4112 St, Hartford, St. Louis, Mo.

For Inventors

We Develop Your Ideas into commercial shape for presentation to purchasers making working models, drawings, experiments or tests. Courtesy, efficiency, secrecy and ample equipment; 30 years' experience. Ducorron-Rich Engineering Co., 504 Pacific Mutual Bldg., Los Angeles, Cal.

Unpatented Ideas Can Be Sold. I tell you how and help you make the sale. Free particulars (Copyrighted). Write W. T. Greene, 808 Jenifer Bldg., Washington, D. C.

Your Chemical problems solved and working process furnished for Five Dollars. Write me. W. Stedman Richards, Consulting Chemist, Box 2402, Boston, Mass.

Patents are expensive. Your ideas can be sold without this expense. Complete instructions. $2. Box 61, Pontiac, Michigan.

We develop ideas into practical shape, prepare working drawings for models, solve problems. Wettstein, Engineer, 150 Nassau St., New York.

Scientific Information for Inventors. Calculations, designing, scientific books. Commercial lists, patent advice. Write Scientific Information Bureau, Baltimore Bldg., Chicago.

For Inventors (Continued)

Inventor—Manufacturer—Contact. Newspaper. Subscribe today. "Progress and Invention In North America" International) 301 Donalda Building, Winnipeg, Canada, $1 yearly.

New Ideas Wanted. Wel. known Radio Manufacturer whose products are nationally advertised and sold everywhere wants new Radio device to sell. Will pay outright or royalty for idea or invention which is really new and salable. Address: Mr. R. F. Devine, Room 1101, 116 West 32nd St., New York, N. Y.

Cashing In—If you have a sound commercial invention to sell, write promptly. American Patents Corporation, Barrister Building, Washington, D. C.

For the Photographer

Have you a Camera? Write for free sample of our big magazine, showing how to make better pictures and earn money. American Photography, 118 Camera House, Boston, 17, Mass.

Games and Entertainment

Free with $25 order our large die box. Send 20c for our large catalogue of tricks, puzzles, wigs, sensational escapes, Oaks Magical Co., Dept. 549, Oshkosh, Wis.

Health

Free—Stop using tobacco. We will give free information how to conquer habit easily and permanently. Results guaranteed. Anti-Tobacco League Box M, Omaha, Neb.

Help Wanted

Detectives Needed Everywhere. Work home or travel. Experience unnecessary. Write, George Wagner, former Government Detective, 1968 Broadway, N. Y.

Silvering Mirrors, French plate. Easily learned. Immense profits. Plans free. Wear Mirror Works, Excelsior Springs, Mo.

Detectives Earn Big Money. Travel. Excellent opportunity. Great demand everywhere. Experience unnecessary. Particulars free. Write, American Detective System. 1974 Broadway, N. Y.

Men to Build Radio Sets in spare time. Leon Lambert, 670-H Kaufman Bldg., Wichita, Kansas.

Earn $25 weekly, spare time, writing for newspapers, magazines. Experience unnecessary. Copyright book free. Press Syndicate, 986, St. Louis, Mo.

Wanted—Mail Clerks to handle mail on trains (travel), Forest Rangers, Guard Forest Reserves, Special Agents, make investigations. Big Pay. Write Ozment, The Coacher, 293, St. Louis, Mo., quickly.

Men Wanted for Detective Work. Experience unnecessary. Write J. Ganor, former Govt. Detective, 104, St. Louis Mo.

Easy Money! Silvering mirrors, Auto-parts, tableware, outfits, Plans free. Sprinkle, Plater, 955, Marion, Indiana.

Ambitious Men, Women, 18 up. Get U. S. Government Permanent Jobs. $95 to $250 month, Steady work. Pleasant. Short hours. Paid vacation. Common education usually sufficient. Write today sure for full particulars and free sample coaching. Franklin Institute, Dept. C22, Rochester, N. Y.

Firemen, Brakemen, Baggagemen, Sleeping car, train porters (colored) $140-$200. Experience unnecessary, 897 Railway Bureau, East St. Louis, Ill.

Indian Goods

Indian hunting bows. $2.50. Indian relics, minerals, butterflies, archery. Catalogue, thousand articles 10c. Indiancraft S. I. Company, 468 Connecticut, Buffalo, N. Y.

Insects Wanted

Why Not Spend Spring, Summer and Fall gathering butterflies, insects? I buy hundreds of kinds for collections. Some worth $1 to $7 each. Simple outdoor work with my instructions, pictures, price-list. Send 10 cents (not stamps) for my illustrated Prospectus before sending butterflies. Mr. Sinclair, Dealer in Insects, Box 1424, Dept. 41, Ocean Park, Calif.

Instruction

Learn Chemistry at Home. Dr. T. O'Conor Sloane, noted educator and scientific authority, will teach you. Our home study correspondence course fits you to take a position as chemist. See our ad on page 7 of this issue. Chemical Institute of New York, 66 W Broadway, New York City.

Correspondence Courses sold complete; one-third usual prices because slightly used; easy terms; money back guarantee. All schools and subjects. Write for special Free catalog. Courses bought for cash. Economy Educator Service, H202, West 49th St., New York.

Railway Postal Clerks start $133 month; railroad pass. Send stamp for questions. Columbus Institute, H4, Columbus, Ohio.

Jazz playing easily learned. New instruction book with popular song (arranged). Play immediately. Price $1.00. Paul Vincent School, Dept. C. Regent Pl., B'klyn, N. Y.

Languages

World Romic System, Masterkey 5000 Languages. Spanish Primer, $1.94. Languages, 8 West 40th, New York.

Machinery and Tools

Concrete Building Block Machines and Molds. Catalogue free. Concrete Machine Co., 505 South Third St., St. Louis, Mo.

Manufacturing

To order: Metal articles, simple, or complicated machinery. Models, tools, patterns. Experimenting. Parma Engineering Works, Brooklyn Station, Cleveland, Ohio.

Miscellaneous

Your favorite beverages and other formulas. Free valuable information. The Formula Co., Dept. M, 122 West Howe St., Seattle, Wash.

Beautiful registered bull pups cheap. Bulldogs, 501 Rockwood, Dallas, Texas.

Your favorite Beverages, Syrups, Extracts and other reliable Formulas. Free information. The Formula Co., Dept. M, 122 West Howe, Seattle, Wash.

Blueprint your photo or circuit on post card with sensitizer. Bottle 50 cents. No stamps. W. Guichard, Beechhurst, Long Island, N. Y.

Motorcycles—Bicycles

Don't buy a Bicycle Motor Attachment until you get our catalogue and prices. Shaw Mfg. Co., Dept. 6, Galesburg, Kansas.

Musical Instruments

Violins—Deep, Mellow, Soulful—on easy credit terms. High grade, wonderful instruments of my own make. Development of many years' expertness. Write for book. Gustav A. Henning, 2424 Gaylord St., Denver, Colo.

(Patent Pending.) Wonder dollar instrument, anybody play, everybody surprised. Imitate orchestra, become professional entertainer; other valuable information. Multitone, 448K W. 38th, New York.

Old Coins

United States half dollar 100 years old 95c; Half cent and bargain price list 25c. Robert Cohen, Box 483, Muskogee, Oklahoma.

Old Money Wanted

$2 to $500 Each paid for hundreds of Old or Odd Coins. Keep all old money. It may be very valuable. Send 10c for new illustrated Coin Value Book, 4x6. Guaranteed Prices. Get Posted. We pay Cash. Clarke Coin Company, 14 Street, LeRoy, N. Y.

Patent Attorneys

Patents—Our Book "How to Obtain a Patent" sent free upon request. Contains full information about patents, trade-marks and designs. If you will send us a sketch of your invention we will promptly make search of the Patent Office records and advise you as to patentability, our charge for the service being $5.00. Prompt, efficient service with moderate charges. Over twenty years experience. Bank and commercial references. Talbert & Talbert, Registered Patent Lawyers, 552 McGill Bldg., Washington, D. C.

Patents. Send for free booklet. Highest references. Best results. Promptness assured. Send model or drawing for examination and opinion. Watson E. Coleman, Patent Attorney, 644 G Street, N. W., Washington, D. C.

Inventors write me about patents. My fees payable monthly. Booklet free. Frank Fuller, Washington, D. C.

Unpatented Ideas Can Be Sold. I tell you how and help you make the sale. Free particulars (Copyrighted 1923). Write W. T. Greene, 809 Jenifer Bldg., Washington, D. C.

"Inventor's Advisor," the valuable Patentbook with 139 Mechanical movements and illustrations, sent free upon request. M. L. Labiner, Patent Attorney, 3 Park Row, New York.

Lacey Patent-Sense. "The book the inventor keeps." Free. See page 80.

"Inventors' Guide" free on request; gives valuable information and advice for all who have original ideas or improvements. Frank Ledermann, Registered Attorney and Engineer, 15-E Park Row, New York.

Herbert Jenner, Patent Attorney and Mechanical Expert, 606 F Street, Washington, D. C. I report if patent obtainable and exact cost. Send for circular.

Millions spent annually for ideas! Hundreds now wanted! Patent yours and profit! Write today for free book—tells how to protect yourself, how to invent, ideas wanted, how we help you sell, etc. American Industries, Inc., 212 Kresge Bldg., Washington, D. C.

Inventors—Send for form "Evidence of Conception" to be signed and witnessed. Form, fee schedule, information free. Lancaster and Allwine, Registered Patent Attorneys in United States and Canada, 242 Ouray Bldg., Washington, D. C.

Monroe Miller, Ouray Bldg., Washington, D. C. Patent Attorney; Mechanical, Electrical Expert. Free Blue Book gives candid advice.

Patents. Write for my free Guide Books "How to Obtain a Patent" and "Invention and Industry" and "Record of Invention" blank before disclosing inventions. Send model or sketch of your invention for instructions. Promptness assured. No charge for above information. Clarence A. O'Brien Registered Patent Lawyer, 9292 Security Bank Building, directly across street from Patent Office, Washington, D. C. See page 79.

Patents Procured; Trade Marks Registered—A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 130 Owen Bldg., Washington, D. C., or 41-T Park Row, New York.

Patent Attorneys (Continued)

Get your own patents. Application blanks, complete instructions $1. Cutting Bros., Campbell, Calif.

Inventors—Send sketch or model for advice and exact cost of patent. Ask for our free book, "How to Obtain a Patent." Tells what every inventor should know. Established twenty-eight years. Highest references. Prompt service. Reasonable charges. Chandlee & Chandlee 476 Seventh, Washington, D. C.

Stronger patents for less money through cooperation. Booklet free. Chartered Association of American Inventors, Barrister Building, Washington, D. C.

Patents

Inventions commercialized. Patented or unpatented. Write Adam Fisher Mfg. Co., 205 Enright, St. Louis, Mo.

Penmanship

Your signature (12 styles) finest you have ever seen. Send quarter, Meub, Expert Penman, 2365 Mar Vista, Pasadena, Calif.

Personal

Lonely Hearts—Exchange letters; make interesting new friends through our romantic club. Write Eva Moore, Box 908, Jacksonville, Florida.

Get acquainted. Make new friends. Exchange Letters. Enclose stamped envelope for plan. The Lilly Club, Station H, Cleveland, Ohio.

Lonely—Join our Club. Make friends everywhere. Particulars free. Write Mrs. Matthews, Box 26, Oakland, Calif.

Lonesome! Make new friends. Write Dolly Gray Club, Box 186K Denver, Colorado. Stamp appreciated.

Phonographic Supplies

Build Your Phonograph. Spring Motors, Electric Motors, Tonearms, Amplifiers, Accessories. Latest Equipment also in Radio Mechanism and Cabinets. Catalog mailed for ten cents. Hoosier Mfg. & Supply Co., Baldwin Block, Indianapolis, Ind.

Photoplays, Stories, Etc.

$ $ $ For Ideas. Photoplay Plots Accepted any form; revised, criticised, copyrighted, marketed. Advice free. Universal Scenario Corporation, 223 Security Bldg., Santa Monica & Western, Hollywood, California.

Photoplay Idea—Original, for sale. Luceal Asencio, P. O. Box 3814, Station D, Philadelphia, Pa.

Printing

250 Bond Letterheads, Envelopes or cards $1.50. Combination $4.25. Walker, R.3, Crown Point, Ind.

Printing Outfits and Supplies

Print your own cards, stationery, circulars, paper, etc. Complete outfits $8.85; Job Presses $12, $35; Rotary $150. Print for others, big profit. All easy, rules sent. Write for catalog presses, type, paper, etc. Press Company, A-6 Meriden, Conn.

Radio

Radio booklet free "Dollars saved clubbing Radio magazine subscriptions." Spencerian Agencies, West Los Angeles, Calif.

Attention! 50 Vacuum Tube Hook-Ups. The greatest collection of Vacuum Tube Circuits ever brought under two covers at such insignificant cost. These diagrams will be found in the great "Rasco" catalogue which contains raw materials and parts in a greater profusion than any other catalogue. 15c in stamps or coin will bring the catalogue to you. Radio Specialty Company, 100 Park Place, New York City.

Boys, don't overlook this! The "Rasco" Baby Detector. Greatest detector ever brought out with molded base. Fully adjustable. See former advertisements in this publication or our catalogue. Detector with Galena Crystal complete, 50c; the same Detector with Radiocite Crystal, 75c, prepaid. Send for yours today. Radio Specialty Co., 100 Park Place, New York City.

Get Radio Sets, parts, at wholesale. Sell to friends. Our discounts insure big profits. Free catalogue. Fuetterer Radio Supply Co., 2115 Locust St., St. Louis, Mo.

Build Radio Sets for friends, spare time. Very profitable. We'll supply apparatus and expert advice. Write us. The Langhein-Kaufman Radio Co., Dept. E, 511 Chapel St., New Haven, Conn.

Before you buy a radio write me for "What radio experts know but don't tell you." Leon Lambert, 670, Wichita, Kansas.

Radio Generators: 500V 100 watt, $28.50. Battery Charging Generators, $8.50. High Speed Motors—Motor Generator Sets. All sizes. Motor Specialties Co., Crafton, Penna.

Motors—Manufacturer's surplus sale, ¼ H.P., $8.50; ½ H.P., $32.50; 1 H.P., $54.50; 8 Volt Charging Generators, $8.50. Complete Lighting Plants—Generators, Light Machinery. Write for Catalog. Motor Specialties Co., Crafton, Penna.

Wanted: Light Machinery—Lathes—Drill Presses—Model High Speed Gasoline and Steam Motors. Best Cash Prices Paid. Motor Specialties Co., Crafton, Penna.

TESTS SHOW FORD CAN RUN 60 MILES ON GALLON OF GAS

The amazing fact that a Ford can run 60 miles on a gallon of gasoline was recently brought to light thru tests conducted by America's foremost engineers. Great strides have already been made in this direction by the recent invention of a simple attachment which can be installed in a few minutes without any alteration to motor. A. C. Winterburn made 41.4 miles on 1 gallon of gasoline after this device was attached. B. O. Weeks, famous aviator and inventor, wants agents and will send sample for trial. Write him today at 426-826 Eleventh St., Milwaukee, Wis.

Radio (Continued)

Salesmen Wanted

Stamps and Coins

Typewriters

Wanted

THE PERIODICAL PRESS, NEW YORK

Let These Guides *Solve Your Problems*

Electricity at your finger ends

HAWKINS ELECTRICAL GUIDES

IN TEN VOLUMES

3500 PAGES **$1 A VOLUME**
4700 PICTURES **$1 A MONTH**

SEND NO MONEY—SEND ONLY THIS COUPON

Know the facts in Electricity. They mean more money and better position for you. Hawkins Guides tell you all you need to know about Electricity. Every important electrical subject covered so you can understand it. Easy to study and apply. A complete, practical working course, in 10 volumes. Books are pocket size; flexible covers. Order a set today to look over.

LEARN ALL ABOUT

Magnetism—Induction—Experiments — Dynamos — Electric Machinery—Motors—Armatures—Armature Windings—Installing of Dynamos—Electrical Instrument Testing—Practical Management of Dynamos and Motors—Distribution Systems—Wiring—Wiring Diagrams — Sign Flashers — Storage Batteries — Principles of Alternating Currents and Alternators — Alternating Current Motors — Transformers — Converters—Rectifiers—Alternating Current Systems — Circuit Breakers — Measuring Instruments—Switchboards—Wiring—Power Stations—Installing —Telephone—Telegraph—Wireless—Bells—Lighting—Railways. Also many Modern Practical Applications of Electricity and Ready Reference Index of the ten numbers.

SHIPPED FREE

Not a cent to pay until you see the books. No obligation to buy unless you are satisfied. Send Coupon now—today—and get this great help library and see if it is not worth $100 to you—you pay $1.00 a month for ten months or return it.

THEO. AUDEL & CO.,
72 Fifth Ave., New York City

Please submit me for free examination, HAWKINS ELECTRICAL GUIDE (Price $1 a number). Ship at once prepaid, the 10 numbers. If satisfactory, I agree to send you $1 within seven days and to further mail you $1 each month until paid.

Name .....

Occupation .....

Employed by .....

Home Address .....

Reference .....

S. I. May


SAVE HALF - INSTALL YOUR OWN
PLUMBING AND HEATING
BY OUR New Easy Method
HANDY MAN BOOK
EASY METHOD PLUMBING & HEATING
HARDIN-LAVIN CO.
Get This Big Book
Any Handy Man
can install his own plumbing and heating by our new easy method and save half. In the past 50 years we have saved our customers hundreds of thousands of dollars in the cost of
Plumbing Goods
Pipeless & Warm Air Furnaces
Steam Boilers
Hot Water Boilers
Water Supply Systems
Water Heaters
Bath Room Outfits
Pipes, Radiators, Valves, Supplies, Etc.
You Save Half
Big Handy Man Book
Tells the whole story. Shows the Hardin-Lavin New Easy Method.
HUNDREDS OF TRADE SECRETS
Send 25c for your copy TODAY.
SUPER-IMPROVED AUTOMATIC ELECTRIC
Water-Supply System, Complete
$98.50
NOISELESS PUMP Runs in Oil
Outfits Complete—No Extras
Special $ 98.50
Special 110.50
Special 122.50
SHALLOW WELL OUTFIT
CHICAGO HIGHEST GRADE Bathroom Outfit
Complete,
$59.95
Highest Quality Snow White Enameled Steel Cabinet
$8.95
Beautiful and Durable
$8.95
White Enameled Bathtub
Special $31.10
White Closet Outfit
$19.95
Deep Apron Lavatory
$11.75
$59.95
CUT-TO-FIT Heating Plants
Steam—Hot Air—Hot Water
We Help You Plan & Install
Read Our Money-Back Guaranty
Ask for Estimate—FREE—No Obligation
MAIL THE COUPON TODAY! →
Pipeless Furnace
Hot Water Boiler
OUR BONDED GUARANTY
and LABEL PROTECTS YOU
Could Anything Be Fairer?
(Signed) HARDIN-LAVIN CO.
HARDIN-LAVIN CO.
ESTABLISHED 1876
When in Chicago Visit Our New Plant at
104-114 West Pershing Road,
CHICAGO
NAME
ADDRESS
STATE

NATIONAL RADIO INSTITUTE

WASHINGTON, D. C.

PRACTICAL RADIO TELEVISION

NATIONAL RADIO INSTITUTE
WASHINGTON, D.C.