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MARCH

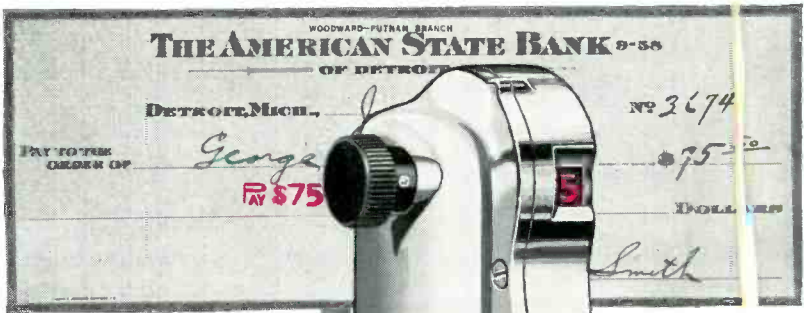
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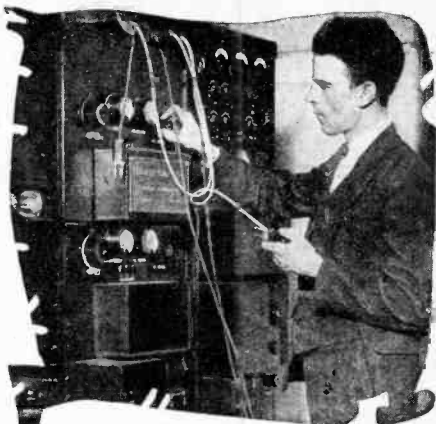
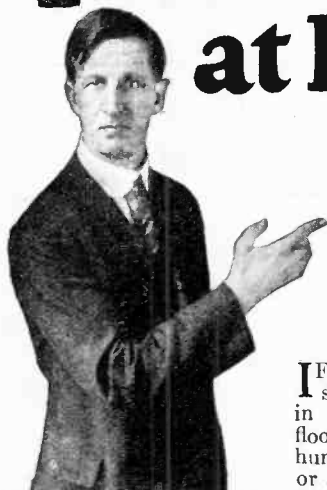
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If you are earning a penny less than \$50 a week, I send for my book of information on the opportunities in Radio. It's FREE. Clip the coupon NOW. A flood of gold is pouring into this new business, creating hundreds of big pay jobs. Why go along at \$25, \$30 or \$45 a week when the good jobs in Radio pay \$50, \$75, and up to \$250 a week? My book, "Rich Rewards in Radio," gives full information on these big jobs and explains how you can quickly become a Radio Expert through my easy, practical, home-study training.

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"I'll give you just the training you need to get into the Radio business. My course fits you for all lines—manufacturing, selling, servicing sets, in business for yourself, operating on board ship or in a broadcasting station—and many others. I back up my training with a signed agreement to refund every penny of your money if, after completion, you are not satisfied with the course I give you."

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Dept. OCS
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the six big outfits
of Radio parts
I give you**

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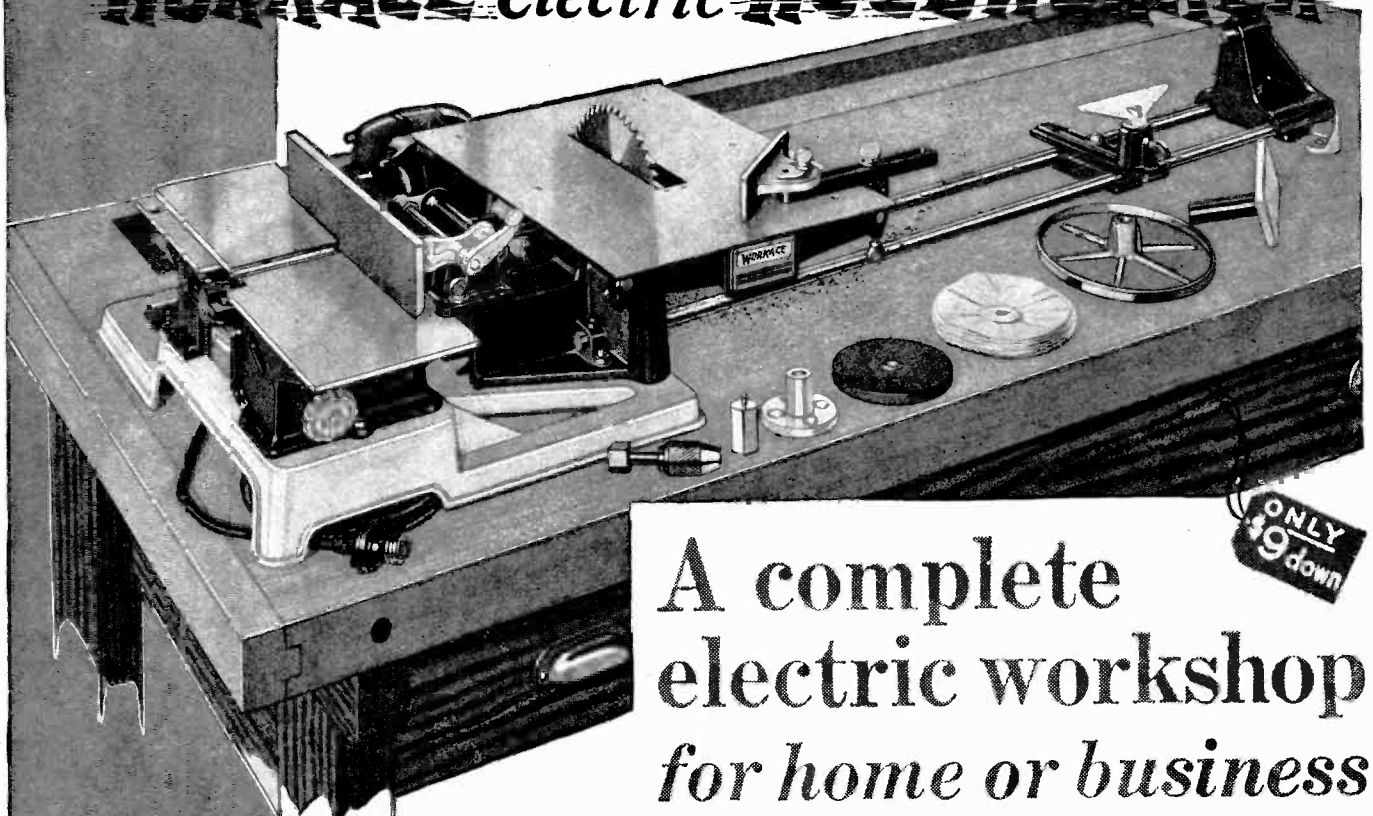
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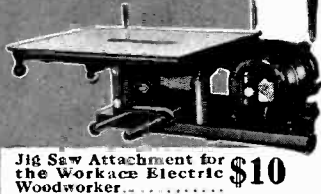


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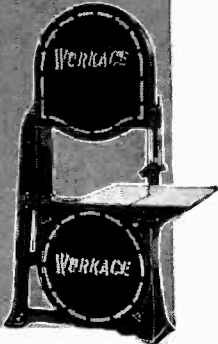
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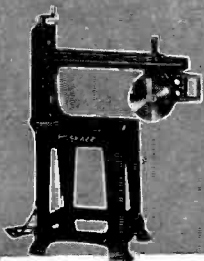
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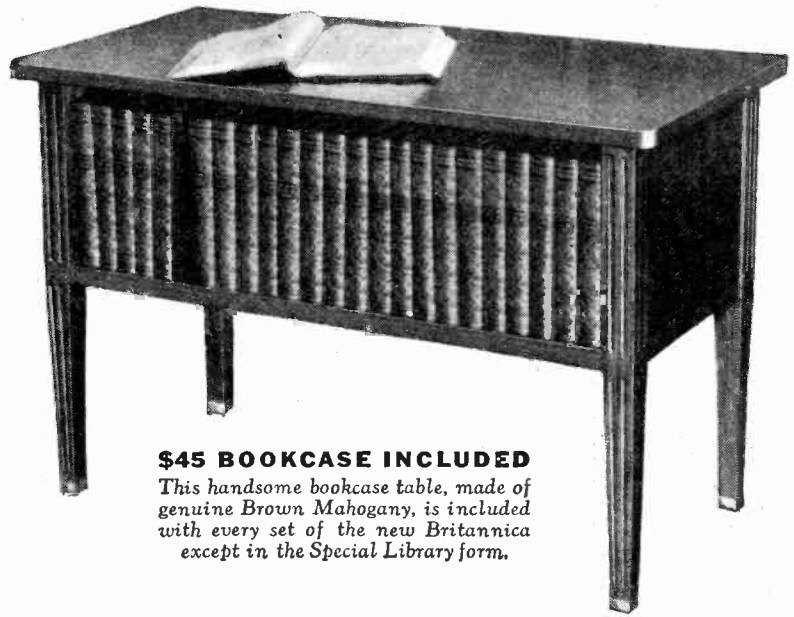


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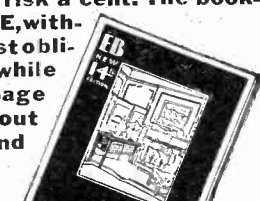
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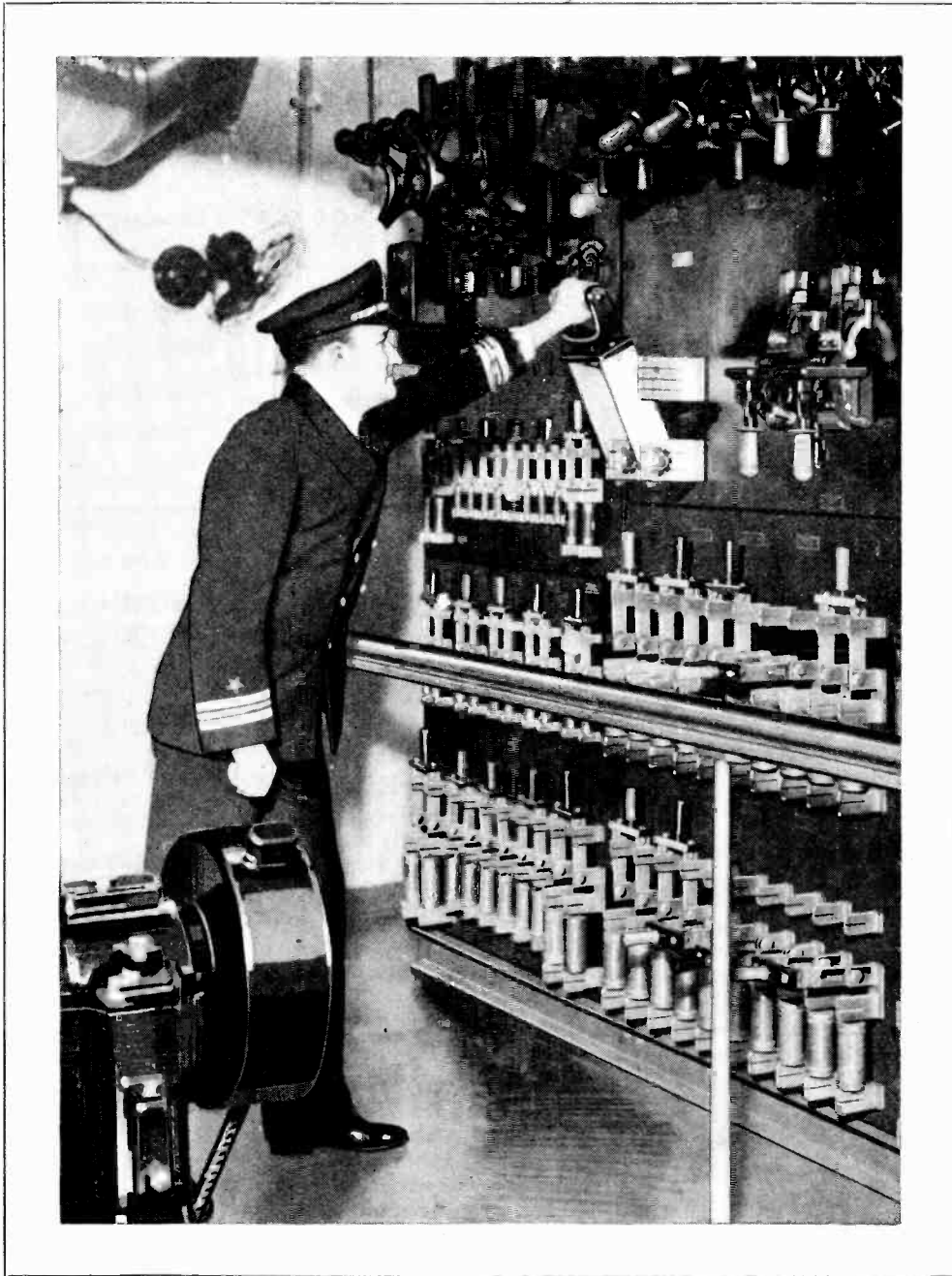
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Editorial

Why Is Shipping "FOG-BOUND"?

EVERY now and then we are agreeably apprised of some additional practical use being made of scientific achievements. At frequent intervals the products of the laboratory step forth into the field of service. The results of chemical experiments, observed by vigilant chemists, appear in your automobile, in your home, on the streets of your city. They constitute the basis of new metal alloys, new kinds of furniture, new clothing, new living conditions.

In numerous industries, we find a progressively widening application of ultra-violet rays and X-rays. "King Ultra," as the invisible violet rays are called, is able to detect the quality of diamonds, and to ascertain the genuineness of many other things; to cause as much fading in textiles or paints within fifteen minutes as could be achieved by sunlight in six months.

In other branches of industry we also find the photoelectric cell—science's latest eye—investigating chemical and manufacturing processes, detecting low quality and flaws in goods ranging from cigars to yeast cakes.

In the infra-red, or radio, field we find practicability following swiftly in the footsteps of laboratory developments. The police departments of certain progressive cities use radio to nip crime in the bud. Railroads are installing radio-controlled signalling systems, are developing radio-phone communication for train operation and passenger use. The geologist is using radio to detect and explore mineral veins in the earth. Aircraft are becoming more and more dependent upon development of this art.

Of startling contrast to the utilization of scientific progress in these industries, however, is the obvious and all-too-perilous indifference shown toward scientific developments by harbor authorities and shipping interests. Marine navigation is thousands of years old, but ships and mariners are just as effectively crippled by fog as they were in the days of the Phoenicians. For days at a time tramp steamers and ocean liners alike have been compelled to lie at anchor outside harbor entrances, fearful of attempting to nose their way to their piers. In December, the harbor of New York was completely fog-bound for a period of approximately five days. During that time a very serious accident occurred—the steamship "Algonquin" rammed and sunk the "Fort Victoria," Bermuda-bound with several hundred passengers, and at this writing the upturned hulk remains lying in the channel, a menace to other craft.

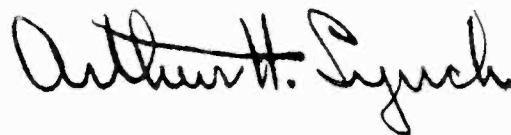
Fortunately, one agency of science was available—the "Fort Victoria," compelled by law to carry radio apparatus, was able to summon aid to rescue its several hundred passengers in the minutes before it turned over and sank.

But has every possibly step been taken to insure safe navigation in our harbors?

Several years ago some "direction-finding" experiments were conducted by the United States Navy in New York harbor. An electric cable was laid in the harbor channel. One end of it was insulated; the other end made contact with the water or ground. From this cable there emanated a 60-cycle hum, or impulse. Coils were mounted on the port and starboard sides of the test ship and connected in series with amplifiers and a telephone head set. When the vessel was traveling directly above this cable the hum was heard with equal strength in each of the earphones, but if the skipper deviated from his course ever so little, the deviation was at once made apparent by the "off-center" quality of the hum. These tests proved quite successful, and inquiries made of New York port authorities and naval authorities fail to elicit the reason why such an auspicious start toward successful harbor navigation was not followed up and made practical for all ships entering this port.

And aside from this submerged cable system, has any attempt been made to adapt to marine work the radio beacon developed for aviation? Has the fathometer, or radio echo device, ever been tried in harbor location finding? Have the numerous buoys which mark the channel been experimented with? Could not low power radio waves be employed to carry distinctive beat notes to and from buoys and to and from ships?

In our opinion, the money lost through the "Fort Victoria" disaster alone would have sufficed to equip numbers of ships with direction-finding and course-directing equipment which would make such disasters impossible. If the shipping interests and port authorities are not interested in this very important fact, marine insurance companies should be.



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

Pledge to the Public on Used Car Sales

- 1 Every used car is conspicuously marked with its lowest price in plain figures, and that price, just as the price of our new cars, is rigidly maintained.
- 2 All Studebaker automobiles which are sold as CERTIFIED CARS have been properly reconditioned, and carry a 30-day guarantee for replacement of defective parts and free service on adjustments.
- 3 Every purchaser of a used car may drive it for five days, and then, if not satisfied for any reason, turn it back and apply the money paid as a credit on the purchase of any other car in stock—new or used. (It is assumed that the car has not been damaged in the meantime.)

© 1928 The Studebaker Corporation of America



Buy
 where *used* cars
 are sold
 like *new* cars...

on the

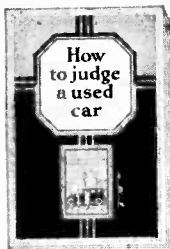
STUDEBAKER PLEDGE PLAN

NOWHERE in the used car market will you find a fairer, squarer basis for used car sales than the famous Studebaker Pledge Plan. More than 150,000 people, appreciating this fact, bought Pledge-backed used cars last year.

When you buy a Pledge-backed used car, you invest in unused transportation. Most cars sold on this plan have been repainted, refinished and reconditioned to look and perform as well as they did when new.

Under the terms of the Studebaker Pledge, you get five days' driving trial to determine for yourself whether or not the used car you select is suited to your needs. On all Certified cars, the Pledge provides a 30-day guarantee for free adjustments and replacement of defective parts. And all Pledge-

backed used cars carry plainly marked price tags—one price to every buyer! Your Studebaker dealer can show and demonstrate Studebakers, Erskines and other makes of cars in a variety of models. You will find the type of motor car you want—and the kind of protection for your purchase that your business sense demands.



Invest 2c—you may save \$200

Mail the coupon below for the free booklet. A 2c stamp is an investment which may save you as much as \$200 in buying a motor car!

THE STUDEBAKER CORPORATION OF AMERICA
 Div. 173, South Bend, Indiana
 Please send me copy of "How to Judge a Used Car"

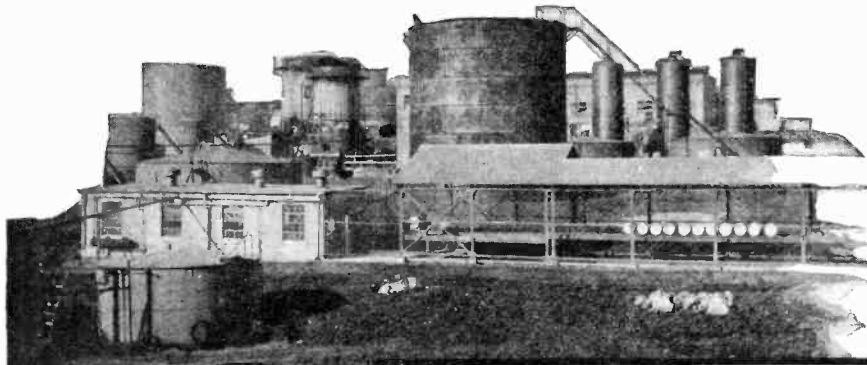
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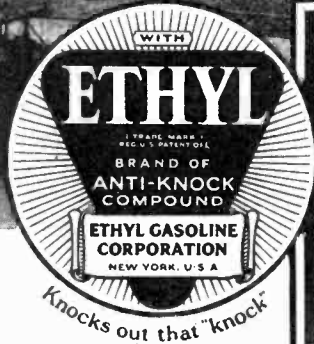
STUDEBAKER

Builder of Champions

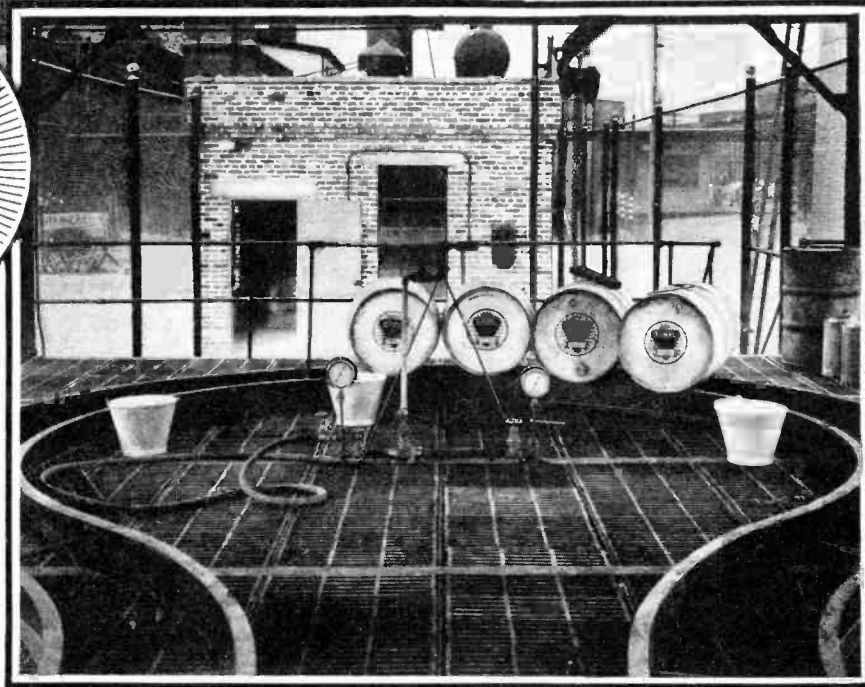


Left—Typical refinery scene with Ethyl mixing plant in foreground.

Below—Close-up of Ethyl mixing plant. Drums on runway contain Ethyl fluid about to be mixed with gasoline to form Ethyl Gasoline.



Wherever you drive—whatever the oil company's name or brand associated with it—any pump bearing the Ethyl emblem represents quality gasoline of anti-knock rating sufficiently high to "knock out that 'knock'" in cars of average compression and bring out the additional power of the new high-compression cars.



How Ethyl Fluid is mixed with gasoline

ANYONE interested in practical chemistry would enjoy a visit to one of the plants in which the oil companies mix Ethyl fluid containing tetraethyl lead with their gasoline to form Ethyl Gasoline.

What would probably be most impressive would be the *precision*

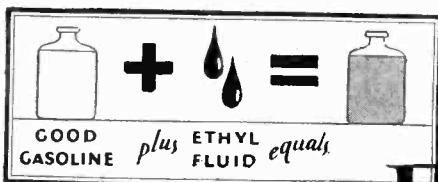
with which it is done. Engineers from the oil company or from the Ethyl Gasoline Corporation supervise every step of the process.

First, the base gasoline with which Ethyl fluid is to be mixed is tested at an Ethyl laboratory. From this test, the exact amount of Ethyl fluid necessary to bring the gasoline

up to a rigid standard of anti-knock quality is determined. An accurate measuring device is used at each refinery to insure that this quantity of Ethyl fluid goes into every gallon of gasoline.

Look for the Ethyl emblem.

Ethyl Gasoline Corporation, New York City.

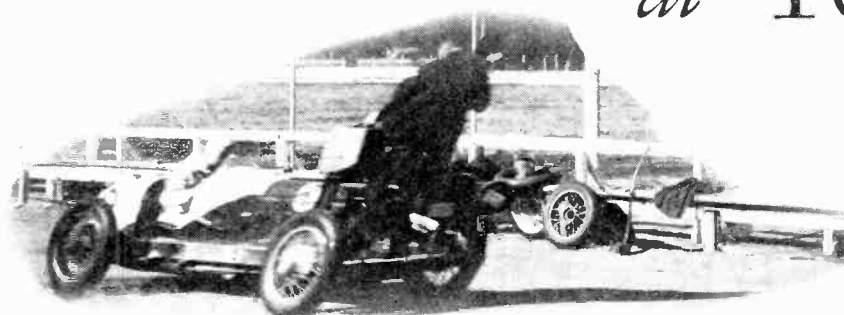


The active ingredient now used in Ethyl fluid is tetraethyl lead.

ETHYL GASOLINE

They Made Talkies

at 100 Miles an Hour!



Precariously perched behind cameras and sound-recording equipment, Director Sutherland hung on for several laps of the course.



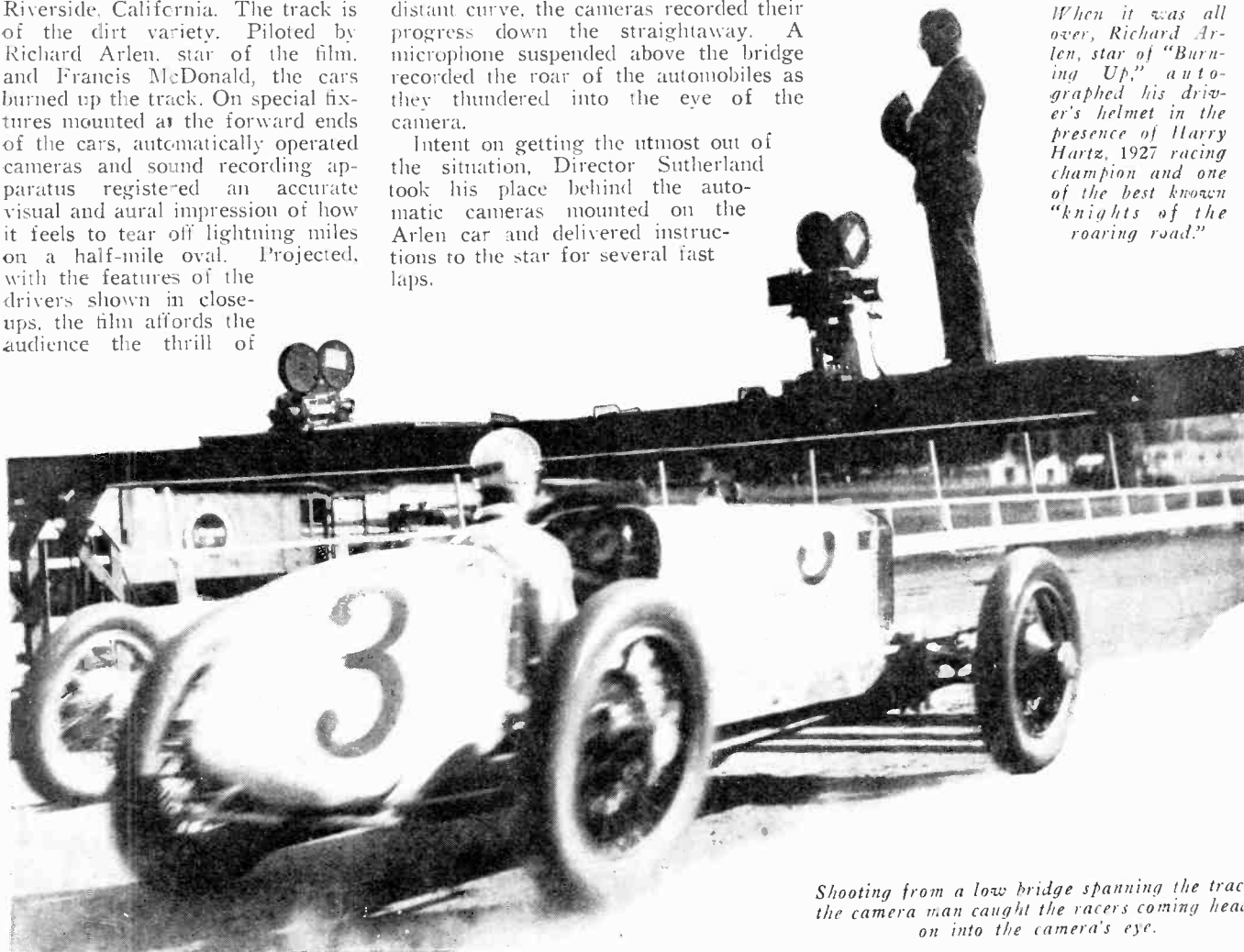
MANY a motion picture thriller has been filmed of the "knights of the roaring road." But it remained for the talkies to sound-film a pilot of the racing track from the head-end of his machine—and at a speed of 100 miles an hour!

The film appropriately is named "Burning Up." The place was Riverside, California. The track is of the dirt variety. Piloted by Richard Arlen, star of the film, and Francis McDonald, the cars burned up the track. On special fixtures mounted at the forward ends of the cars, automatically operated cameras and sound recording apparatus registered an accurate visual and aural impression of how it feels to tear off lightning miles on a half-mile oval. Projected, with the features of the drivers shown in close-ups, the film affords the audience the thrill of

race driving carried out with a realism extraordinary on the screen. Another thrill for the film was achieved through motion- and sound-shots made from a bridge spanning the track. The clearance between track and bridge was merely sufficient to permit the squat racing machines to get under it by inches. Picking up the oncoming cars as they skidded around a distant curve, the cameras recorded their progress down the straightaway. A microphone suspended above the bridge recorded the roar of the automobiles as they thundered into the eye of the camera.

Intent on getting the utmost out of the situation, Director Sutherland took his place behind the automatic cameras mounted on the Arlen car and delivered instructions to the star for several fast laps.

When it was all over, Richard Arlen, star of "Burning Up," autographed his driver's helmet in the presence of Harry Hartz, 1927 racing champion and one of the best known "knights of the roaring road."



Shooting from a low bridge spanning the track, the camera man caught the racers coming head-on into the camera's eye.

SCIENCE *and* INVENTION OFFERS \$400

for the Best Answer to the Question

"How Can We Best Utilize Waste Basement Space?"

1st prize	\$100.00	3rd prize	\$40.00
2nd prize	\$60.00	5 prizes of	\$20.00
		10 prizes of	\$10.00

IN this SCIENCE AND INVENTION basement plan competition there are no restrictive requirements. Any reader may enter, and he may submit as many separate plans as he desires, although not more than one prize will be awarded to a single individual.

All you need to do is write a letter not exceeding 1,000 words, containing your plan for utilizing the waste space in any basement — existing, imaginary, or proposed. Or, if you or one of your friends has a basement in which the space has been utilized in an interesting and practical manner, your letter may describe this. If you submit more than one plan, make each the subject of a separate letter.

A drawing will aid the jury to understand your idea. Make a rough sketch showing approximate dimensions of the basement, location of doors, windows, permanent equipment, etc. If you plan remodeling an existing basement, it will help the jury if you provide two drawings, one showing the existing and the other the proposed layout.

In the latter case it will help if you divide your letter into three parts. In the first describe the existing basement and the problems involved. In the second describe the changes you propose. In the third discuss the materials and methods you propose—wall, floor and ceiling treatments; kind, location, and purpose of partitions, if any; provisions for damp-proofing, heating, ventilation, lighting, equipment, etc.

If you describe a basement already remodeled, you may limit your letter to the basement as it stands, including materials, methods, and equipment employed in making it comfortable and attractive. A photograph will help.

If you describe a basement such as you would want in your own home, explain the purposes for which you would use the space, and the provisions and materials you would employ to make it dry, comfortable, and attractive; also the equipment you propose to install.

Should you feel that you lack sufficient knowledge of the materials and equipment needed for your plans, you can obtain it from literature which manufacturers will be glad to send you. A list of literature will be published in the April issue of SCIENCE AND INVENTION, together with a convenient coupon. Simply fill in the coupon and forward it to SCIENCE AND INVENTION. The literature will be mailed to you without charge.

In the average home only about 25% of the basement floor area serves really useful purposes. With proper thought and treatment the other 75% may be converted into one or more rooms equal to the upstairs rooms in comfort and attractiveness, for entertainment, playroom, den, shop, or other purposes. To explore the possibilities of the livable basement, SCIENCE AND INVENTION is offering \$400.00 for practical ideas from readers.

Other fruitful sources of information are Mr. Taylor's article, "The Basement Playroom" and Josef W. Von Stein's "Make that Wet Cellar Dry," which appear in the present issue.

It is desirable that your letter be typewritten. However, this is not essential. Your letter should occupy only one side of each sheet. Your name and address should appear on each sheet.

The jury will select as the winning plans those which are best from the standpoint of *comfort, attractiveness, and ingenuity of arrangement*, allotting them prizes in the order of their merit. But it must be understood that a plan, to be considered on these grounds, must *first of all be*

capable of being worked out in practice.

The decision of the jury will be final. In case of a tie, the full amount of the award involved will be given each tying contestant.

The competition opens with this announcement and will close on May 31, 1930. All entries, to be eligible, must be received by SCIENCE AND INVENTION, at 381 4th Ave., New York, before midnight, May 31, 1930.

The prize winners will be notified within approximately two weeks after the closing date. Their names will also be announced in the September issue of SCIENCE AND INVENTION.

SCIENCE AND INVENTION cannot undertake to return the letters submitted by contestants. It is suggested that duplicate copies be retained by readers who desire them.

SCIENCE AND INVENTION reserves the privilege of publishing any idea submitted. Entries thus published will upon publication be paid for at the rate of \$5.00 each, if they have not been awarded regular prizes.

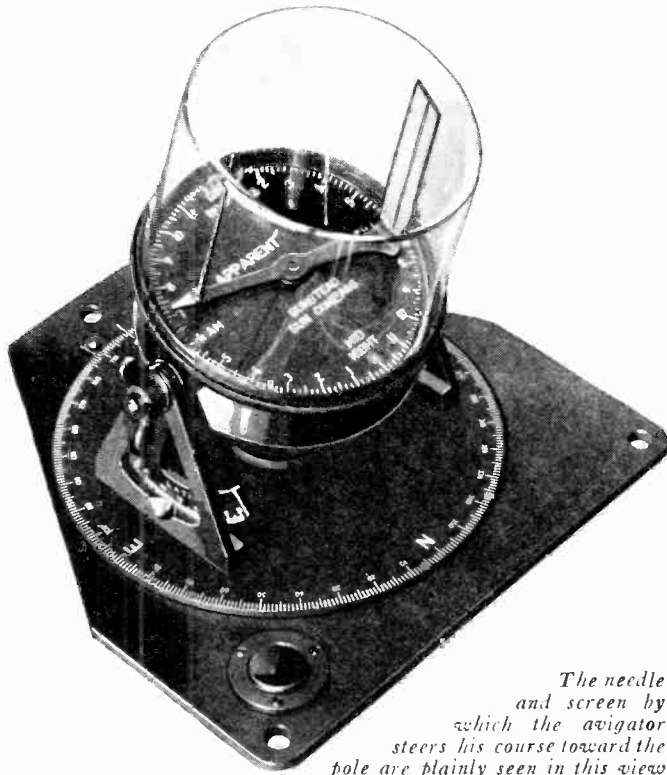
The prize winners will be selected by a jury of three outside specialists. This jury will be composed of:

LELAND HUBBELL LYON, A.I.A., of the New York architectural firm of Lyon & Taylor, an authority on home design.

LOUIS C. STONE, Editor of BUILDING INVESTMENT MAGAZINE, a practical builder of homes, and a specialist in home building materials and equipment.

S. GORDON TAYLOR, Research Director of Taylor, Rogers & Bliss, Merchandising Consultants in the building field, and author of the article "Have a Basement Playroom," in this issue.

A Needle's Shadow Showed Byrd *the* Pole



The needle and screen by which the avigator steers his course toward the pole are plainly seen in this view of the Bumstead Sun Compass. The clock face rests on a mat of India rubber sponge, so that it can be leveled by hand pressure.

As He Soared Across the Waste of Antarctic Ice and Snow, Commander Byrd Kept His Course True With a Wonderful Sun Compass Designed Especially for Polar Avigation.

cut is referred to, its construction is easily understood. The upper dial, across which lies a clock hand, is divided into 24 primary divisions representing 24 hours. The case surmounted by this disc contains a clock which moves the hand around the dial once in 24 hours. On one end of the hand there is a vertical stylus; on the other end there is a vertical translucent screen. The apparent plane of the sun's rotation varies from day to day, and coincides approximately with the equator only twice in the year—at the equinoxes.

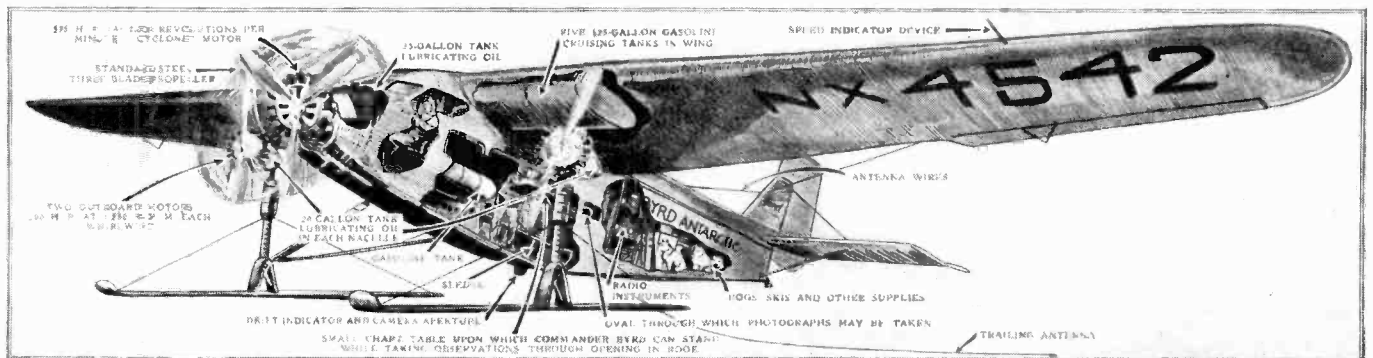
Now suppose the clock is going. Having determined by navigational astronomy the inclination of the apparent plane of the sun's revolution to the elliptic, the operator sets the clock to that angle. If the hand is then set to point at the figure of the hour of the day, and the compass is set so that the shadow of the stylus falls directly in the center of the screen, noon and midnight figures will lie north and south. The avigator steers a course which keeps the shadow of the stylus in the center of the screen, changing at very short intervals the angle of inclination of the clock face, so as to keep it in parallelism with the apparent path of the sun. By keeping this path he will pass directly over the pole, north or south as the case may be. The success of his venture, however, depends on the visibility of the sun, for if clouds conceal this from him his compass becomes useless.

And now the question comes of how the avigator is to know when he reaches the pole. This he will have to determine by dead reckoning and observation of the altitude. Knowing how fast his plane is going, and the distance of his starting point from the pole, he can apply these data to the path which his sun compass has given him, and determine approximately when he arrives above the pole. To confirm it, he must take some altitudes with a sextant. This Admiral Byrd did very fully in crossing the North Pole, and his observations were confirmed by calculations made in Washington, showing wonderfully accurate results on his part. For the definite determination of the location of the pole these altitude observations are absolutely essential.

ALL the world knows that Commander Richard Byrd has added the conquest of the South Pole to his conquest of the North. But most of the world remains in the dark regarding the instrument that guided him to that minute geographic spot. For the quest demanded a special instrument, and not until our day has that special instrument been designed. It is the Bumstead Sun Compass.

The Bumstead Sun Compass is a substitute for the ordinary mariner's compass especially designed for polar work. At the north and south poles of the earth there are two other poles, the magnetic ones. Over one of these, the magnetic needle tends to take a vertical position, so that it possesses no north or south directional power, for in the vicinity of the magnetic poles there is very little directional influence exerted on the needle. If the magnetic poles were obliging enough to be located exactly at the geographical poles, the dipping needle might be of help in locating the latter; but as things are, when a magnetic pole is located, the explorer has to go further to reach the geographical pole, and his compass is useless.

The design of the Bumstead Sun Compass is based on the apparent motion of the sun around the earth. If the



Precisely fitted for the flight toward the pole was the all-metal cantilever monoplane used by the Byrd expedition.

Passengers, fuel and a parachute are provided for in a rocket planned by Professor Robert Oberth, of Germany, a model of which finds place in the UFA film, "The Girl in the Moon." Professor Oberth was awarded a prize by the French government for advancement in aeronautics.



Shall

Liquid Propellant Rocket Will Make Earth-to-Moon Flight Possible, Says Dr. Goddard



With these liquid propellant rockets Dr. Goddard has conducted many experiments at Clark University. A rocket of this type may ultimately reach the moon!

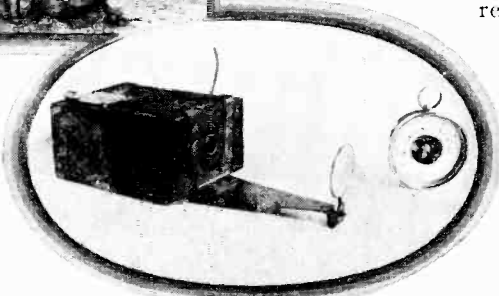
WHAT may be expected of the new rocket-propulsion scheme for aircraft?" If one limits the question to include only those planes already equipped with rockets, or bundles of rockets, the answer is *nothing*. If, however, the question includes the adaptation of my liquid-propelled rocket to airplanes, the answer may well be *everything*.

First, the question arises as to whether or not rockets will supplant the present gasoline and Diesel engines for propelling aircraft. Black powder rockets, such as have been used in the recent rocket flights in Germany, cannot supplant present engines. Even hundreds of tons of such rockets would not be sufficient to send a small craft across the Atlantic. This is quite obvious to all trained engineers and has, I believe, prejudiced them against the whole rocket problem, and possibly retarded the development of the rocket's real contribution to human progress—that of the use of liquid propellants for rapid transportation.

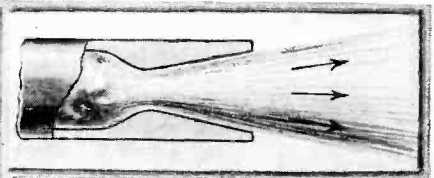
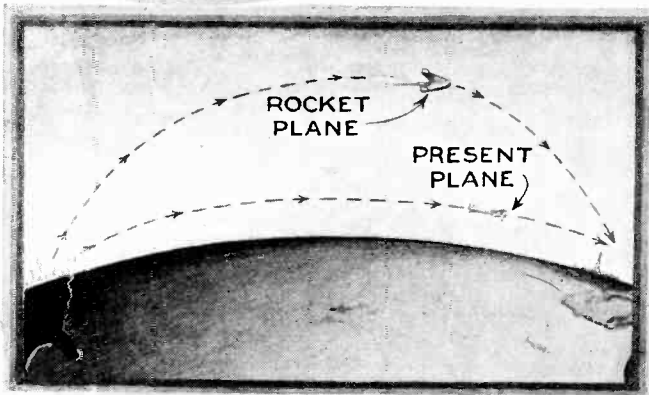
Today, if a rocket were to consist of a large proportion of liquid propellant material of greater heat energy per pound than powder, and this were burned efficiently, that is, if most of the heat energy of the material were converted into energy of motion of the ejected gases, then very great distances could be covered with a rocket of moderate size.

Most engineers do not yet realize that a rocket consisting chiefly of liquid propellant can be very efficient. The rocket usually considered is the black powder

A special camera and barometer were attached to Professor Goddard's rockets to record the actual altitude reached at the limit of their flight. Parachutes enabled them to land without harm to the instruments.



The nature of the rocket plane would enable it to fly at an altitude of slight atmospheric resistance.



Hurled through the air by the reaction of expanding gases, the rocket reaches a flying efficiency far higher than that of today's airplane, and the liquid propellant rocket has proved itself definitely superior to the rocket in which powder forms the fuel.

we Fly by Rocket?

By Prof. Robert H. Goddard



PROFESSOR GODDARD'S extensive experiments with rockets at Clark University have made him known as the foremost authority on the subject in this country. You will find his discussion of liquid propellant rockets especially interesting, for he has made an intensive investigation of this type.

rocket. Very little of the mass of such a rocket is ejected as gas, and this gas has such a high speed relative to the rocket that it takes with it most of the energy of the charge. With a rocket composed largely of liquid propellant, on the other hand, the speed of the rocket itself becomes very high, so that the gases, after ejection, possess a speed that is the difference between the rearward speed of ejection and the forward speed of the rocket, and this resulting speed will be low after the rocket begins to travel rapidly. When this happens, much more of the energy of the charge will go with

the rocket than with the ejected gases.

The possibility of covering very great distances by such a rocket as above mentioned was first shown theoretically in my paper, "A Method of Reaching Extreme Altitudes," in Smithsonian Miscellaneous Collections for 1919, in which calculations were made for various propellants, with the effect of air resistance taken into account.

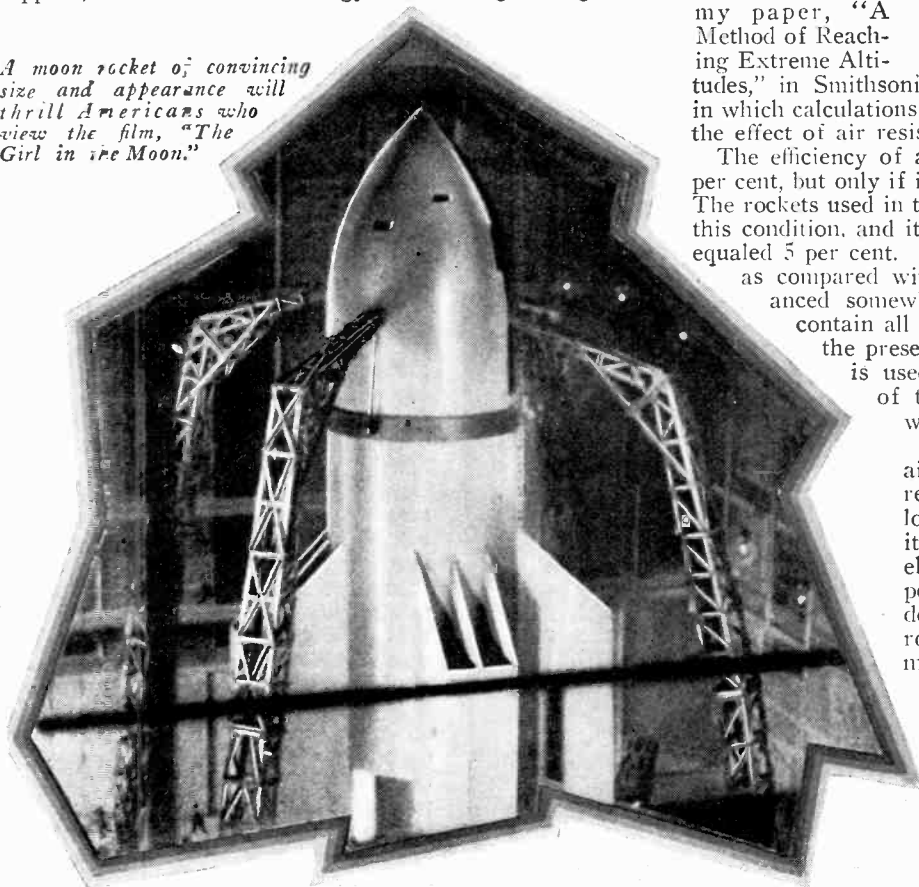
The efficiency of a liquid-propelled rocket can exceed 50 per cent, but only if it consists largely of propellant material. The rockets used in the German rocket planes did not satisfy this condition, and it is very improbable that their efficiency equaled 5 per cent. This high efficiency of the rocket plane as compared with the ordinary airplane is counterbalanced somewhat by the fact that the rocket must contain all of its propellant material, whereas with the present airplane engines a large mass of air is used along with the gasoline, the weight of this air not, of course, being included with the plane.

This utilization of air by the ordinary airplane engine, while an advantage in regard to weight of propellant at rather low elevation, is the very factor making it entirely unsuitable for travel at high elevations. It cannot possibly be a competitor of the rocket above a certain air density. As to the matter of speed, the rocket, and also the rocket plane, has much greater possibilities of high speed than has the ordinary airplane. The slowing of the rocket, or rocket plane, at the end of its course can be accomplished by air resistance and need require no extra fuel.

And now we come to the question which fascinates so many all over the world—How long will it be before a rocket (Continued on page 1033)



A moon rocket of convincing size and appearance will thrill Americans who view the film, "The Girl in the Moon."



"Cold Light"

in

Perfect

Form

Found in Firefly "Species"

WHAT makes the firefly flash? What makes the glow-worm glow? Can the scientist in his laboratory imitate and duplicate the phenomenon of bioluminescence, as the production of light by living organisms is called? For the last few decades a considerable amount of research and investigation has been done to find a satisfactory answer to these questions. Much valuable information has been gleaned as a result, particularly in the chemistry of animal light. The study opens a vast field of possibilities, leading perhaps to the ultimate solution of that tantalizing and as yet unfathomed problem—the artificial production of "cold light."

Strictly speaking, the firefly is not a fly at all; neither is it a worm. It belongs to the beetle group of insects, and is technically designated as the *Lampyridae photinus*. The appellation "glow-worm" is due to the fact that the female of this species is wingless, and bears a striking resemblance to a worm, as does the insect in the larva stage. Not only is the adult, particularly the female, light-producing; even in the egg, larva and pupa stages this organism gives off a pale phosphorescent glow.

Examined under an enlarging glass, the lantern mechanism of the firefly appears on the last three segments of the abdomen. The microscope discloses further that this photogenic organ is made up of a ventral mass of large cells where the luminescence originates, and directly behind it is another layer of small cells which acts as the reflector. Two large tracheal trunks or air tubes pass into the light organ and branch out into every cell. These



The West Indian beetle, "El Cucujo," is so luminous that the natives use it for light and ornament.

THE chemistry by which certain insects produce light within their bodies has been a puzzle to scientists for ages. In this article Dr. Lemkin tells what science has discovered of the process and indicates its possible bearing on the illumination plans of tomorrow.

By

William Lemkin, Ph.D

tubes give an abundant supply of oxygen to the photogenic cells. Paralleling the air tubes is a system of white, thread-like branches which are the nerves controlling luminescence.

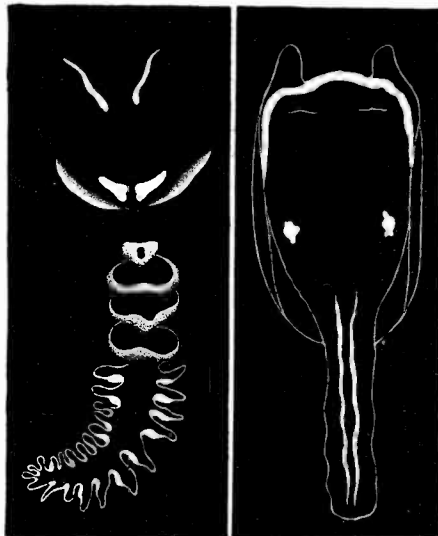
It is obvious that the production of light by the firefly is the result of some oxidation process, regulated by the respiratory organs. The oxidizable material is some substance manufactured in the mass of white cells at the tip of the abdomen. The thick tube carries an "air blast" into these cells and the supply of oxygen intensifies the light. When, through some nervous action, the air flow slackens or suspends, the light grows fainter, or even disappears.

Scientists agree that the luminescent

flashings of all insects and other organisms are intended for signaling and attracting the opposite sex during the mating periods. "There is not a doubt," says Fabre, the famous entomologist, "that the glow-worm himself manages his light-apparatus, extinguishing and rekindling it at will."

The chemical composition of the photogenic material has fascinated and mystified scientists for many years. The readiest suggestion is phosphorus, but no amount of research has revealed the presence of this element in appreciable quantity. Indeed, anything more than the minutest trace of phosphorus would be highly objectionable to living cells because of its extremely poisonous qualities. In spite of the name "phosphorescence" which is frequently applied to the light emitted by the firefly and other luminous animals and plants, we must look elsewhere for an explanation of this strange natural phenomenon.

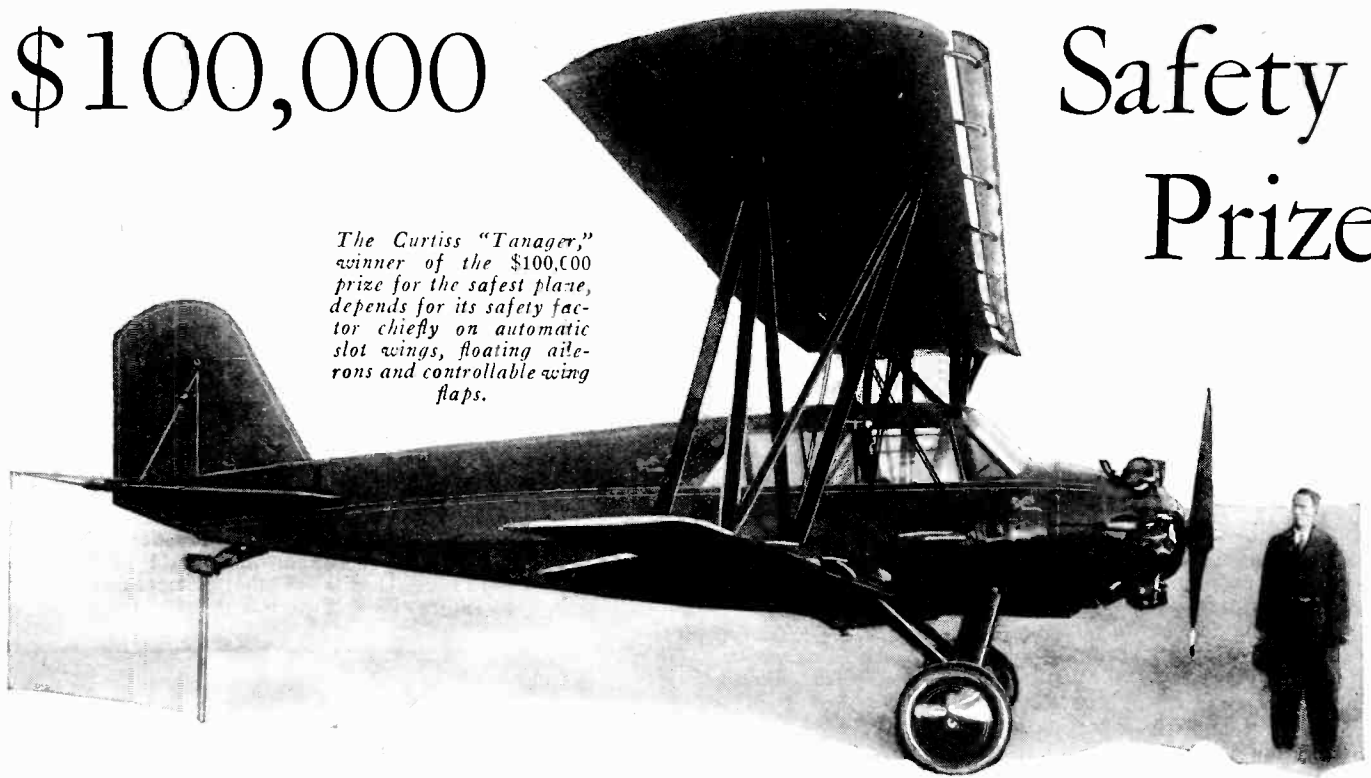
As far back as 1667 the necessity of air in the production of bioluminescence was proved by no less renowned an investigator than Robert Boyle. He placed a bit of phosphorescent wood under the receiver of an air pump and exhausted the air. The light disappeared but returned when he readmitted the air. Another vital chemical fact was discovered by the famous Italian scientist Spallanzini in 1794. He proved that water was almost as important as air in the production of animal luminescence. By drying any light-giving organism he caused the light to disappear. This dried material, kept for a long period, he subsequently moistened, and showed that it again became luminous. Here (Continued on page 1058)



Complete lighting systems distinguish these common luminous insects.

CURTISS *Tanager* WINS \$100,000 Safety Prize

The Curtiss "Tanager," winner of the \$100,000 prize for the safest plane, depends for its safety factor chiefly on automatic slot wings, floating ailerons and controllable wing flaps.



IT'S the safest airplane I ever flew," said Lieutenant Stanley M. Ustead, army test pilot. He had zoomed the Curtiss "Tanager" in an almost vertical climb straight from the ground over the top of a thirty-five foot tower and then landed it with a run of about thirty feet. This remarkable feat ended the competition conducted by the Daniel Guggenheim Fund for the Promotion of Aeronautics in an effort to secure "progress in flying safety." The competition lasted over a period of several months, during which time manufacturers of airplanes both in this country and abroad submitted craft in an effort to win the \$100,000 prize offered for a "safer plane." The Curtiss "Tanager" is particularly prized by its owners, for it not only won the prize for a safer plane but also proved that no radical changes in design were needed to procure a safe plane. The main features of this plane are the automatic slot wings, floating ailerons, and controllable wing flaps. According to Curtiss engineers, these features do not make the plane completely fool-proof but do render it the safest airplane to date.

Two Years Spent in Research

THE Curtiss Tanager is the joint project of Robert R. Osborn and Theodore P. Wright and is the outgrowth of experiments performed in the wind tunnel at the Curtiss Factory in Garden City, Long Island, N. Y. It is the conventional biplane with certain safety devices. Two years of laboratory work were spent in the endeavor to obtain a plane which would make

By Joseph M. Mellen

The Curtiss "Tanager," voted the safest plane, embodies no radical changes in design. Nor is it "fool-proof." The element of human error, however, has been considerably reduced by its advent, and this should result in a real gain for commercial aviation.

commercial flying a safe and sane proposition. The Curtiss engineers believe this condition has been fulfilled, and offer this plane to the flying public in the hope that the factor of human error will be greatly eliminated from air travel.

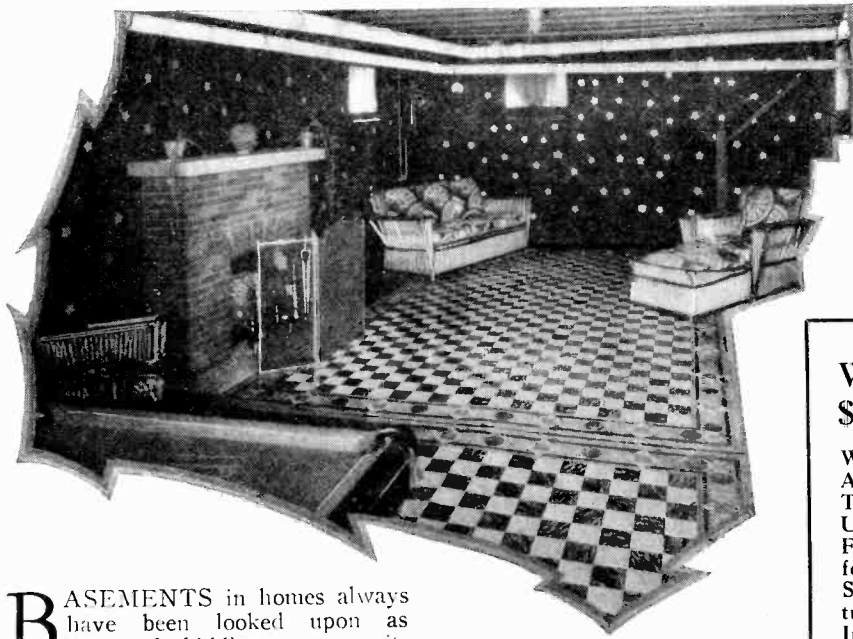
"PROBABLY the most unusual feature of the Tanager is the new Curtiss Aileron, which is floating and non-stalling," says Mr. Osborn. "This aileron is mounted on the tip of the lower wing, where it operates in air undisturbed by the wings, and where its operation does not disturb the lifting characteristics of the wings. In its simplest terms, the upper and lower surfaces of the aileron are identical, so that it has no lift unless presented to the wind at an angle."

"When the aileron control is used in the usual way, these ailerons displace with respect to themselves and not with respect to the airplane, and their action is equal and opposite. As an instance, if the control is moved so that a ten degree angle is made between the two ailerons, one will be up five degrees from the relative wind and the other one down five degrees, and this condition will maintain whether the airplane is stalled or at high speed. The maximum displacement is fifteen degrees from the wind direction."

In other words, the ailerons always operate directly into the wind, no matter what position the plane assumes in the air, using the term "wind" in an aerodynamic sense instead of an atmospheric sense to indicate the rush of air created by the plane as it moves in any direction. For example with the plane moving forward in level flight, the ailerons are level and even with the lower wing. With the wings at an angle to the wind, as in a stalled position, the ailerons still head into the wind, at an angle to the wings.

Slots and Flaps Added Safety Aids

THE entire wing surface of the Tanager is fitted with automatic front slots and controllable rear flaps. The latter have a small slot open at all times just in front of them, which prevents the flaps from stalling and burbling at the high angles necessary for maximum lift. This wing arrangement was developed after two years of research in the Curtiss Wind Tunnel. The tunnel tests (Continued on page 1037)



BASEMENTS in homes always have been looked upon as damp, forbidding areas, suitable only for the accommodation of heating plants, pipe lines, and coal bins. Fortunately this condition is rapidly changing. In many new homes today formerly wasted basement space is providing one or more rooms comparable in comfort and attractiveness with those upstairs. In addition, many owners of existing homes find that simple remodeling of the basement provides their homes with facilities not enjoyed heretofore.

Many recreational activities require space not ordinarily available in the home of moderate size. Ping-pong, shuffle board, pool and billiards are examples. All four can be readily accommodated in the basement. A space where the electric railway may be permanently set up, or where the doll's home may be a permanent attraction, will gladden the hearts of children. For the man of the house the basement provides a place for a private bar and game tables for the entertainment of friends. Here, too, he finds a "room where he may ride his hobbies to his heart's desire.

Whether the basement is to be used for recreation or for some strictly practical purpose, certain elements must be considered in its design and planning.

If the floor is of cement and in sound condition, its transformation may require only a coat or two of good waterproof cement paint in any desired color. Ceramic or quarry tile will provide the floor de luxe. In between these and the painted floor are a number of other attractive treatments, particularly those employing composition tile or other types of finished flooring with an asphalt base. A wood floor laid over sleepers to provide air space beneath. The wood floor may be finished to suit almost any individual taste.

Linoleum, rubber tile, and other floorings which are subject to deterioration from dampness should never be used directly over concrete not absolutely dry.

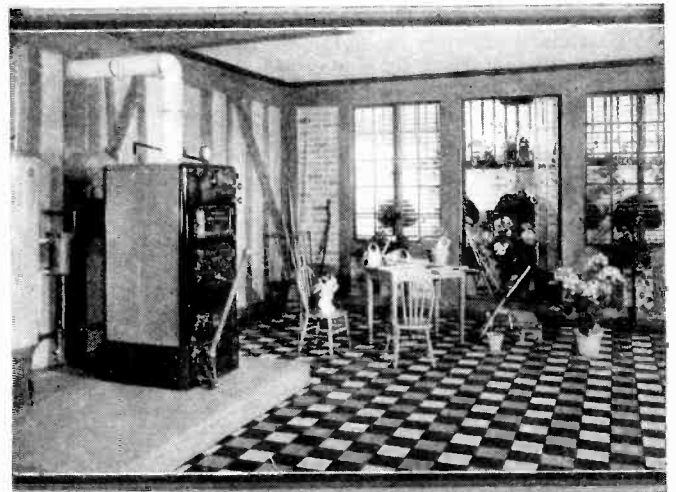
Both walls and floors will require thorough waterproofing treatment if this has not been provided for during construction. If they are subject only to surface dampness resulting from condensation or slow absorption, proper ventilation of the basement will eliminate the trouble. Dampness from these sources identifies itself by its absence in winter when the heating plant is in operation and its presence during the summer when the basement windows are closed. If dampness makes its appearance even while the

Stencilled silver stars on the dark wall provide an effective contrast with the checkered Congoleum rug in this basement billiard and lounge room. (Congoleum-Nairn Co.)



Every man with a hobby will find this trim, bright basement workshop an interesting example of what he can do in his own home. (Hamacher-Schlemmer Co.)

heating plant is in operation, it will be necessary to apply some sort of waterproofing treatment on the interior surfaces to make the basement comfortable and livable.



Once the coal-burning heater was identified with ugliness, drudgery and dirt. Today's coal burner in no way disfigures this charming basement playroom. (American Radiator Co.)

Have a

First of a Series of Six

WIN YOUR SHARE OF \$400.00 IN CASH AWARDS

With the Appearance of This First of Six Articles on Home Improvement by S. Gordon Taylor, We Feel We Are Doing Something Unusually Worthwhile in This Important Field. For We Are Offering Awards Totaling \$400.00 for the Best Plans on Basement Conversion Sent Us by Our Readers. Here Is an Opportunity for Every One of You to Put Your Ingenuity to Work. Work Your Plan Out Carefully. Make Sure It Is Practical. You Have Every Chance in the World to Win. Read Full Details of the Competition on Page 980

Basement Playroom

Interesting Articles on Improving Your Home

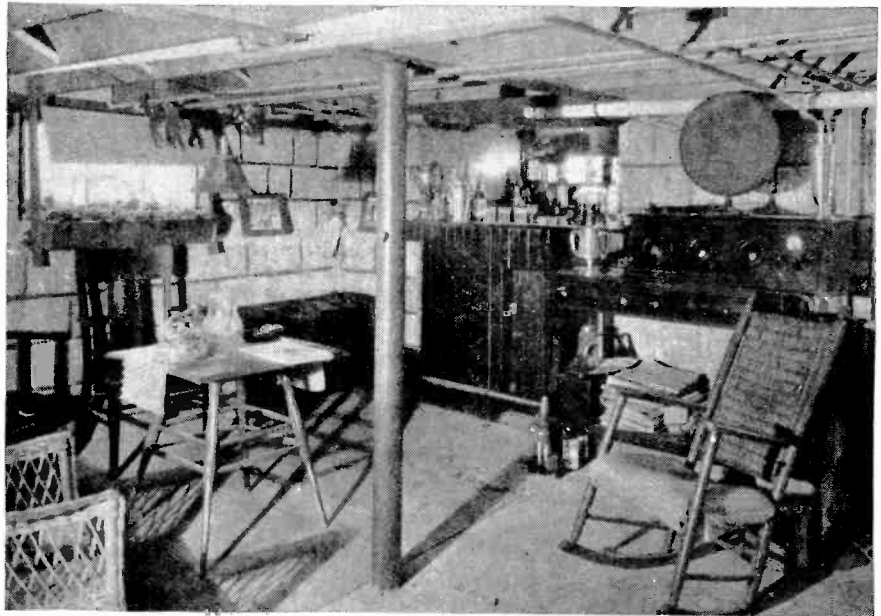
By S. Gordon Taylor

Waterproofing compounds on the market for this purpose are too numerous for discussion here. Complete information, not only on the products themselves but also on the principles of waterproofing, may be obtained from waterproofing manufacturers or from local building supply men.

The treatment of walls, like that of floors, offers almost unlimited possibilities. In fact, it is not imperative that any special treatment be given the walls, although a coat or two of suitable paint will improve the appearance of the bare masonry. Greater attractiveness can be obtained through the use of plaster. Bond plaster or cement plaster may be applied directly to dry masonry walls or added to the waterproofing coat, if waterproofing has been required; lime or gypsum plaster on wood lath is often used, or, better still, metal lath. Walls thus plastered will take any desired finish as easily as will walls of the upstairs rooms.

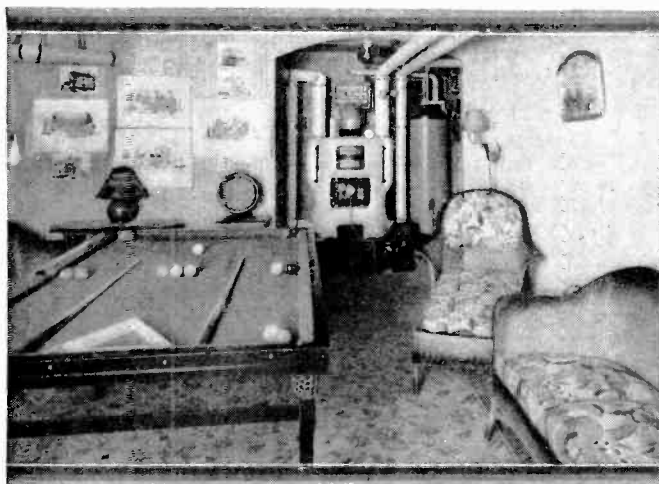
If the heating plant is of the modern type, attractive in appearance and clean in operation, partitions may be quite unnecessary, except where two or more rooms are desired. The simplest practical partition is of wood, or of plaster over wood or metal lath. Partitions of common or face brick are extremely attractive, and, while they are more costly, have the advantage of being also more nearly sound proof. In general, basement partitions may be of any type which is used successfully in upper rooms.

In many basements which are utilized for living purposes no attempt is made to cover overhead timbers or piping. These may be made more attractive by paint which harmonizes with the room scheme. Plaster board provides an inexpensive material, if a finished ceiling is desired. Lath and plaster combined, of course, are extremely suitable for this purpose, because of their greater fire-resisting qualities.



In this joyful basement layout the post-Volstead chemist and the radio fan find themselves equally at home. (American Radiator Co.)

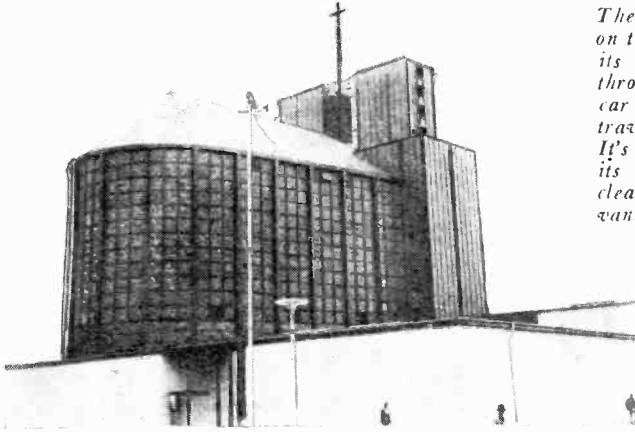
A single wood partition was the only structural feature needed to convert this basement into a tasteful clubroom. (Home Owners' Institute.)



A modern oil burner warms this basement recreation room; cement plaster beautifies the masonry wall; the partition is of wood, the ceiling of plaster board. (Home Owners' Institute.)

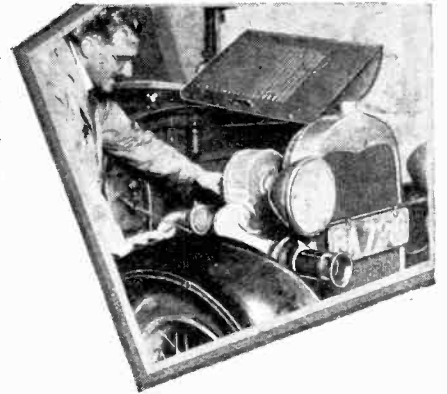
It is essential to comfort that the basement be adequately heated during the winter months. If the utilized space is separated from the heating plant by a partition, it may be necessary to install a radiator or other heating unit. Where a steam vapor or hot water heating plant is used in the house, it is usually possible to install a radiator. Such a radiator must be mounted either on the ceiling or fairly well up on the wall to insure proper drainage to the return line. Where the return line is too close to the ceiling to allow room above it for a radiator, a portable gas, oil, or electric heater will solve the problem. Or a so-called unit heater, consisting of a fin-type metal radiator and fan combined, may be installed in a closet or recess on the ground floor, and the basement heated from this source through a grille in the ceiling.

Closely allied with heating is ventilation. Unless partitions interfere, the small windows found in the ordinary basement are adequate for this purpose. Or if partitions must be installed, it is usually possible to arrange them so that the enclosed section will have windows on two sides to provide the air circulation (Continued on page 1040)

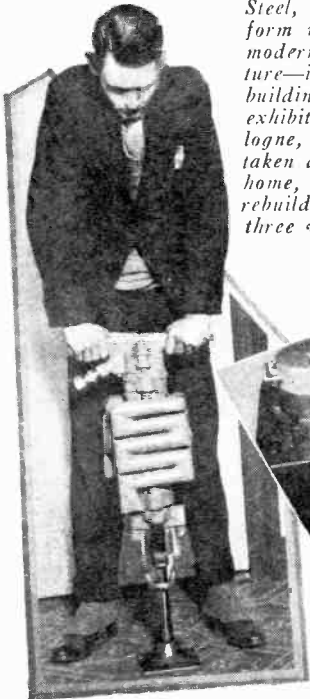


Steel, glass, and clean-cut simplicity of form make this German church a truly modern structure. Another modern feature—it has a mobility remarkable for a building of its size. After serving as an exhibit at the World Press Show in Cologne, it was bought by the city of Essen, taken down, shipped to its new home, and reassembled. The rebuilding process takes only three weeks.

The instrument being fondled on the right is a "Foggon," and its purpose is to bore tunnels through fogs, so that the motor car on which it is mounted can travel on a clear right-of-way. It's an English invention and its makers say it will bore a clear hole several feet in advance of a car through even an English fog.



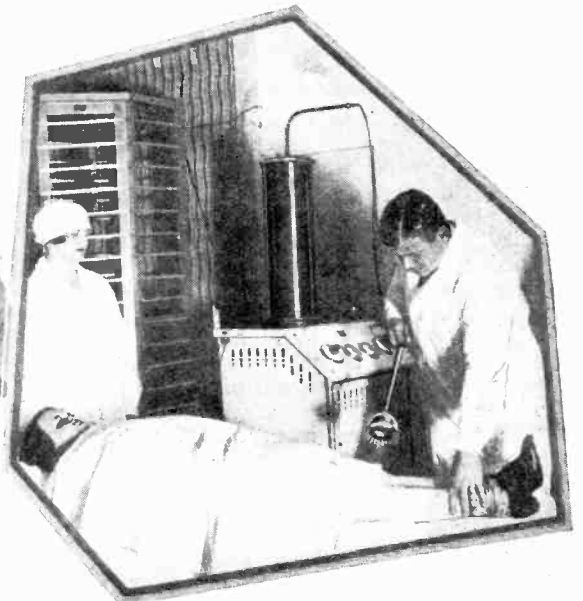
In the Spotlight



Enjoy this view of the British "Hushbuster," claimed by the inventors to be a silent pneumatic road drill.



"Echophon" is the name given by Dr. Kurt Stille to his telephonic recorder, which preserves for possible reference the words spoken during a conversation over the wire. A report pronounces it "invaluable to business men," and perhaps it is, seeing that any conversational record can be effaced in a minute.



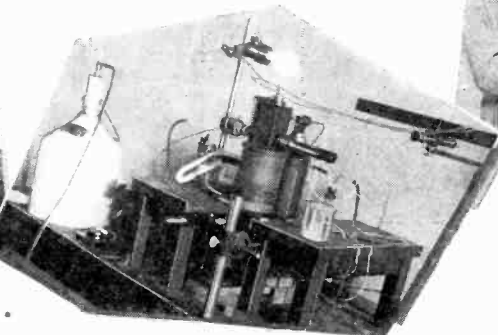
High-frequency current at 750,000 volts, Roentgen rays, and a helium lamp charged with radium are features of this machine used by Valentin Zeileis, Austrian "miracle" doctor. Heavy guns, to be sure—but heavier yet are the claims that it will cure cancer, dumbness, blindness, and lameness; and that is what its friends say it will do.

This chair, equipped with jolting and slaking apparatus, was exhibited at a chiropractic convention.

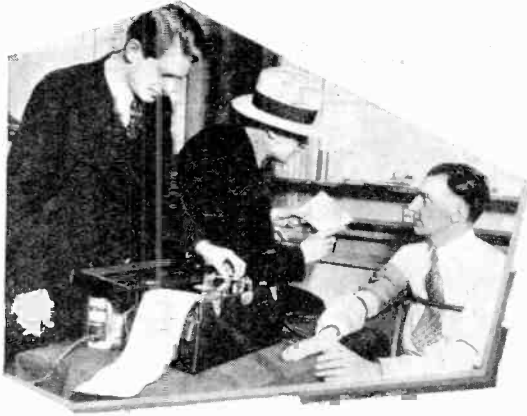


When it rains in Berlin, you step aside to an automatic machine and treat yourself to fifteen cents worth of umbrella. And if we do say it, it's a lot for the money. The covering is of oily paper, the handle of wood.

Experiments at the University of California came to a climax when snow crystals were produced artificially for the first time in the apparatus shown below.



A box lined with reflecting metal and containing a large electric bulb makes it possible to compare forged handwriting with the handwriting of forgery suspects. Naturally it is called the "comparograph."

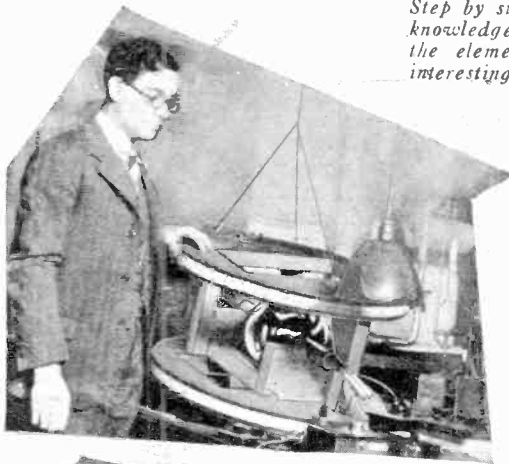


A pneumo-cardio-sphygmomanometer functioned in the rôle of "lie detector" when Seattle officials questioned De Castro Earl Mayer regarding his alleged part in the murder of James Bassett, missing since 1928.



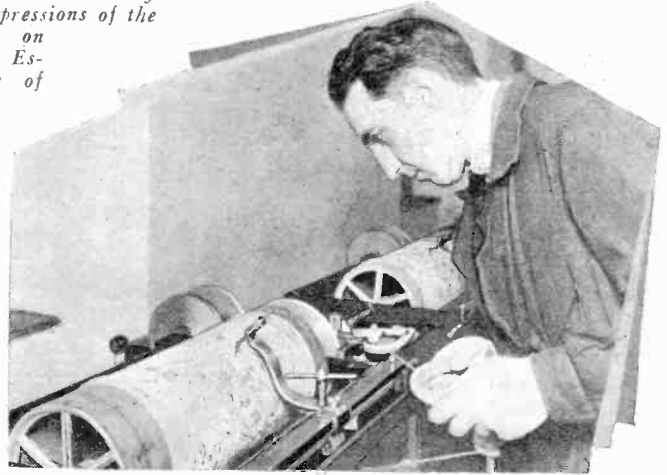
M. Santos Dumont, French aeronautic pioneer, is having fun with his inventive talent these days. His latest antic is a mechanical female figure which automatically goes through the motions of skiing. The cycle of motions involved is so perfectly carried out by this sport-style robot that she is said to serve as an inspiration for novices. In the old days, the genius of M. Dumont was directed to the development of aircraft. Long ago he circled the Eiffel Tower in a blimp of his own design.

of Science



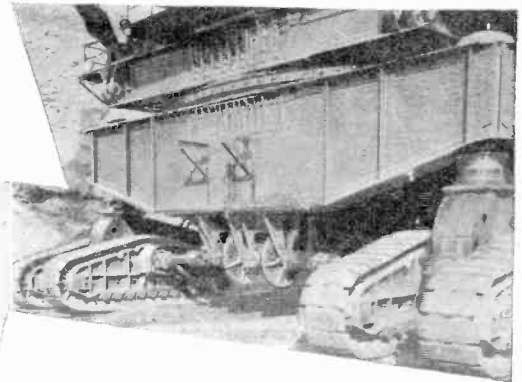
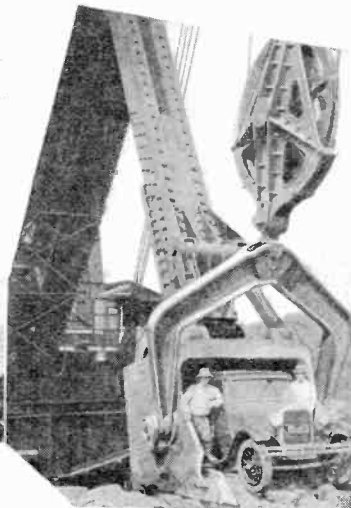
Step by step man draws nearer to complete knowledge of the mechanism of the atom and the elements that compose it. Extremely interesting and definitely pertinent to the quest for knowledge of the electron is the achievement of Dr. P. H. Carr, graduate student at Cornell University. After much experimental work, Dr. Carr has succeeded in making photographic impressions of the electron stream on metal surfaces. Especially worthy of note is the fact that the developing process can proceed while the reproductions are made.

Street maps revolving on drums play an important part in tests for prospective motor car operators in Vienna. Manipulating a steering wheel, the candidate must steer his way through the streets, as represented on the map, while a pencil controlled by the wheel records his success or failure.



The progress of Behavioristic theory has brought with it a multiplicity of experiments in psychology with non-human subjects. At Columbia, Professor C. J. Warden has been working intensively on the intelligence of cats. Grids electrically charged were used to repel the animals from certain paths, while a bowl of milk lured them on to find the right one.

Her name is Marion—that shovel you see below—and she is of the 5600 type. The cameraman caught her stripping the overburden from coal at the Fidelity Mine of the United Electric Coal Companies, Du Quoin, Ill.



When Marion, type 5600, moves—she moves, and that's all there is to it. The reason can be seen readily in the view of her caterpillar feet above. Ponderous as she is, she works on electricity—and thrives on it.

Fifteen cubic yards—that's the capacity of Marion's dipper per bite. To her a Model A Ford is simply a passable dipperful. Let's hope that this Ford moves before she does.

Ship and Shore Linked by Phone and Radio

Phone lines and carrier waves now extend the long line of communication to vessels at sea.

By George R. Brown

IT was a day in late winter. The scene was the imposing offices of the American Telephone and Telegraph Co. in New York City. A group of prosperous business men sat around a long mahogany table. In front of each was a telephone. They chatted and exchanged greetings. We tried to make ourself comfortable against the corner of a bookcase, but finding this impossible, we decided to accept our lot with resignation and be uncomfortable.

Suddenly the room grew quiet. A man of good appearance and business-like demeanor had entered and sat down at the head of the table. He began to make some remarks, so we decided to go to sleep. Suddenly we were galvanized into action—no, not galvanized; we were *rocketed* into action, for we saw him lift the receiver of the phone and heard him say, "Get me Commodore Hartley on board the *Leviathan*, please."

A minute later he continued, "Commodore Cunningham, I am glad to open this service with you, the Senior Ranking Officer of the American Merchant Marine, and to the *Leviathan*, the largest American ship afloat. Transportation and communication have been linked together since the beginning of history and we are glad to continue that old relation by extending the long lines of the Bell System aboard ship so that anyone on the *Leviathan* can talk to anyone ashore."

And a moment later we heard a voice which, from its accent, might have come from the sidewalks of New York instead of from the decks of the *Queen of the Seas*.

"Mr. Gifford, the *Leviathan* is indeed fortunate in being

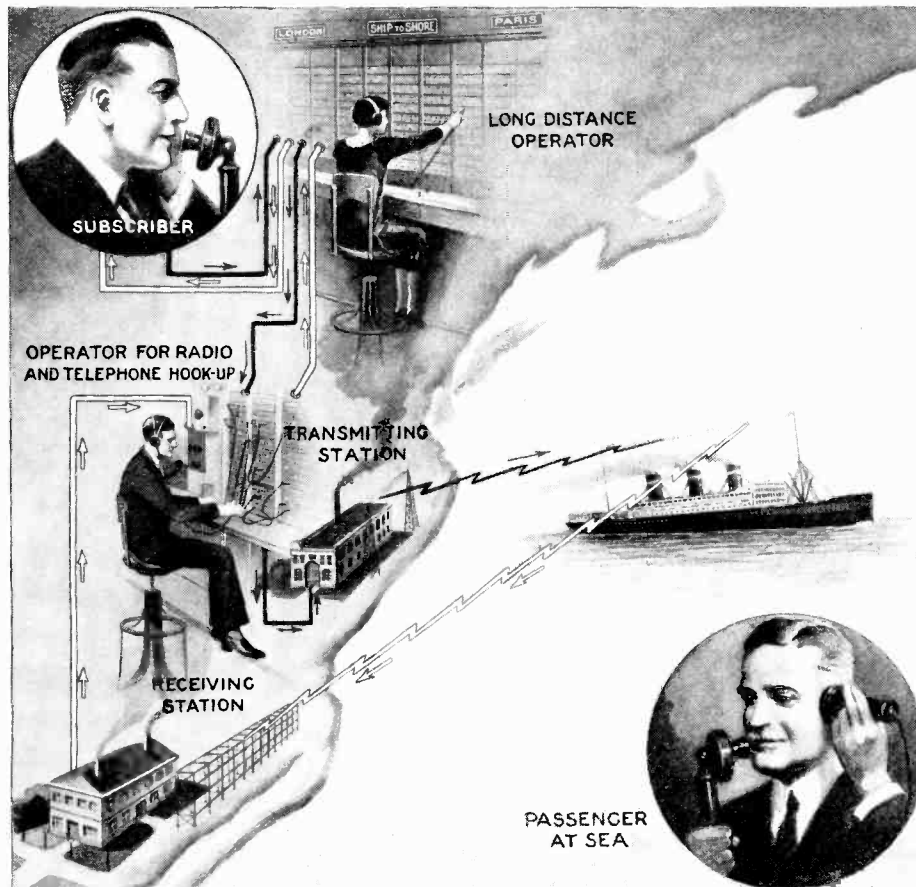
the first vessel to have the commercial wireless telephone for commercial use. Up to now, our passengers have enjoyed every comfort, convenience and luxury that the finest hotels in the world can provide, and now they can demand nothing more than when they can pick up a telephone receiver aboard

this great American flagship and talk to their relatives back home. Permit me to congratulate you and your staff for this very splendid achievement."

Thus a commercial venture was inaugurated which began as an experiment by the Naval Department back as far as 1916. This experimental work was carried on as part of the communications preparedness work, and was later continued after the war from 1919 to 1922. The trials did not establish the commercial venture because the conditions of commercial shipping did not warrant inaugurating this telephone service. The great increase in steamship travel and the use by the public of long distance telephone

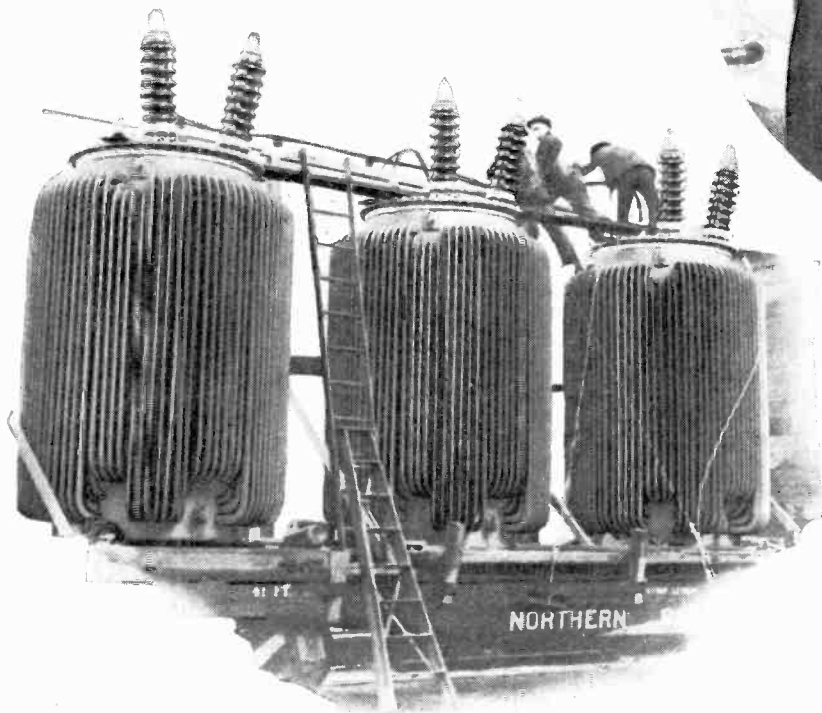
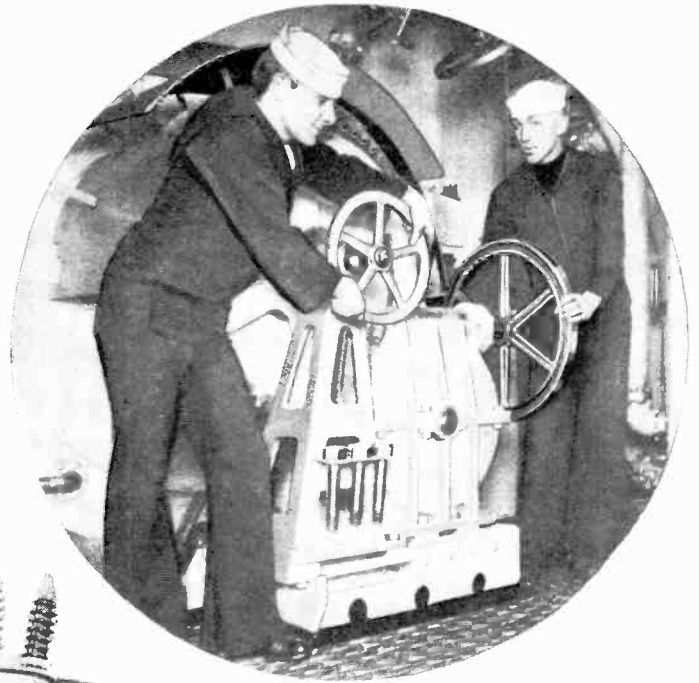
facilities, suggested the feasibility of a ship-to-shore telephone service. In addition, the contributions of radio engineers had placed this idea on such a practicable basis that it was a comparatively simple undertaking to proceed with this plan.

To complete this venture a transmitting station, located at Deal Beach, N. J., operating on a wave-length of 34.8 meters, and a receiving station located at Forked Rivers, N. J., were erected. Their radio circuits were connected to the telephone circuits leading to the long distance headquarters in New York City. (Continued on page 1037)



*In America a telephone subscriber picks up his phone and asks for the *Leviathan*. He is connected with the long-distance operator, who, in turn, connects him with the technical operator. The technical operator arranges the radio hook-up to the ship, through the transmitting station. The reverse procedure takes place in calling from the ship.*

SEAGOING POWER HOUSE Saves TACOMA



Gobs turned the wheels. Jets of steam rushed through the blades of a giant turbine aboard the aircraft carrier Lexington. The electric current supply of the city of Tacoma went up to normal again. So large are the power resources of the Lexington that a single unit of its generating equipment served to supplement the lessened power of Tacoma's municipal plants.

Three massive transformers stepped up the voltage of the Lexington's generators from 4,400 to 50,000 volts, the pressure required by the city's power equipment. Tacoma's estimated monthly power bill to Uncle Sam's navy will reach \$66,000, and there will be a standing charge of \$45,000 per month for the ship.



Crowds gathered at Baker Dock, Tacoma, Wash., for the moment when for the first time in history a ship began to serve a city with electrical power. Despite the extraordinary nature of Tacoma's supplementary power source, the charge per kilowatt hour was kept by the navy at the municipal level.

Radio Speaks

*We Announce a New and Compact Set that
Clock, or Desk. No Expensive*



The radio set now finds its way into many convenient corners of the modern home. With a simple remote control drive this new receiver may be placed in an end table or buffet.

By Volney D. Hurd

IS your home cramped for space? Have you an unsightly radio cabinet in your living-room? Have you ever seen a radio receiver—the tonal quality of which you liked but the price of which you did not like because of an expensive cabinet? Have you a bookcase which has some extra space, a desk which is not entirely used, a grandfather's clock with a hollow base, a buffet with an empty drawer? If you have—and you certainly must have one of these articles of furniture around your home—you will delight in this new radio set, product of the National Company. It is small, compact and modestly priced. It measures exactly ten inches by twelve inches in size. It has good tonal quality, good sensitivity and selectivity. It is completely electrified and may be slipped into a bookcase, desk, grandfather's clock or buffet. No expensive cabinet to buy; no clashing with your present scheme of furniture style or arrangement; no mysterious collection of wires or batteries—merely a compact unit to be slipped into a piece of furniture.

You would not like to have to buy a certain piano when you bought a house. You would want to put in the instrument you preferred. Neither would you want to have to buy a certain house to get possession of the piano it contained. Yet that is really what the purchaser is doing in radio today.

Take, for instance, some well-advertised receiver. You read about it and become convinced that you would like to

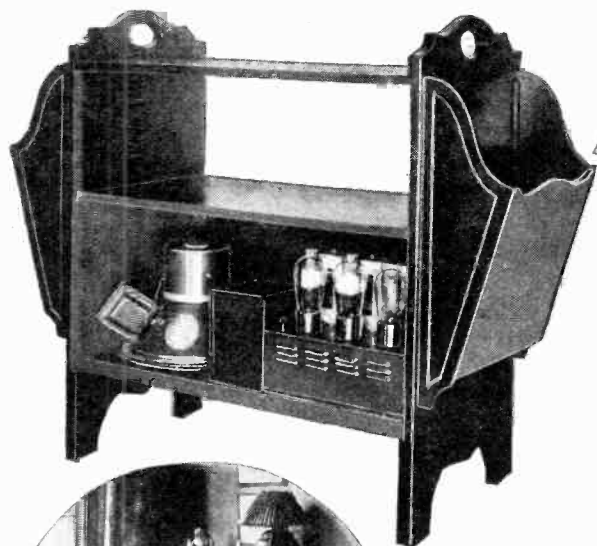
hear it. You go, and after listening to it perform, you realize that it has just the tone quality that you like. Then you try and visualize it in your home and start asking to see the different cabinets.

You find that the line is limited to two or three and, worst of all, that there is a considerable price difference in these various models. You see a lowboy for, say \$135. Then you ask for another model. A highboy is shown which sells for \$165. You find that the speaker and chassis are identical. Then you see you are paying \$30 extra for a little more woodwork. That \$30 is probably the difference between your having a set and not having one. It is the price of a set of tubes for the new job. If you are still fond enough of the tone, you compromise and take the cheaper model, but always wish it had a cabinet that fitted in more with your interior decorations.

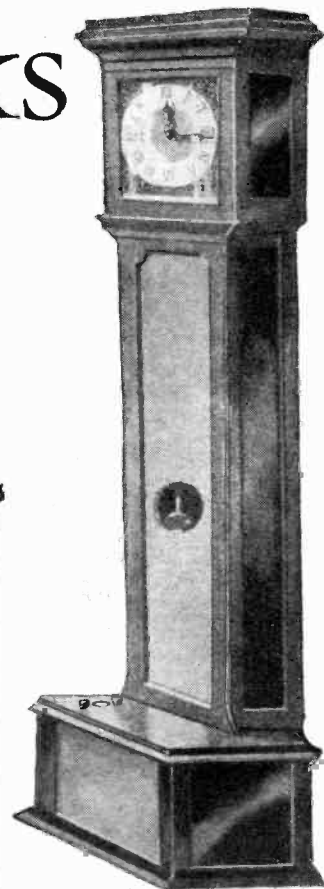
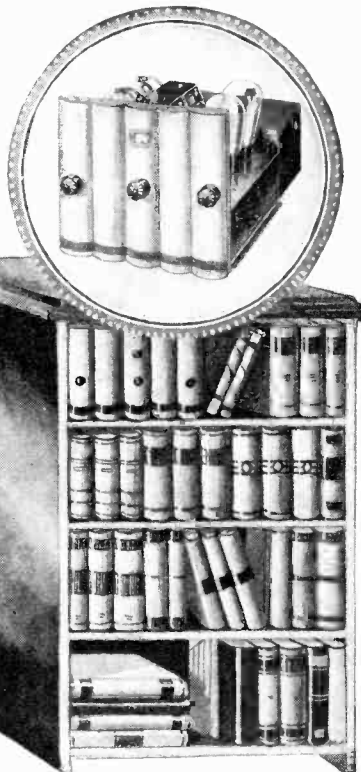
If you could get a small, compact chassis designed to give you good sensitivity and selectivity and particularly the best in tone quality at a good low figure, you could buy a good dynamic speaker chassis and then put these two in a cabinet of your choosing and have the very best in radio reception at

from Clocks and Books

May Be Concealed in Your Bookcase, Cabinet to Buy!



A panel fashioned as book-fronts will make this set an integral part of your book-case. In the bottom of the end-table or a drawer in the desk it may also be effectively concealed.



The capacious depths of the base of a grandfather's clock provide another hiding place for this unique radio.

a price within the range of the average radio purchaser.

If you had a small apartment, you could get a miniature console that would take this compact chassis and a dynamic speaker. This would be in keeping with the room in which it was placed and still you'd be getting superb reproduction.

Perhaps you have a living-room that demands a certain type of cabinet to fit in harmoniously with its appointments. You go into the market and pick out a cabinet to your liking, slip the chassis into place, put the speaker in and screw it into place, and there is the set for your home, all you wanted not only in tone but also appearance. And now you can obtain such a chassis. It is the National NJ 30. It is compact; it is small; it is inexpensive.

Naturally the first question which arises is, "How can you get quality in such a small set?" The answer is, "Intelligent design."

The shield grid tubes permit of considerable amplification per stage. Two stages are equal to three or four of the old type of circuit. Thus we find the set has two stages of shielded grid radio frequency. The antenna system is tuned so as to get maximum amplification and selectivity. This gives us three tuned circuits.

Sufficient amplification is obtained with this arrangement to permit of power detection. Coming to the audio end, we find for the first time in a commercial offering, as far as we know, the screen-grid tube as an audio amplifier. Here is where the quality obtained so far is insured against the invasion of distortion.

Whatever may be said about the various forms of audio amplification, it is generally accepted that resistance coupled

audio is the finest possible to obtain, so much so that it is used exclusively in television sets which must have perfect audio characteristics. Using the shield grid tube as an audio amplifier, this form of audio amplification may be utilized to the full. This new tube will give as much amplification per stage in this arrangement as the ordinary tube with a step-up ratio audio transformer and still retain the total purity of resistance coupling.

Thus we have a single stage of resistance coupled audio using a shield grid tube following the detector. This in turn feeds into a 245 power tube for the last stage of audio. This tube will give as much undistorted output as a 210 or a pair of 171's in push-pull, which is more than the average house can stand.

It may now be seen that the finest tone quality is obtained and yet no bulky transformers are needed. The chassis consists of a small panel on which are located the off and on switch, a tuning knob, and a volume control knob. Behind this is a raised metal platform on which are mounted three variable condensers in a row, running back from the panel. On the left of this condenser gang are the two r.f. and detector tubes. On the right are the first audio, power, and rectifying tubes. This gives six tubes in all, making the first cost of tubes relatively low.

Under this platform are three shielded r.f. transformers and the various other coupling units. On the rear of this platform is attached the power supply, which is very efficient although small, and gives a good humless supply of current.

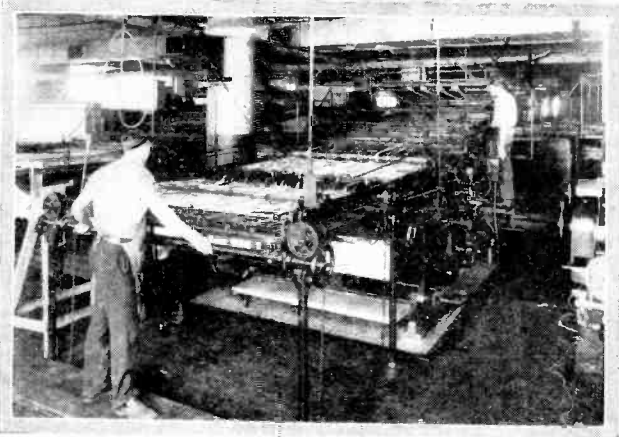
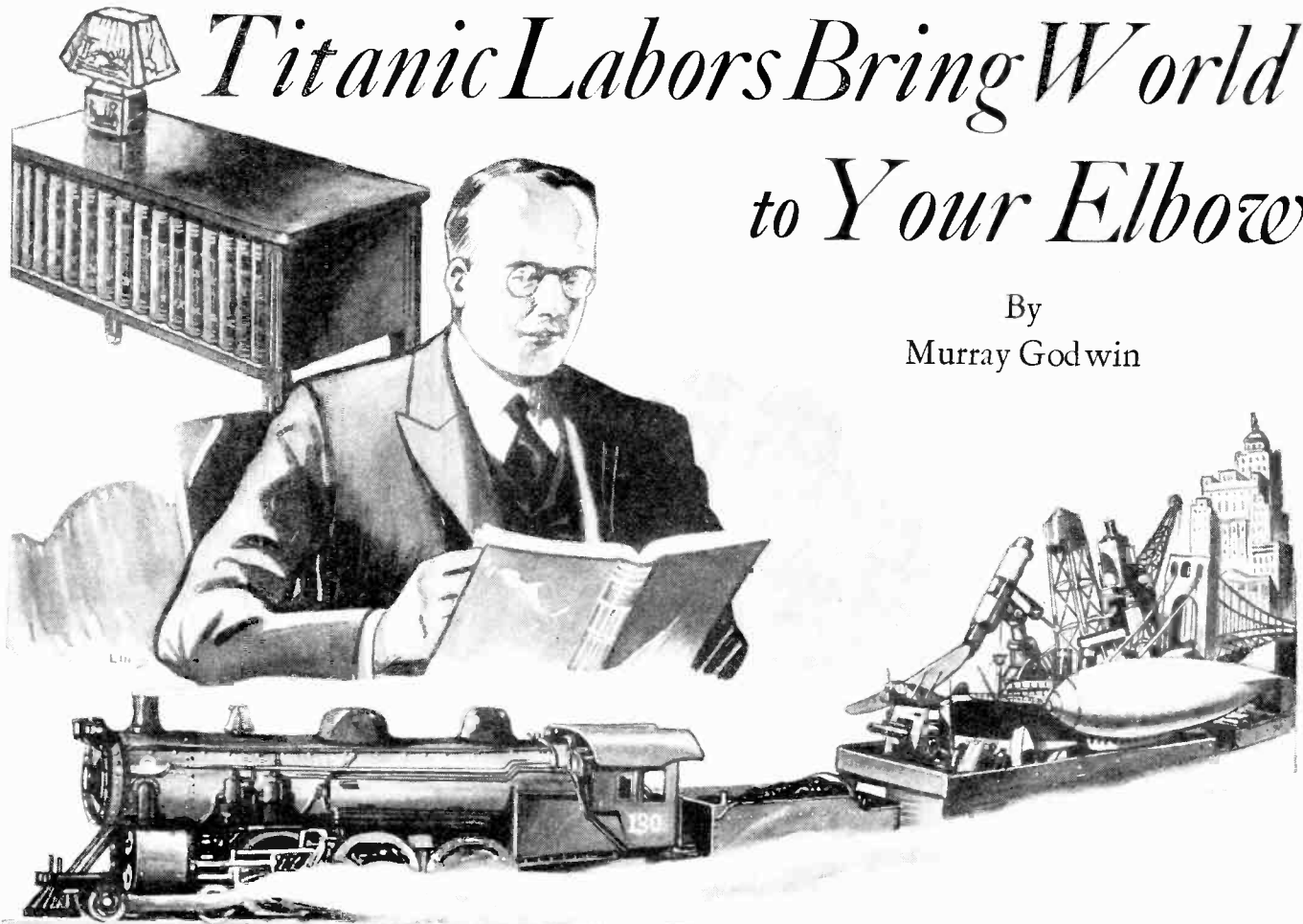
With this chassis we need only a good speaker and we have a radio receiver with the best in tone quality. Now we get back to our question of cabinet design. This little chassis will fit in the smallest of cabinets and look equally as impressive in a big cabinet.

Coming to disguised radio sets, we find we have a unit which lends itself admirably to concealment. It can be fitted up so that the front panel appears like the ends of a few books tucked into your bookcase, and your radio is not taking up valuable room space.

An end table which comes up (*Continued on page 1034*)

Titanic Labors Bring World to Your Elbow

By
Murray Godwin



On finely registering presses of the most modern type, the millions of pages composing the first printing of the fourteenth edition were impressed with their universal story.

THE world as the world's best minds know it, concentrated, classified, cased, and placed at your elbow for ready reference. . . . That is the goal at which the editors of the Encyclopedia Britannica have aimed in the fourteenth edition of this universally known work. And it must be said that never before has a goal comparable been so effectively achieved.

Would you like to learn the ins and outs of quantity production? In the new Britannica, Henry Ford tells you about them in detail and at length. Does space-time puzzle you? The Britannica offers you a pointed survey of this modern dimension by Einstein himself, and supplements it with a consideration of the philosophical phases of the relativist theory, by Bertrand Russell. Do you know your electron? In the fourteenth edition, Milikan reveals to you its nature and habits.

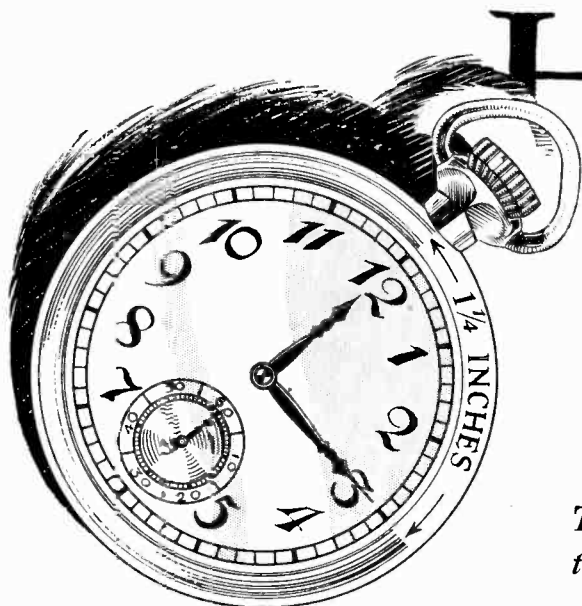
And these examples are typical of the treatment accorded the thousand-sided contents of this fascinating work.

TO produce 62,500 sets of the new Encyclopedia Britannica—the fourteenth edition—were required 225 carloads of paper—enough to form a freight train 2 1/10 miles long—and 9,000 gallons of ink. Twenty thousand goatskins were used to bind the sets. Type metal equal in weight to a locomotive and tender was employed in the printing process. Placed end to end, the pages would encircle the earth and reach the moon. But far greater in importance to us were the editing labors involved in this greatest concentration of knowledge the world has known. For practical reference or for the satisfaction of knowing, here is a marvelously rich, modern and orderly compendium of what the world's most intelligent minds know about life, nature, things, and man.

Voronoff tells you what he knows of rejuvenation. The atom is displayed to you by Niels Bohr. Andrew Mellon expertly exposes the inwards of government finance. James J. Davis discusses labor law. Sport is covered by Gene Tunney, Grantland Rice, and other high-calibered observers. Milton C. Work describes the mechanics of bridge. The technique of mask design is explained by W. T. Benda, famous in this field.

In all, 3,500 men and women of intelligence, talent, and repute have contributed their knowledge of as many subjects and phases of subjects to the greatest editorial achievement. Nor in any instance have they merely skimmed the surface of their knowledge. The new Britannica's survey is essentially complete. Within its covers you will find more than 700 articles on the architectural field alone! Investment, science, aviation, child care, painting, manufacture, travel, home craftsmanship, and a multitude of other subjects are exhaustively explained. And you will find each explanation given point by illustrations which are a delight to the mind and eye, carefully selected, finely reproduced. There are 15,000 pictures in all and 1,500 of these are full-page plates, many of them in full color. Particularly worthy of note are the color plates. They have been produced with a richness and accuracy that make the new encyclopedia not only a book of knowledge but a work of art.

The cost of producing the new Britannica was more than \$2,000,000, and the task was completed in two years.



On the face of a watch, 15 minutes represents a distance of 1 1/4 inches.

HOW MANY MINUTES Make a Mile?

The Relativist and His Friends Join Issue Again Over the Mingled Identities of Time, Space and Motion

By Donald H. Menzel

Lick Observatory, Mt. Hamilton, Calif.

RELATIVIST—In our discussions about the universe, we agreed that it is meaningless to speak of the curvature of empty space. For the expression to have any significance, we must introduce some sort of test-rod to detect the curvature—and then space ceases to be empty. Curved space is an abstract conception; curved measuring rods are tangible and concrete.

In our last discussion we temporarily laid aside a very important fact. The universe is four—not three—dimensional. This brings us to the question of time, and its part in relativistic geometry.

Layman—Just a minute. I don't see how time can have a part in any sort of geometry.

R.—There is not a tremendous difference between geometries of two and three dimensions. The line that bounds one side of a triangle may go to form an edge of a cube. On the other hand, if we are going to consider time as a fourth dimension, there arise, as you say, some fundamental difficulties. How can we build triangles out of time?

Let us try. A man walks one mile north and two miles east. We can draw a diagram of this say on the scale of one inch to the mile.

Now take this problem: A man walks a mile in fifteen minutes. The mile-part again can be diagrammed. But how are we to put the fifteen minutes into the picture?

Physicist—That is easy. Draw it on the scale of one inch to fifteen minutes.

Relativist—The problem

isn't as simple as that. We could draw the first picture without trouble, both because miles and inches are measures of space. But you will not find it so easy to divide time into inches.

L.—I know a common instance where time and space are regarded as interchangeable. You frequently hear such an expression as "I live thirty minutes from Times Square," when in reality the speaker refers to the distance he must travel to reach a certain point.

R.—You are on the right track. And here is the crux of the matter. In past discussions we found it necessary to distinguish between time itself and intervals of time. We are conscious of a sequence of events which our minds recognize as being accompanied by the passage of time. This vague sort of time is of little importance to Physics, where clear definitions are necessary. You know, yourself, that the fundamental nature of time is of no consequence to you. Your chief interest is in clocks, in measures of time.

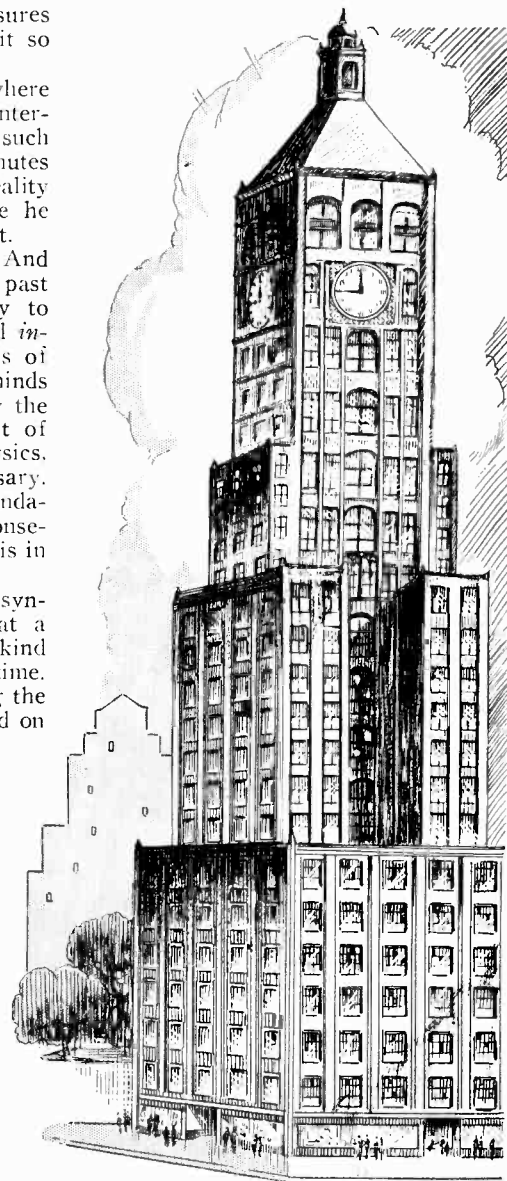
Time and motion are practically synonymous. I have said before that a world without movement of any kind would also be a world without time. There are many ways of measuring the passage of time, but all are founded on the same idea—motion of something or other—water flowing through an orifice, falling sand, the earth's rotation, revolving clock-hands, and so forth.

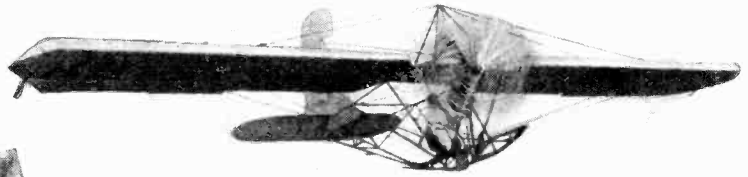
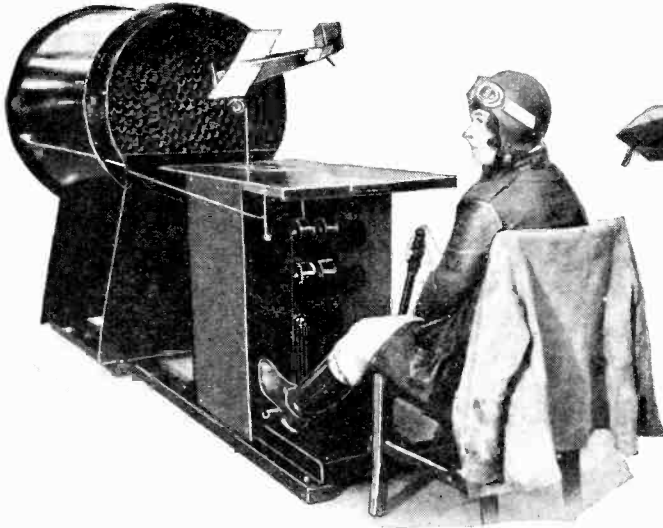
This gives us a chance to complete our picture; we see that intervals of time may be represented as intervals of space. On the face of my watch, for example, fifteen minutes are approximately an

(Continued on page 1048)



A tower clock read at the distance of a mile gives you the time 1/186,000 second later than it actually is.





A POWER glider that will take off in one-fifth the time and distance required by an airplane and that will glide to a safe landing at 15 miles per hour was recently demonstrated at Seal Beach, California. It is powered with a 40-horsepower motor.

What's New

Learn to Fly With Midget Plane

STUDENT pilots find that controlling a miniature ship by means of the usual stick gives them all of the necessary movements that they will eventually have to execute when they pull their first big ship off the ground. The control is mounted on a base and by means of appropriate cables communicates with a miniature airplane model held directly in the path of wind produced by a small wind tunnel. All sorts of maneuvers can be executed.



Boat Carried Like Parachute

A COLLAPSIBLE rubber life boat that is strapped to the flier's back in the same manner as a parachute was recently demonstrated at the National Safety Council's Annual Conference at Chicago. Should the plane be forced down in water, the boat is unfolded and inflated. It will hold four men.



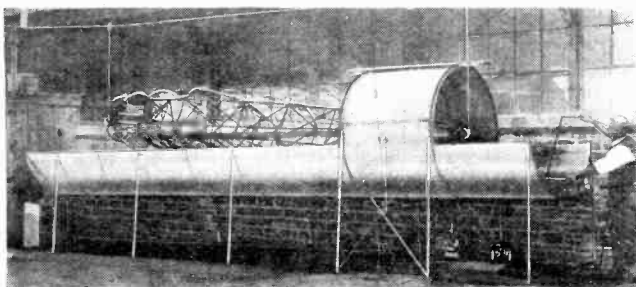
Reversible Propeller Becomes Brake

A REVERSIBLE propeller has recently been designed which for the first time gives a brake and a reverse to airplanes. A chain drive changes the pitch of the propeller. When passengers enter the plane the pitch is so decreased or even reversed that no dust or wind is produced. When ready to take off, the pitch can be increased to maximum giving a much faster take-off, a faster climb, and faster cruising speed. By reversing the pitch of the propeller when landing, the landing area can be greatly decreased. Mr. A. K. McLeod is demonstrating the propeller to Miss Vera Dawn Walker at Los Angeles, California.



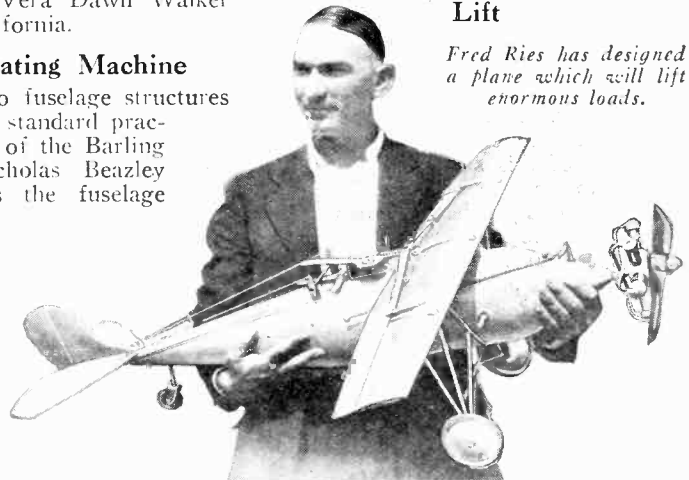
Fuselage Treating Machine

APLYING oil to fuselage structures of all of planes is a standard practice in the building of the Barling planes in the Nicholas Beazley plant. This treats the fuselage against corrosion. Oil is supplied from perforated tubes inside the cylindrical-shaped booth.

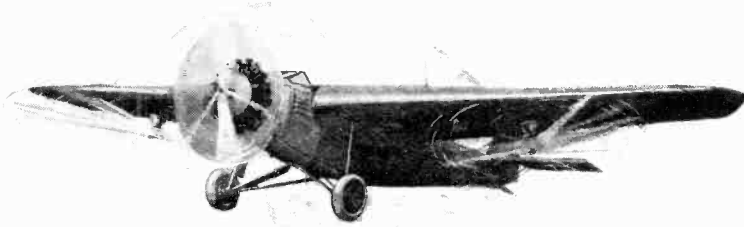


Sliding Wing on Plane Changes Lift

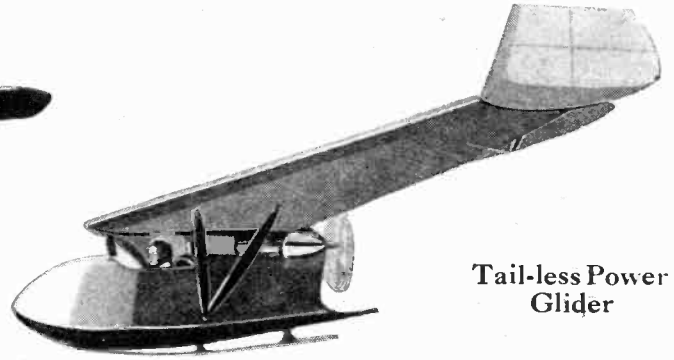
Fred Ries has designed a plane which will lift enormous loads.



IF a practical plane could be built which would change its wing surface, increasing it for both the take-off and the landing, and decreasing it when in the air, the speed of the plane could be greatly enhanced. With these facts at his command, Fred Ries, of Compton, California, has been granted a patent on a sliding wing device for airplanes which will do just this.



PROPELLERS under each wing of a large metal monoplane helped to get this ship into the air with a run of but 75 feet. The inventors, Messrs. Allison and Johnston, of West Palm Beach, Florida, gave the demonstration at Milwaukee, Wis.



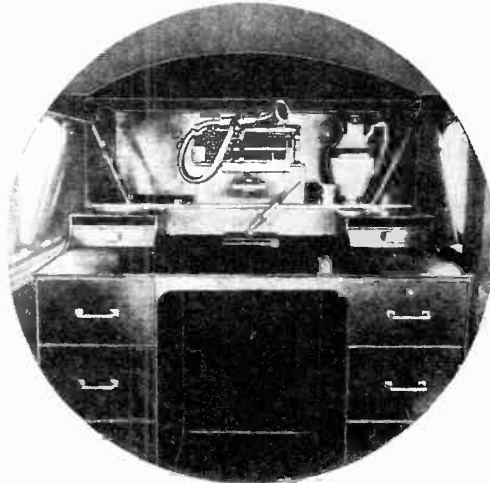
Tail-less Power Glider

ALL Germany watches with deep interest the flights now being made by the power-driven tail-less glider. This glider has an 8 horsepower motor which is very compact, and is placed behind the pilot's seat. The rear fuselage has been almost completely eliminated and the wings present a V shaped form when viewed from the top. The rudders are placed at the tip of each wing, and the elevators are the trailing ends of the V shaped wing structures. The glider has no wheels, but is provided with a runner. It is launched by the usual elastic band method.

in the Air

Limousine Comfort in Plane

THE sister ship to the "Spirit of St. Louis" typifies the trend toward comfort in the new Ryan Brougham. It is equipped with a 300 horsepower Wright Whirlwind and has a cruising speed of 120 miles per hour.

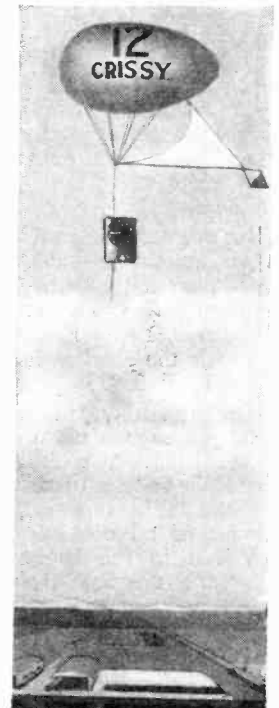


Flying Office

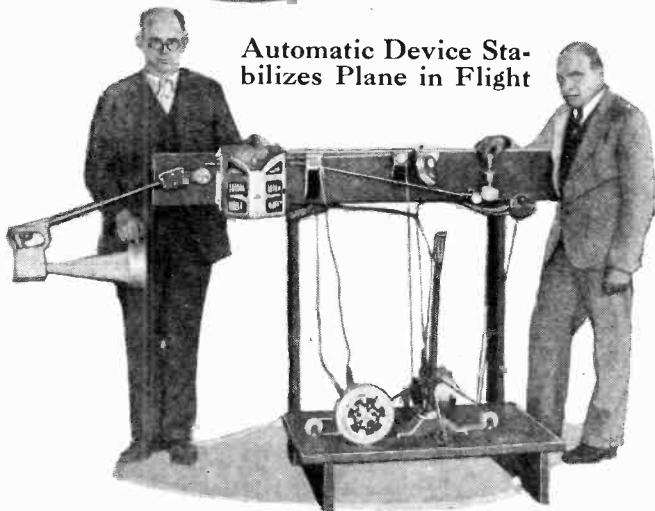
BECAUSE of the demand for an office-equipped airplane for business and professional men, the Ryan Aircraft Corporation has designed a model equipped with office desk, dictaphone, filing cases and other office conveniences.

Glide Planes to Fogless Fields

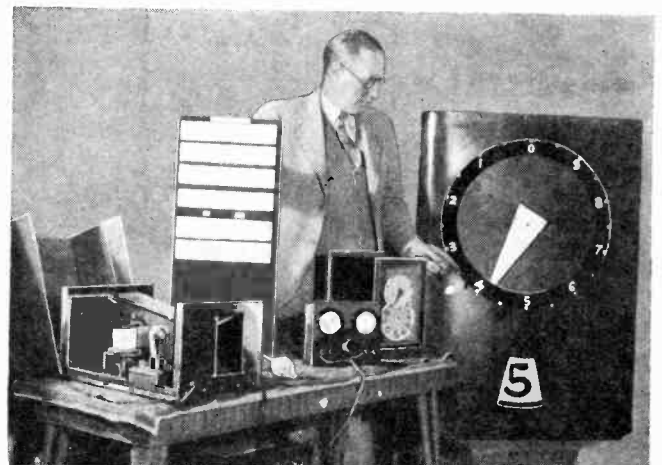
AS long as radio apparatus on planes is subject to mechanical difficulty and failure of operation, other means for guiding planes to air fields must be devised. Accordingly, Captain Burdette A. Palmer, of Los Angeles, California, has developed a captive balloon system which promises to create considerable interest. The device consists of a captive balloon which supports several electrically - controlled automatic instruments that inform the operator of the extent of the fog, indicate the wind direction to the aviator, show the pilot the extent of visibility below the fog, and also show the pilot the number of the nearest airport where there is a ceiling of sufficient height for landing in case there is no visibility over the airport where the balloon is anchored.



Automatic Device Stabilizes Plane in Flight



A DEVICE to keep the plane level without the aid of the pilot was perfected after years of work by Otto W. Greene of Elyria, Ohio. The control is a combination of vane and pendulum which react to a disturbance of balance of the plane either laterally or fore and aft. These make the necessary corrections.





Aladdin's Lamp in the Laundry

By
Mrs. Christine
Frederick

Founder and Director of
Applecroft Home Experiment
Station and Authority on
Household Problems

AMERICAN women are saying farewell to laundry drudgery. Not even content to stay where they were a few years ago, with electric washing machines and wringers, they have gone beyond. They use electric ironers and new soap preparations which do by chemical action what women did by rubbing years ago—all veritable Aladdin's lamps. It is perfectly amazing how the labor of the family laundry has been cut down. Not for American women is the work which European women still consider necessary. As a matter of fact, few things shock Americans traveling in Europe more than seeing women kneeling on stones at the edge of a river and rubbing clothes. That savors of the Middle Ages!

But one must be equipped for modern laundry methods—must provide an efficient plan and layout. The house with sufficient space may have a laundry 8 by 10 feet, 10 by 12 feet, or 12 by 14 feet; for the smaller house a laundryette 4 by 6 feet is practicable.

Unfortunately, in the past, the laundry area was usually located in the house basement, with its damp floor, poor light and ventilation. Extra plumbing had to be installed, and most important of all considerations, to wash and iron in the basement meant unnecessary absence from other house duties and supervision of small children, as well as constant running up and down stairs.

Therefore, especially in new houses

of the "self-service" type, locate the laundry on the first floor level. Here it will be much more convenient for the housekeeper, will effect money saving by a combination plumbing installation between kitchen and laundry area, and will be a warmer, lighter, more cheerful place in which to work.

Just as we know that the modern kitchen must be located properly, so that laundry is most efficient where the equipment is placed for work to pro-

ceed in a chain of steps to a definite end—what the experts call "routed work." Should the stove be placed near the set tubs so that hot water may be poured easily from stove to tubs? Or at the opposite side of the room, where it will be necessary to walk ten feet with each pail of water?

machine in one group; B—Ironing board, ironing machine and table for sorting in separate group. Stationary tubs of slate or enamel, connected to a waste outlet with both hot and cold water greatly reduce the labor of laundry work. Although generally a washing machine is filled by a section of rubber hose, it is possible to permanently install one, placing it against the wall to fill from hot and cold faucets. In every case a washer should be piped to a discharge, as this saves the laborious work of pailing waste water. If a boiler is used, it should be fitted with a faucet at the lower end, to facilitate pailing.

The washing machine should be considered as a third tub, and both tubs and washer should be placed at the same height—from 40 to 42 inches. Which distance from the floor to the top of the roll rim of tubs proves excellent even for short women. It enables them to work at elbow level. Making both tubs and washer of the same height permits continuous, easy movement from one to the other.

Every laundry requires some kind of table on which to remove stains, sort, and sprinkle clothes. The improved steel tables with porcelain top are excellent, especially if in cabinet form. In these the lower compartments hold irons, starch, soap and other supplies. In large laundries an entire kitchen cabinet serves well as both table and cupboard.

The ironing machine is usually fitted with its own stand, insuring perfect height and sanitary cleaning. An indoor dryer is not a necessity, but is convenient if space and purse permit, and often combines with the stove to heat the boiler.

Intelligent systematization in doing laundry work is a great saver of time and energy. Unfortunately the sheer technique of laundry work, as made possible by (Continued on page 1060)

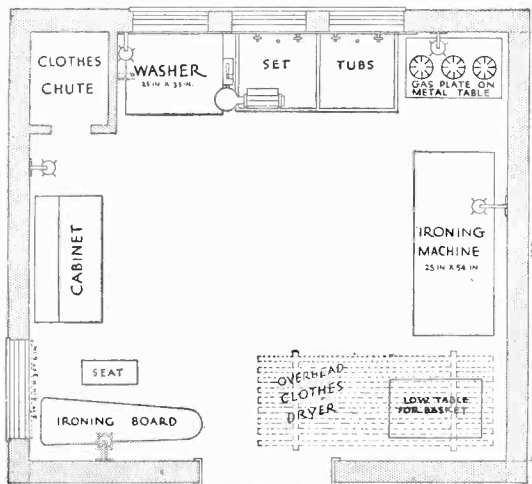


Landers, Frany & Clark

Doubling up on work, this combination machine washes clothes speedily, then dries them in three minutes.

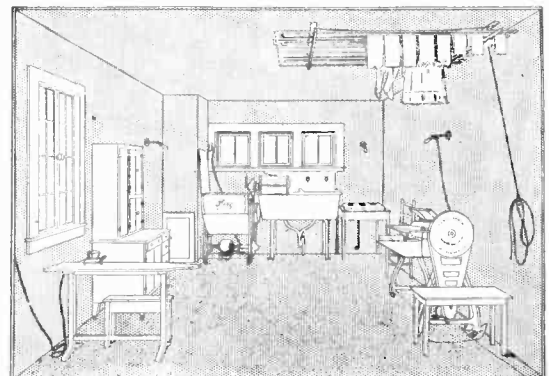
ceed in a chain of steps to a definite end—what the experts call "routed work." Should the stove be placed near the set tubs so that hot water may be poured easily from stove to tubs? Or at the opposite side of the room, where it will be necessary to walk ten feet with each pail of water?

Arrange all equipment so that there is the shortest distance between any correlated points of work, thus: A—stove, set tubs and washing



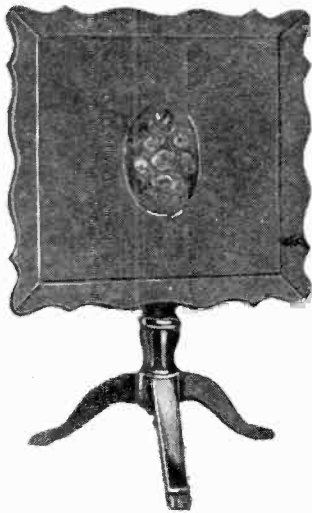
You will save weary hours of labor in this scientifically planned home laundry.

The well-arranged laundry proves as decorative as it is useful.

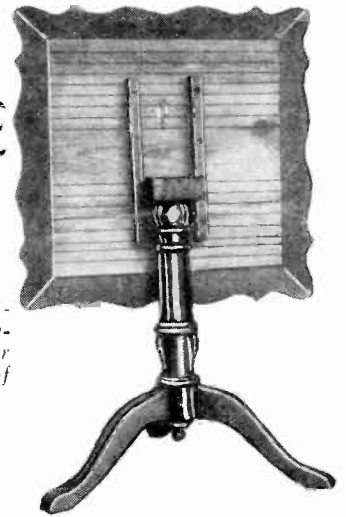


Build Your Own TILT-TOP TABLE

By H. L. Weatherby



The three-legged table may be made with either a plain finished top or an inlaid center and molded edge, as shown at the left.



This back view shows the simplicity of construction which renders it easy for the home worker to build this serviceable piece of furniture.

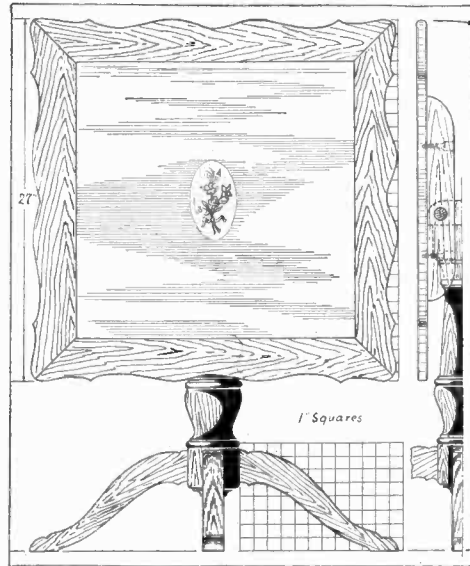
IF you men would like to gain the favor of the women of the household, sit down, read the plans on this page carefully, and make a card table, at a nominal cost, which will delight the heart of any good housewife. Three centuries ago a tilt-top table of this identical design pleased the women of Merrie England and kept the men at home playing cards. Why should it not do the same for you and yours? It is simple in design, easy to construct, beautiful to look at—and it costs very little.

Building the Top

THE writer selected American black walnut as being the most satisfactory wood for the table. Building the top calls for careful tool work and a good job of glueing, otherwise open joints may result. A cross-section of the top, shown in the detail drawings, illustrates how the top was built up. A pine base for the center portion was used. This was run over the circular saw at about one-inch intervals on both faces, to permit the kerfs or cuts to take up the expansion that will occur to a considerable degree in a wide piece of wood. These saw kerfs can be put in at the local mill, if the home shop does not have a small circular saw.

Beautiful Grain Possible

TO this pine base a piece of three-ply 1/4" walnut veneered wood was glued for the top surface. This construction was used for three reasons. Beautifully figured grain can be secured in plywood panels much more easily than in solid wood, inlay designs can be easily set into the wood by cutting and peeling off the top layer, and in building the top up in this manner there is very little danger of warping and splitting that might occur in solid wood. Numerous hand clamps are necessary to glue these



The woodworking may be easily constructed if the dimensions shown above and the suggestions for cutting the legs are carefully followed.

Follow the dimensions for turning the pedestal, the method of laying out the top, and the illustration for tilting mechanism, and you will have no difficulty in building this table.

two parts together or the work should be put into a press. In case the center portion is built up of a single thickness of 7/8" wood, numerous saw kerfs should be cut with the grain on the bottom side to prevent warping and swelling. When the center portion has been prepared and very carefully squared to size, a three-inch mitered frame is built up and glued to the edges. The best method to follow in glueing this edge is to fasten the whole thing down to a bench top or other level surface and then to use bar clamps both ways. The miters must be very carefully fitted of course, and they should not be nailed.

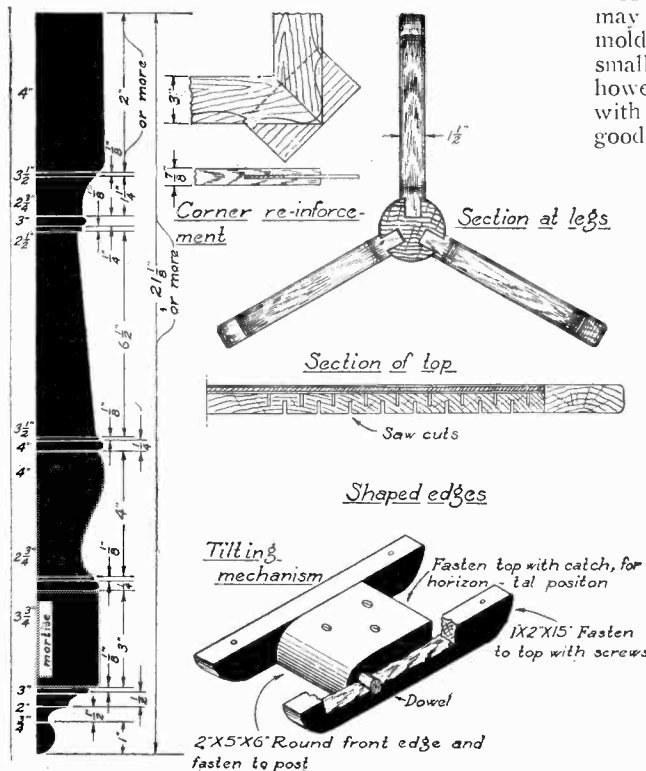
After the glue has set on the frame, splines are set in the corners by making a saw cut and glueing in a thin piece of wood, as the drawings show. After this has dried, the next step is to lay out and cut the edges of the top, using a cardboard pattern laid out by the design given.

After this has been done the top may be taken to the mill, where a molded edge may be cut at very small cost. This is entirely optional, however, and an edge left square with rounded corners may be quite as good looking.

Inlay designs may be had which, with very little trouble, can be set into the top and add greatly to the appearance of the finished table.

Turning the Pedestal

WITH the completion of the top, we may turn our attention to the construction of the center leg or pedestal. It is quite likely that this piece will have to be built up. It is a difficult matter to secure a sound piece of wood four inches square. After it has been prepared, a hexagon should be laid out on the end, in order to locate the mortises for the feet, which should be cut before the piece is turned. In this way the mortises can be so spaced that they will be equi-distant on



(Continued on page 1034)

The way I see it—

Science at the Draining Board

SCIENCE anciently was identified with whiskers, flowing robes, solitude, and a tendency to gabble mystically. Twentieth Century Science sociably snuggles close to home and shows a deep interest in common things. For instance, dishwashing—Science recently held a stopwatch at the University of Chicago, while Miss Nellie Vedder washed a carefully averaged selection of dishes, glasses, silverware, and stored them in their proper places. Three ideal methods were tested. One of them, by which a day's accumulation of tableware was washed just before luncheon, was found to save the housewife six minutes in time and 500 distinct motions in labor—an achievement of which Science can be modestly proud. Undoubtedly there was some amusement in being a scientist in the ancient days. At the same time, it's more fun to help folks than to awe them. Science has found that out.

Long-Distance Freshmen

ANOTHER thing it's hard not to like is the way Science is bringing the Higher Education, once reserved for the Elect, to the elbow of practically everyone who has the will to learn. Considerable useful and interesting knowledge has been distributed by radio in the past. Now it seems that radio is going to be employed as a medium for university courses on a national scale. . . . At least that is what has been proposed to Secretary Wilbur by the Advisory Committee on Education by Radio. The committee's plan calls for a national university, set up in the Federal Office of Education, endowed to the extent of \$10,000,000. With a fund of that size the finest teaching talent could be engaged, and every man and woman in the land could help himself to a university degree by turning a knob and listening in at regular intervals. Nor, regardless of where he might be, would he have to miss a lecture, as long as there was a receiving set within earshot. One of the drawbacks would be the impossibility of class reunions.

Relief Yrrhgently Needed

ONE phase of education that offers a puzzling problem to Science is the anarchy of English spelling. At present, spelling depends not on rules but on memory. After exhaustively studying the phonetic possibilities of the single word "circumference," Dr. Horn of Iowa State University has found that it may be spelled in no fewer than 396,000,000 ways, all—from the standpoint of sound—correct. You begin to understand the reasonableness of this figure when you consider the number of ways in which the second sound in "circumference"—"ir"—may be arrived at. An inventory of English words shows that er, or, ar, our, ear, ere, are, err, car, sur, re, yr, yrrh, irr, urr, and orr (nor is this list complete) are pronounced, at one time or another, like the "ir" in "circumference." From this hint it isn't hard to imagine what the possible variations in spelling may be, when the many other sounds in the word are similarly analyzed.

Large Selection Now Available

IN the course of his investigations Dr. Horn found that English contains twenty-two combinations having the phonetic value of long "e." For the letter "a" alone a child must learn forty-seven phonetic equivalents. Such hope as exists for sane spelling rests on the fact that in the United States "parasite" letters are being dropped—for instance, the "u" in "honour,"—but these gains are as nothing compared with the confusion that characterizes English spelling as a whole. . . . One fundamental defect which seems to inhere in "memory" spelling is that things wrongly learned persist as strongly as those learned in the right way.

Post-Volstead Vision

PROFESSOR Paul E. Fields of Ohio State has been investigating the educational field, too, and very interestingly, below the human level. . . . Or, to be strictly scientific, *outside* the human area. After administering hundreds of lessons to twenty-four white rats, Professor Fields was rewarded by seeing them learn to distinguish between simple geometrical figures, including triangles of various types. In the latter case the rats learned to recognize difference in size, position, and distance apart. Professor Fields' primary purpose, however, was not to teach geometry, but to gain an idea of the efficiency and peculiarities of the rats' optic equipment. The results of the experiments indicated the image presented to the rat eye is large and slightly blurred.

Why They Speak Loudly

WHILE Professor Fields was discovering that Nature had mysteriously provided an out-of-focus optic equipment for rats, New York's Committee on Noise Abatement discovered that the modern metropolis was providing taxi and bus drivers, traffic policemen, and printers with an out-of-focus hearing equipment. Several other occupational types were included among those whose aural impressions were becoming increasingly "blurred" from the impact of the city's noise.

Quiet Radiators

THE modern world isn't as modern as we think—at least in the matter of domestic conveniences. Exploring the ruins of the palace of Founi, Isle of Cyprus, built about the fifth century, B. C., Professor Gjerstad of Sweden found a hot-water heating system of practical form. Water boiled in a room in the lower part of the palace formed steam which was distributed for heating purposes to the second-floor bedrooms. . . . From one standpoint, ancient plumbing was superior to ours. It was constructed integrally with the house itself, anticipating by some centuries the type of concrete house proposed—I think by Edison—for us today.

Off Like a Shot

THE expressed opinions and plans of Herr Hans von Opel, recently arrived in this country for a study of our aviation and automotive industries, synchronize in a gratifying degree with the conclusions reached by Professor Goddard of Clark University, our foremost experimenter with rockets. Particularly in point are Herr Von Opel's views of the rocket powered by liquid propellant. . . . Rocket power thus generated, declared the distinguished German, can by its nature be controlled with the same certainty as that which drives a modern motor car. As Professor Goddard points out, the liquid propellant rocket is also more efficient with respect to the proportionate weights of fuel and complete rocket. . . . First to fly in a rocket plane, Herr Von Opel sees the day when 1,000-passenger planes will be rocketed across the Atlantic at a height that will free them from all but the slightest atmospheric resistance.

Nose Up, Nose Down

THE Guggenheim competition for safe airplanes brought forth nothing as revolutionary in design as the autogiro of Cierva. Yet it appears that the winning "Tanager" demonstrated itself a safe ship in an extraordinary degree. Lieutenant Stanley M. Umstead drove the "Tanager" in an almost vertical climb over a 35-foot tower, then landed it with a roll of only about 30 feet. Here, surely, is safe aerial performance.

Type Like Lightning

~~300 WORDS A MINUTE~~

By Mary Jacobs

"NINETY percent of our daily vocabulary consists of 400 words—words for which the stenographer must memorize signs and symbols. 'Dear Sir,' 'Yours truly,' and more complicated phrases occur time and time again. Yet she must type each letter of each word singly. Why not a typewriter on the shorthand basis to print common words and phrases with about two operations? No more shorthand notes for the stenographer; no longer would she exhaust her energies pounding out page after page, every word requiring several depressions of keys."

So thought Clyde C. Balston, and started out to design the typewriter of his dreams. Model after model he made and cast aside; years and dollars he consumed in pursuit of his task. Today he has perfected a series of 16 machines, all using a keyboard with interchangeable vocabulary charts and spelling or calculating factors, but serving varied purposes—from office spelling and writing to billing, automatic subtracting, and posting.

All the models follow the design of the office phrase spelling and writing machine, a definite improvement upon the office typewriter. This automatic writer has a mechanical speed of 1,000 words a minute, an operative one of 300 words a minute. The longer the word or phrase to be typed, the greater the speed per word—for simultaneously with the depression of one of the outer keys and one of the "blind" keys of the keyboard, the word or phrase will appear, regardless of its length. The operation is practically noiseless; the machine can write and spell in foreign languages; the chance for human error in ordinary spelling and calculating is almost eliminated.

The machine is twice the size of the ordinary typewriter, and includes a detachable pasteboard vocabulary chart,



The typist recognizes the words printed on the pasteboard vocabulary chart (represented by letters here) attached in back of the automatic keyboard. The chart and spelling factors are changeable for writing, billing, posting—for any 16 different types of machines.

corresponding to the keys of the outer left and right sides of the keyboard, a "blind" keyboard, and the regular type-writing keyboard (for odd or unusual words).

The most common words and phrases are printed in the chart squares above the automatic keyboard. This chart has 4 horizontal rows of 10 squares each; the upper 3 for words in ordinary use, the lowest one for technical phrases peculiar to any particular business or profession. It can be removed instantly to permit the substitution of any other strip with another set of technical terms.

The initial letters of the words grouped on each square is printed in enlarged form (see the S of the illustration) and the letters follow the standard keyboard arrangement. The operator locates words and phrases from the chart and types them with the corresponding keys of the keyboard. She depresses one outer key and its complementary "blind" key for an entire word or group of words.

The 4 horizontal rows of keys, 5 to the left and 5 to the right of the automatic keyboard, follow the exact order of the chart squares, which they govern.

As to the "blind" keys, they contain no lettering at all; they pertain to all the words or phrases of the chart. Just as each square there contains a left, center and right column of 18 words each, so the center "blind" keys represent an equal number. We have 3 separate vertical sections, and each section has 6 vertical and 3 horizontal keys, making 18 to the section.

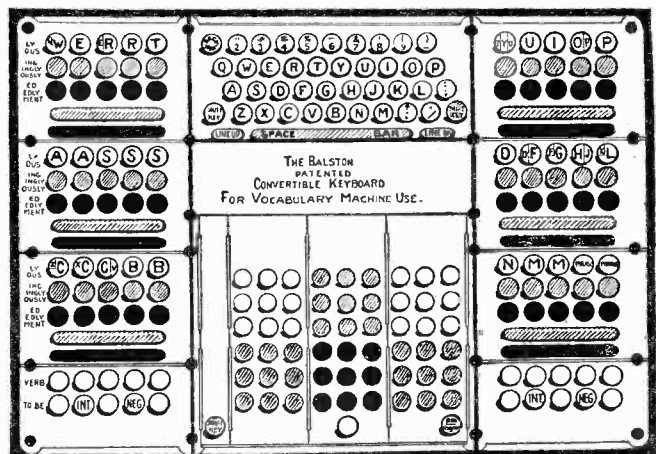
For example, we want to spell (Continued on page 1045)

—Specimen Word Group of Balston Vocabulary Chart—

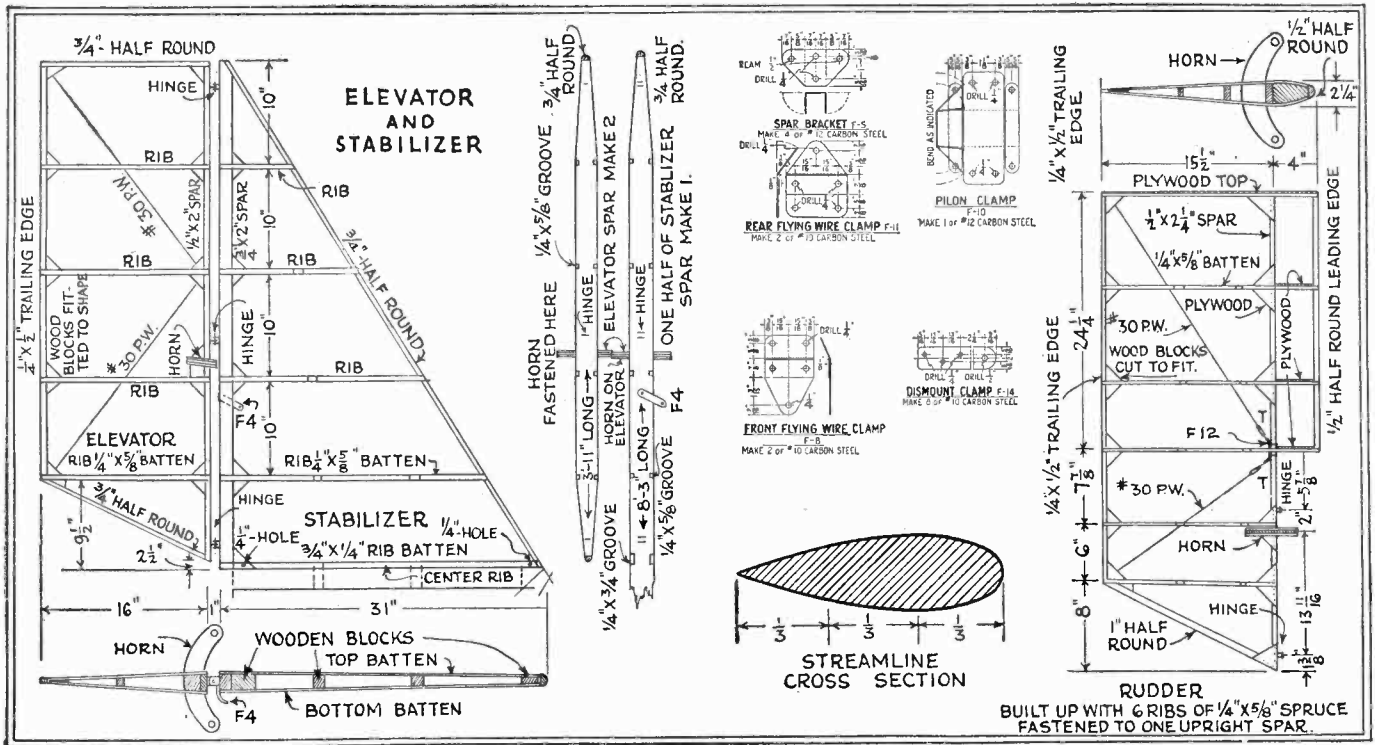
SAD ^D LE	SEVERAL SENSATION	STOP STENOGRAPHY
SAY ^D ME	SILENCE SIMULTANEOUS	SUBMIT SUGGEST
SATISFACTION	SOMEWHERE SMELLOW	SUCCESS SUFFICIENT
SCRUTINY	SPEAK SPECIFY	SUPPLY SUPPORT
SECURE	STATE STATIONARY	SURPRISE SUSTAIN
SENT	STORY STATEMENT STATION	SYMPATHIZE STEM

—Published United States — Copyright 1924 by Clyde C. Balston — All Rights Reserved — Patented —

Each square of the chart contains 6 vertical and 3 horizontal columns, alphabetically arranged. The squares follow the standard keyboard for position of letters.



The regular single type typewriter keyboard, center back, serves for infrequently used words; the "blind" bank of keys, center front, together with the lettered keys arranged to the left and right sides, print the words or phrases with but two operations.



Here's the Second in Training Glider

By Lieut. H. A. Reynolds, 368th F.A.O.R.C.

As a sport, gliding is spreading with amazing rapidity over the United States. Many glider clubs are being formed. Most of them will build their primary training gliders themselves. For the benefit of those who wish to build their own gliders without incurring undue expense, the writer offers this primary training type, which follows closely the description printed in the June and July numbers of SCIENCE AND INVENTION.

Simplicity of construction has been aimed at throughout. Bolt sizes are presented in easy procurable dimensions, and drills of stock sizes consequently can be employed. Where it is found most practical to secure parts from an airplane supply concern, the names and addresses of firms patronized by the writer are given. Prices and specifications of parts purchased are also included, so that the amateur builder will have some standard to guide him in securing his own supplies.

In the first article of this series (published in the February issue) the wing framework was explained.

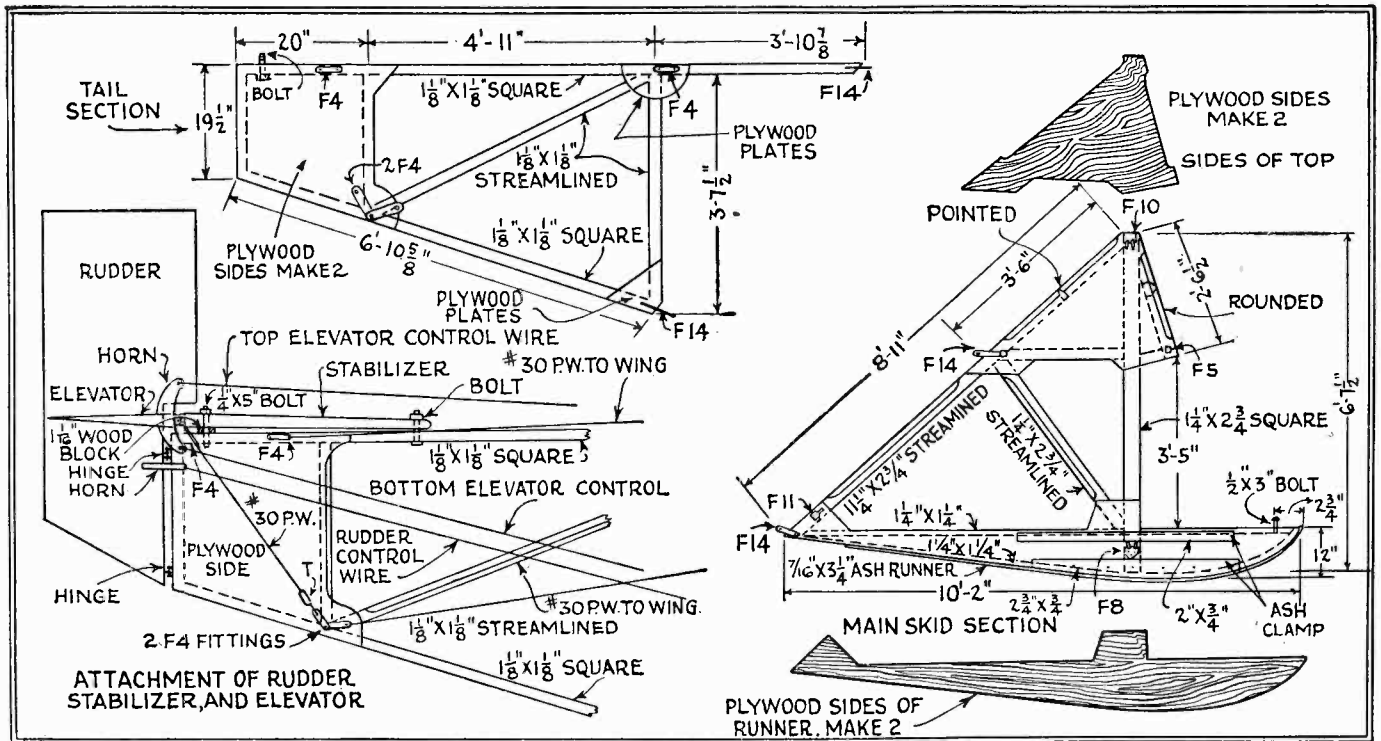
The present article takes up the construction of some of the main framework, to which the wings are attached. A primary training glider is usually made up in four removable sections: (1) The Wings. (2) The Rudder Section. (3) The Tail Section. (4) The Main Skid Section.

The Rudder

THE rudder is built first and is supported chiefly by a main spar of 1/2" x 2 1/4" spruce. Spruce battens 1/4" x 5/8" are

fastened to this main spar by nailing and gluing triangular plywood gusset plates at the different points of attachment, as shown in the rudder drawing. Short cross-pieces are nailed and glued between these battens, to give the back part of the rudder ribs strength and regular shape, as shown in the top view of the rudder drawing. Triangular spruce blocks, somewhat wedge-shaped as to thickness, are fastened in like manner between these battens at the trailing edge. The trailing edge is next fastened with glue and nails to the ends of these battens and the triangular spruce blocks. Short strips of muslin can be glued to each batten tip and around the trailing edge to further strengthen these joints. The trailing edge can be planed to a slight taper at its back edge to give a knife-edge appearance to the trailing edge of the rudder.

A plywood top is cut to shape and glued and nailed to the top rudder rib. Three plywood tops are cut to shape for the front section of the next three rudder ribs. The front section of the top plywood-covered rib may be used as a pattern for marking these. They are attached as shown in the rudder drawing. A 1/2" half-round piece of spruce 24 1/4" long is next glued and nailed to the front of these four top rudder ribs as a leading edge. Muslin strips should be glued around these leading edge joints also. The bottom two rudder ribs end at the rudder spar in front. One horn is attached in position as shown in the rudder drawing. This can be reinforced with plywood triangular gusset plates and spruce blocks to make it very secure. One metal fitting F. 12, is bolted with 1/4" machine bolts to the rudder spar, as shown in the drawing. No. 30 piano wire, with inexpensive 5 and 10-cent store turnbuckles, are next installed and tightened to slight tension which will give the rudder rigidity. A 1" half-round spruce strip is next glued and



Here are construction details of the elevator, stabilizer and rudder in the primary training glider built by Lieut. H. A. Reynolds, and also the method by which the parts are attached to the frame of the craft.

Step Construction!

IN the first article of this interesting series—published in the February number of SCIENCE AND INVENTION—Lieut. Reynolds described the construction of the wing framework. The third article in the series will cover controls, launching hook, and control connections. It will appear in the April issue.

nailed to the bottom tip of the rudder spar. This strip is tapered to shape at the trailing edge and fastened by using triangular plywood gusset plates. Muslin strips can also be glued around this to strengthen its attachment. Two rudder hinge bolts are now bolted through the rudder spar, in the position shown in the rudder drawing. The rudder framework is now finished, and it can be laid aside until it is next needed to mark the position for drilling the hinge positions in the tail section.

Elevator and Stabilizer

THE elevator and stabilizer surfaces are usually left permanently fastened to the top rear of the tail section, but if their removal is necessary, it is accomplished by simply removing the rudder horn and stabilizer horn. (Continued on page 1041)



Lieut. Reynolds' father, G. W. Reynolds, appears in this view of the main skid section of the glider.



Bird-houses should always be attached firmly to the trunk of a tree so that they will not have a motion of their own. It is useless to put a bird-house on a thin pole standing in an exposed position. A house in such a location is never used by birds. They do not like a rocking house.

ONLY a few months ago the forests and woodlands were charming for a short time as the autumn sun caressed the gayly painted leaves. The foliage of the birch and poplar, aspen and cottonwood were brightly yellow; that of the oaks presented all the various shades from yellow and orange to fiery red; the maples assumed a far deeper red; the poison ivy deep yellow along the veins with the rest of the leaf varying from bright red to dark brown. The sumachs glowed with scarlet colors, while the Virginia creeper seemed to be consumed with an inner fire. Day by day, as the night frosts continued their unsuspected ravage, more of the leaves of tree and shrub and bush fell gently to the earth, until, at last, the slender twigs alone lifted their waving arms towards the sky. Then, indeed, the forest became a lonesome place. The migratory song and other birds had long since gone South—only a few of the permanent birds and some wanderers were still to be seen. The cold and unfriendly season did not send them away. It had no terrors for them. There was still plenty of food to be found for the diligent searcher. Many weed seeds and seed capsules and even carelessly hidden insects sufficed for the food of the few remaining birds.

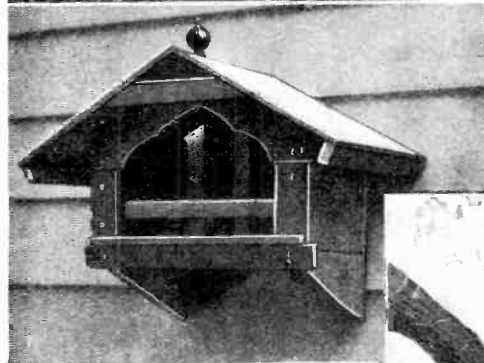
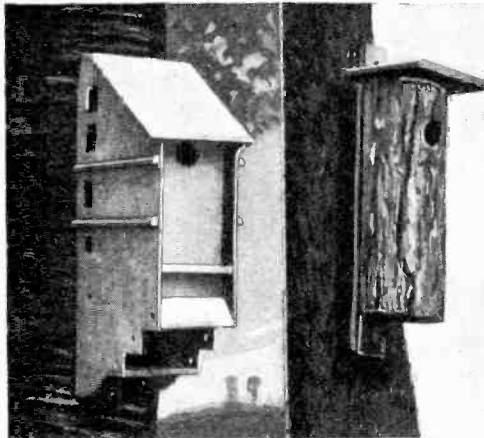
Prepare to Welcome Feathered Friends

By Dr. E. Bade

But when the snow begins to fall and cover everything with its soft down coverlet, that is the time of trial and tribulation for the feathered folk. Food cannot be found and shelter is taken in any available crevice, which, unfortunately, is too seldom ever left again. Or the birds seek their accustomed sleeping-places in their favorite tree. But here, during the night, the weak foot gradually loses its grasp upon the twig until, at last, the bird, exhausted, drops down to the snow below, which soon covers and hides the little body.

Then food should be provided for the birds. Giving it to them at other times tends to draw them from their natural inborn occupation of seeking their food, which, if they are not fed by us, gives them the necessary exercise to maintain the heat in their little bodies.

Under the ordinary methods of feeding, the common, imported English sparrow is the only bird that is favored. The really useful birds are seldom benefited. In order to help protect and feed our useful birds the characteristics of the bird must be taken into consideration. Of prime importance is the location of the winter feeding-place, which must be as protected as possible. If such a natural place is not available, then one must be made. This usually (*Continued on page 1036*)



Bird-houses may be as ornamental as desired, as long as they are adapted for the birds that are to use them. For those birds that build nests in holes of trees, the house should be patterned after a tree trunk. Photo immediately above represents a robin-house.

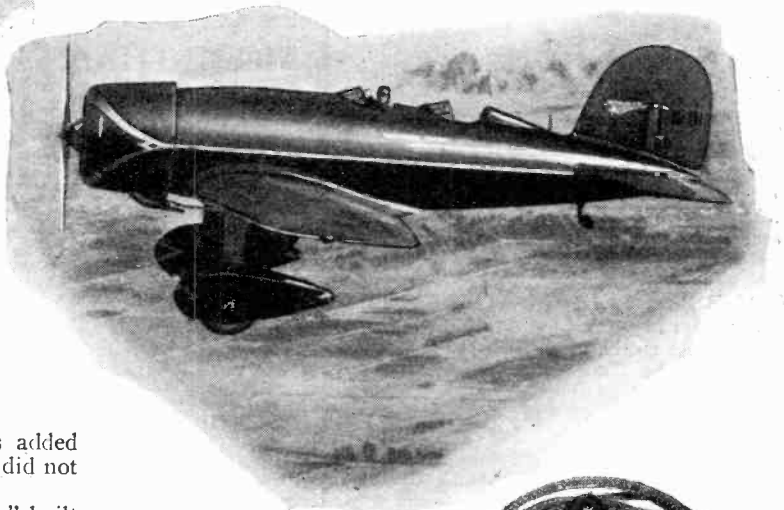
Bluebirds like their homes in the top of a tree. A piece of tree-trunk hollowed out and covered makes an abode for these birds.



LINDY Gets New Wings



Colonel and Mrs. Charles Lindbergh, equipped with heavy flying suits and carrying a camping outfit, made an inspection trip along the lines of the Trans-continental Airport. Following this, Lindy took delivery on his new "Bullet" plane.



Lindy's new plane, a Lockheed low-winged monoplane, is capable of flying more than 4,300 miles at 160 miles an hour without landing. Its stream lining is remarkable.

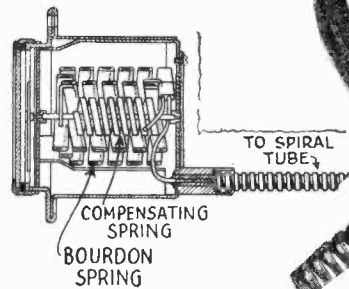
WHEN Charles Lindbergh reached France on his epochal trans-Atlantic hop, he made the word "WE" famous. At that time "WE" meant the plane and himself. Now "WE" refers to the Lone Eagle and his mate, and the newest Lindbergh plane and has added equipment in the form of many new instruments that did not appear on his historic ship.

The new Lindbergh airplane is a two-place "Bullet," built by the Lockheed Aircraft Co. Tests have indicated that this plane can travel at a speed of nearly 200 miles an hour. The ship is a monoplane of the low-winged type and is reputed to have the longest cruising range of any pleasure craft. It is capable of flying 4,320 miles at a speed of 160 miles per hour without a landing. This is roughly equivalent to the distance from New York to Berlin, via Paris, plus 300 additional miles.

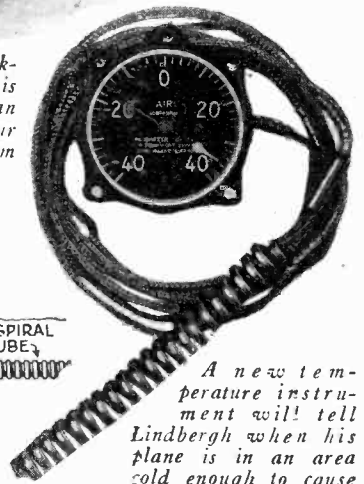
The instrument board presents a variety of meters and dials. On the top row of the main instrument board, left to right, as it appears on this page, are the fuel-level gauge from gravity tank, the air speed indicator, the bank and turn indicator, the rate-of-climb indicator, and the fuel-level gauge for main tank. The three small instruments on the left, reading from top to bottom, are the oil pressure gauge, the oil temperature gauge, and the fuel pressure gauge. The bottom row of instruments are the fuel flow meter, the tachometer, the magnetic compass, the altimeter, and a clock. In the extreme lower right-hand corner we see the ice-warning indicator.

The ice-warning indicator is a very important piece of apparatus for long-distance flights. Formation of ice on the wings, struts, wires and controls of an airplane has been suggested as a causative factor of failure in trans-oceanic flights. If a pilot knows that the area into which he is flying is likely to cause moisture to freeze on the wings, thus changing the contour of the wings and decreasing the aerodynamic efficiency of the plane, and also causing an increase drag through the deformation of the air foil at the leading edge, he can change his course and avoid the danger. No great concern is felt over the increased weight that such ice produces because most planes operate with less than capacity load and are often relieved of much of

(Continued on page 1054)

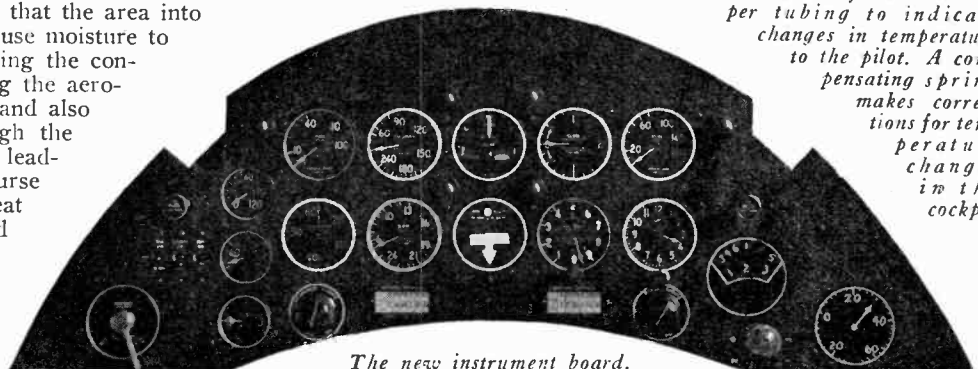


The ice-warning indicator consists of a spiral tube attached to the leading edge of a wing or to a strut. A flexible tube runs to the instrument on the dash. The tubes are filled with xylene, a liquid, under pressure. Within the instrument there is a Bourdon spring made of seamless copper tubing to indicate



A new temperature instrument will tell Lindbergh when his plane is in an area cold enough to cause ice formation on wings.

changes in temperature to the pilot. A compensating spring makes corrections for temperature changes in the cockpit.



The new instrument board.



Albert G. Illich, first prize winner, is Vice-President of the Bronx Chamber of Commerce and has been interested in magic in an amateur way since his eighth birthday.

THE Buzz Saw Illusion Contest was a success in every way. More than 10,000 worthwhile entrants sent in what they considered to be the most practical working methods. Lack of space prevents me from presenting many of the interesting high lights in this contest. Suffice it to say that the task of awarding the prizes was stupendous. I present herewith the list of prize winners and the text of the first prize winner, and wish to thank the many fans of magic for their interest and support.—Dunninger.

Mr. Illich says of himself:

"I am thirty-five years of age and was born in the Bronx. I was commissioned in the army after competitive examinations and was the youngest staff officer in France. I then engaged in real estate business and am considered to be an expert. I am vice-president of the Bronx Chamber of Commerce, the third largest in the world. Since I was eight years of age I have been interested in magic in an amateur way and have invented several tricks and illusions which I have never seen used. I am a constant reader of SCIENCE AND INVENTION magazine and, most of all, like Dunninger's department. I think he has done more to interest and keep people interested in magic than anyone in the business."—A. G. Illich.

The First Prize-Winning Entry

WHEN the casket is closed, the lady releases her hands by contracting her muscles and sliding her hands out of the shackles, which are sufficiently large. Her feet are withdrawn from the boots which have been stiffened with wire frames, to retain their form.

She now moves her body to the back section of the box, where she adjusts herself comfortably, aided by a trap cut in the back section, pushing outward and rendering additional room.

A loose board, hinged to the bottom of the box lined with metal, is pulled into position, and acts as a protecting

Awards Made in \$250.00 "Buzz Saw" Contest

By Dunninger

MORE THAN \$250.00 IN PRIZES

First Prize—\$100.00—Albert G. Illich, 3860 White Plains Ave., New York City.
Second Prize—\$50.00—Bert Sollander, 1025 South New Hampshire St., Los Angeles, Calif.
Third Prize—\$25.00—Bill Coney, 401 Haight St., San Francisco, Calif.
Fourth Prize—\$10.00—Nelson C. Halne, 144 Bank St., Dayton, Ohio.
13 Fifth Prizes—\$5.00 each.
Al Douglas, 1245 Park Ave., New York City
Walter Smith, 1911 Cullom Ave., Chicago, Ill.
S. B. Lewis, 125 Pine St., Fitchburg, Mass.
Stan Leyl Judd, 120 Albany Ave., New Britain, Conn.
Carl E. Pedersen, 624 Dartmouth St., San Francisco, Calif.
Carl Petriani, 3922 North Clark St., Chicago, Ill.
Albert H. Miller, 436 Stokes Ave., North Braddock, Pa.
Derrick P. Rusden, 125 Butler Ave., Providence, R. I.
F. A. Seymour, 51 Manor Road W., Toronto 12, Canada
Edward M. Heyman, 234 N. Jersey Ave., Brooklyn, N. Y.
F. H. Dean, 6342 Belmont, Dallas, Texas
Henry Schullermann, 1141 Glenmore Ave., Brooklyn, N. Y.
Bertha L. Johnston, Masten, Pennsylvania
Clifford M. Griffin, 2100 S. College Ave., Grand Rapids, Mich.

The following were awarded 25 sixth prizes, consisting of a year's subscription to SCIENCE AND INVENTION Magazine and an autographed copy of Volume III, "Popular Magic and Card Tricks," by Dunninger.

Dr. Clifton, New York City; Wilfred Beckmen, Montreal, Canada; Roger M. Johnston, San Dimas, Calif.; C. A. Bauer, Portland, Ore.; Victor Gard, Rossville, Ind.; Robert C. Edgerton, Rocky Mountain, N. C.; John P. Pappas, Bridgewater, Mass.; U. Bradner, Hamilton, Ohio; J. O. Seahorn, Hot Springs, Ark.; Arlie Markley, Jordan, Mont.; Jack McKenzie, New York City; Frank Frumviller, Detroit, Mich.; Robert M. Bennett, Downers Grove, Ill.; Rev. William B. Richmond, Bell, Calif.; F. S. Gustafson, Cleburne, Kansas; John Maker, Detroit Mich.; Earl Bernin, Chicago, Ill.; Emil S. Johnson, Wilkinsburg, Pa.; Michael Stacho, Cleveland, Ohio; Fred Brode, Jr., Jersey City, N. J.; Sam J. Black, Mile Seven, Alaska; George T. Conner, Dallas, Texas; Edwin Holt, Atlanta, Texas; Raymond S. Brown, Columbus, Ind.

shield. The girl adjusts her body so as to allow the three swords to pass her in entering their respective cavities.

With all arranged, the buzz saw can now pass through the box, with the girl comfortably protected.

Readjusting the trap, replacing the protection board, adjusting the shackles, and replacing her feet into the boots, everything is now ready for inspection at the finale.

The casket should be lined with black flannel or felt to make the working parts invisible and noiseless.

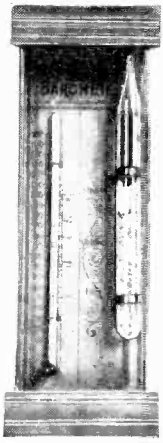
Editorial note: Mr. Illich's solution, in Mr. Dunninger's opinion, is the best workable method of performing the trick, submitted in this contest. What is still more remarkable, the solution is very similar to the manner in which the illusion is actually produced.



Dunninger checked over the solutions in the Buzz Saw Illusion Contest with Mr. Arthur H. Lynch, Editorial Director.

Is It Going to Rain?

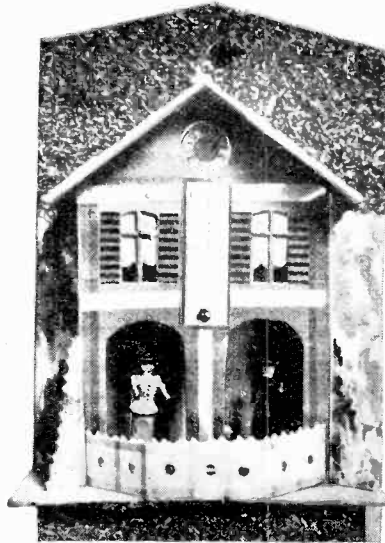
Peculiar Instruments Intended to Show Weather Changes



The Camphor Barometer is now a rarity. A glass vial at right has a solution of camphor and alcohol with crystals of saltpeter and sal ammoniac. Weight of lower flaky part is asserted to indicate the weather. At the left is a thermometer. It is of no value.

CRUDE contrivances, supposed to indicate coming weather changes—and in some cases, earthquakes and mine explosions—have been popular for ages. Although Uncle Sam's Weather Bureau uses a great variety of instruments, none of those herein illustrated are included. Yet every one of these unofficial and non-scientific devices is designed for predicting the weather.

In the Rathaus at Rothenburg, Bavaria, there has hung for centuries a chandelier bearing a female figure, which turns one way in damp weather and another in dry. These movements, which result from variations in atmospheric moisture, are due to the twisting of a hempen rope by which the chandelier is suspended. The same principle is embodied in the most familiar of all weather toys—the weather house. In this house a string of twisted catgut supports the figures and causes them to swing in and out as it absorbs or loses moisture. Weather houses were made by Jacob Leupold, of Leipzig, as early as 1720, and there is reason to believe that they were known several centuries before his time. The twisting of a catgut string with increase of moisture causes it to shorten, and this property is utilized in another ancient

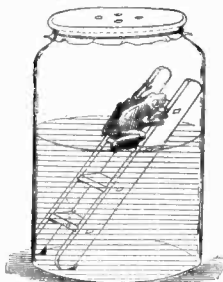


The Weather House with Jocky and Jenny is the most familiar indicator. "Peace to the artist whose ingenious thought Devised the weather house, that useful toy! Fearless of humid air and gathering rains, Forth steps the man—an emblem of myself! More delicate, his timorous mate retires." —Cowper.



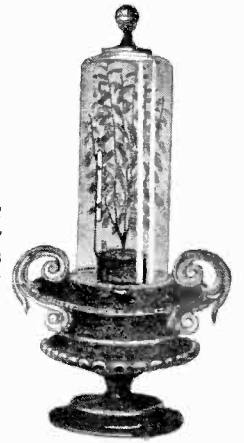
Harold the Lifeguard, devised by P. J. Marschall, is bow-legged when air is dry and straight-legged when damp. One form has a thermometer; the other a removable paddle with humidity scale to place under feet. Distance apart shows humidity.

The Capuchin is a little figure of a monk. Inside, a catgut string, by entwisting, draws a hinged cover over the prophetic monk's head in moist weather, as if to shield him. In dry weather it draws it off his head.



The Frog Ladder stands in a glass full of water. The prophet is usually a living tree-toad—Hyla arborea. When he climbs to the top most "authorities" say it is a sign of fine weather, but some say just the reverse! Please yourself.

The Weather Plant is a member of the pea family—"Abrus precatorius." Its leaves and stems assuming different positions are fantastically alleged to predict not only storms and weather changes, but also earthquakes!



weather indicator—the Capuchin—whose head is hooded in damp weather and bare in dry.

Most non-scientific weather instruments are merely crude hygrosopes, which indicate whether or not the air is well supplied with invisible water vapor. Though many of them are described as "barometers," they do not, like the true barometer, measure the pressure of the atmosphere. Whatever value they possess as weather prognosticators depends upon the fact that an increase of atmospheric moisture points to a probability of rain and a decrease to the likelihood of a dry spell.

Besides these devices in which movements are due to variations of moisture, there are some in which color changes occur, whose action is chemical. In these the sensitive part consists of paper treated with substances that cause it to assume different colors according to the degree of humidity. Generally the principal ingredient is cobalt chloride. When dry it is blue in color, changing gradually toward pink with increase of moisture. These chemical hygrosopes are made in a number of fanciful designs, including flowers, landscapes and the like. In the "Parisian barometer," a girl's paper skirt changes color with the state of the air.

The once popular device variously known as the "camphor barometer," (Continued on page 1035)

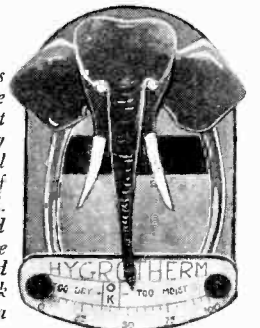


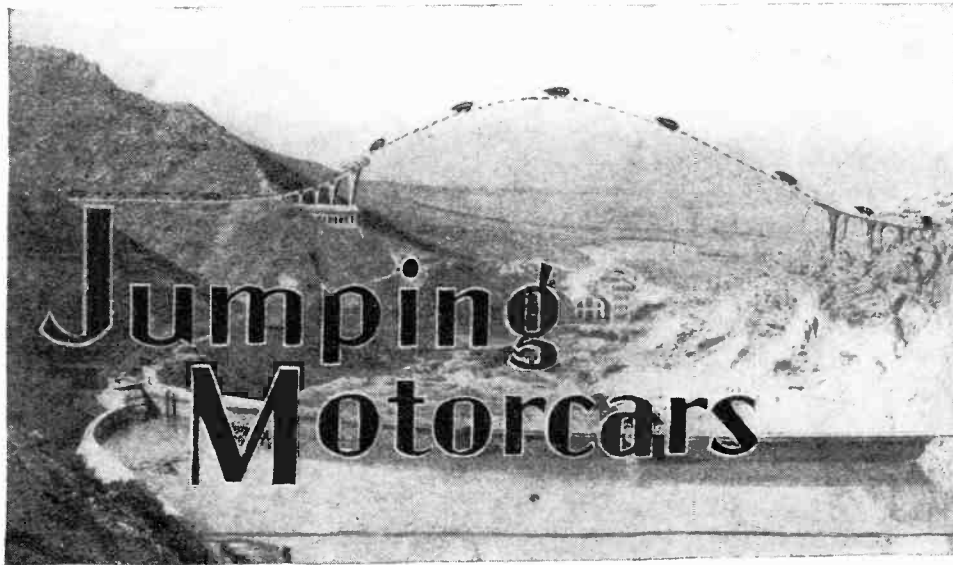
The Flower Barometer, like the chameleon barometer, varies in color with the humidity in the air, the colors having the same significance.



The Chameleon Barometer is a chemical hygroscope using a cobalt salt, which changes color from blue to pink with increase of atmospheric moisture. The significance of the colors is shown by three tinted sectors in the margin.

The Hygrotherm has at the right a double strip of cedar and at the left a steel spring connected by small chains to the axis of the elephant's head. As the strip of wood curves with moisture changes, the head nods and the trunk shows humidity on a scale.





Is the Schneller Plan for Jumping Motor Cars Scientifically Sound? Write Us a Letter Telling Us What You Find Wrong with It. We Will Pay \$10.00 for the Best Letter (Maximum 100 Words) We Receive.

YOU won't need an airplane to cross the Grand Canyon—you won't need a bridge across the Niagara Falls—if the fantastic scheme of the German engineer, Schneller, can be made practicable.

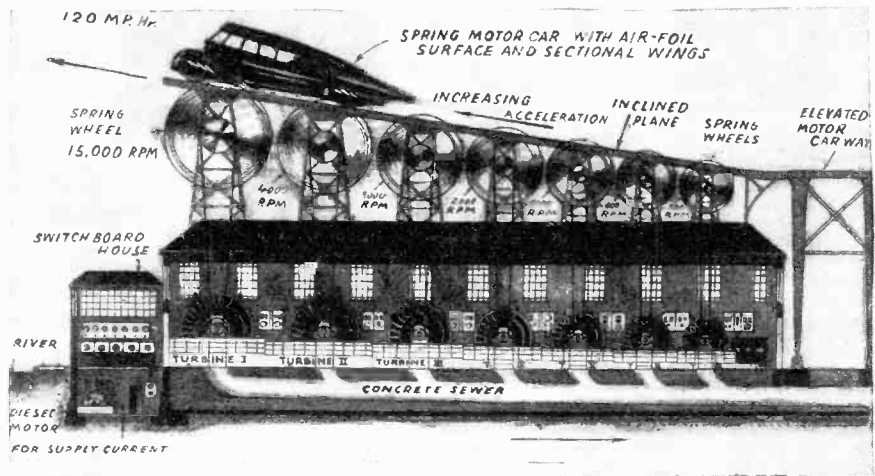
For Mr. Schneller has devised a jumping motor car, whose use would eliminate bridges over gorges and rivers. The motorist would merely drive up an inclined take-off and make a parabolic flight to the opposite side. Naturally, his speed would be far greater than he could make it in a present-day automobile.

Hydro-electric stations are found on all our medium and large sized water-courses. According to Schneller, merely utilizing the superfluous power of the turbines now in use would do the trick.

Following the Schneller plan, the car takes off from the inclined plane at a velocity of 120 miles an hour. Acceleration is provided by rotating wheels, which form the surface of the incline. These are driven by individual belts connected with the shaft of the turbines. The speed of the wheels increases steadily toward the taking-off point, and the car leaves the incline at lightning speed.

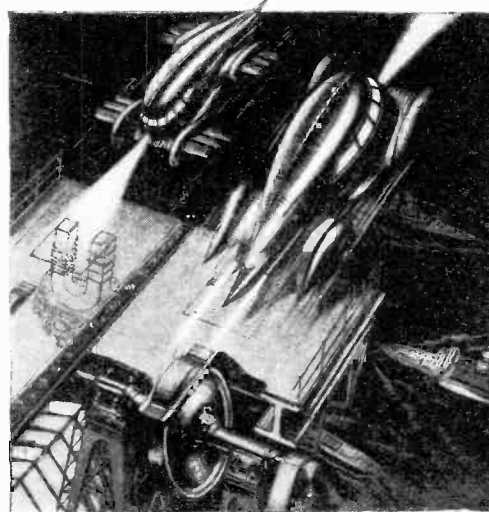
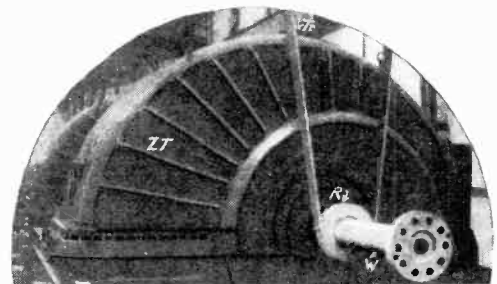
A small compass mounted in the tower of the vehicle provides steering accuracy in the air. A 1000 horsepower high speed engine, located above the rear axle of the car, furnishes the necessary impetus. When the car reaches the inclined plane, the engine is automatically stopped, and the rollers alone propel the car.

At the highest point of parabolic trajectory, the motor of the car again comes into action and forces out six small divided wings on both sides. These retard the rate of descent. When the car lands, a two-cored electrical magnet built into the roadway automatically acts as a gate or block signalman, halting the car. To provide further safety, forty-eight India rubber-oil shock absorbers come into action the second the car reaches the ground. To prevent collision, there is a strip of heavy grass between the two motor car tracks.



According to the engineer's plan, the rollers forming the roadway are driven by belt from hydraulic turbines. Do you find this plan feasible?

Here is one of the giant turbines which will power the spring wheels of the driving platform. The driving belt is connected directly with the shaft.

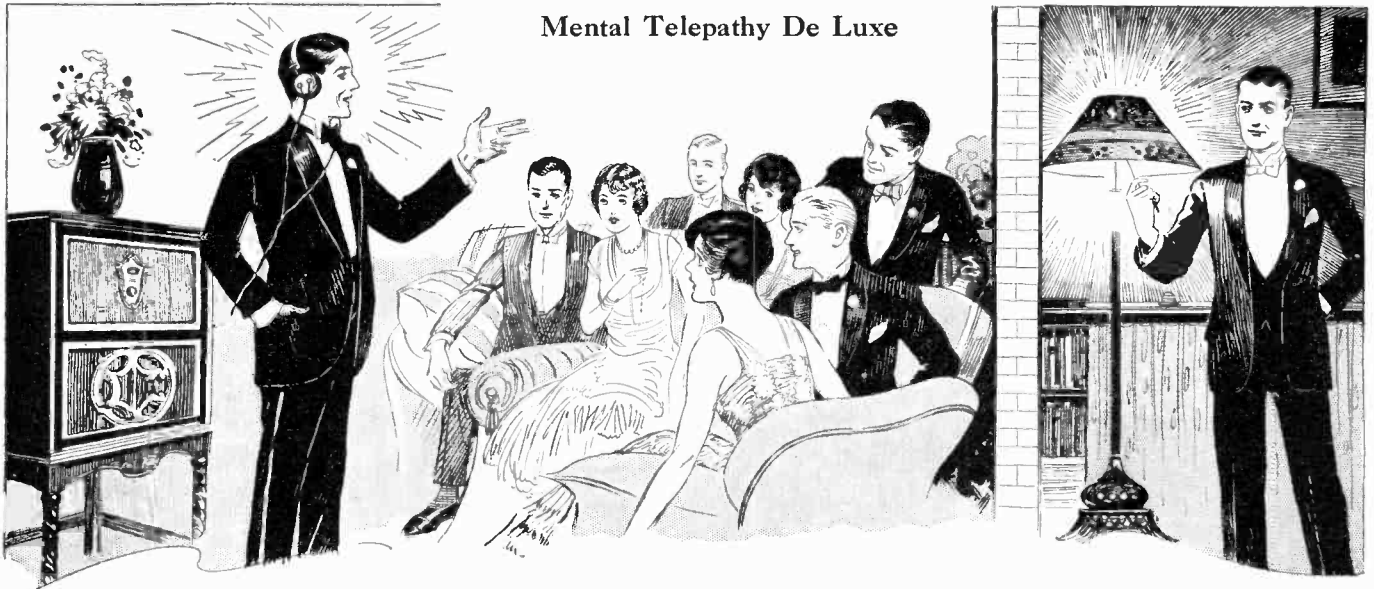


In Germany, one of these jumping car units has already been set up. An old hydro-electric station serves as the base for necessary equipment. If experiment proves the project workable, there is a possibility that similar equipment may be constructed in the vicinity of other hydro-electric stations.

Mr. Schneller thinks his plan for inclined tracks and cars suitable for the United States. We believe the entire scheme fallacious. What do you think? For the best letter sent in, telling the weak points of this jumping motor car plan, as illustrated, we will give a \$10.00 prize. The letter must be limited to 100 words.

The cars would land and take-off at lightning speed. A magnet placed beneath the roadway would retard the speed of the cars as they land.

Mental Telepathy De Luxe



THIS exceptional trick in thought transference can be presented as an impromptu demonstration, with absolutely no prearranged paraphernalia. The wizard explains that he can use a radio to demonstrate the possibility of broadcasting thoughts over the ether. The loud speaker is disconnected from the set and the earphones are attached. The assistant who is to partake in this demonstration is now led to another room, and after a committee has been chosen they impart a word and the name

of a playing card to this assistant, who naturally is stationed at a fair distance from the performer. The committee return to the radio chamber, and after a few moments are amazed to find that the magician is in possession of the secret name or card.

Explanation: Anyone who has experimented with radios knows that if an electric switch be turned on or off in another room a click or sound is distinctly heard. A code is prearranged and the trick is done.

MAGIC

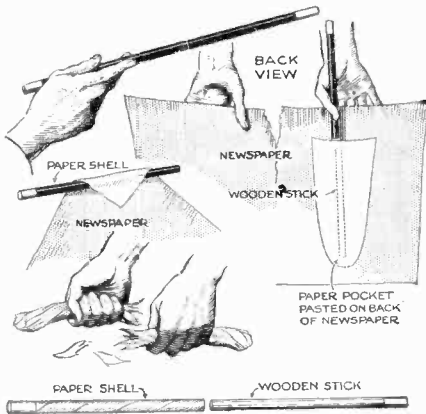
By

Huminger

No. 79 of a Series

Wand Vanish De Luxe

THE effect: The magician proves the wand that he has been using to be solid and apparently unprepared, by giving it a few violent raps upon table top. Taking a sheet of newspaper which has been hanging across the back of a chair, he tears the paper in two and proceeds to wrap the wand snugly into one of the sections of the paper. Without any suspicious moves he nonchalantly tears this paper into small sections, the wand having completely disappeared.



The secret: The wand consists of a wooden stick, concealed within a piece of paper tubing, which has been painted to represent the genuine article. In the act of tearing the newspaper in two, the solid stick slides from out the tube into a newspaper pocket which has been pasted in back of the paper. Thus, the paper tube which, to all appearances, is the solid wand, is afterward torn to bits.

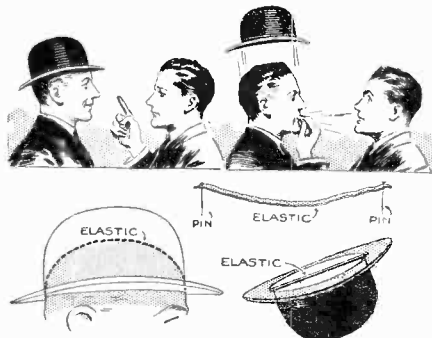
The Phantom Derby

THE magician enters a room, and for a moment shocks the ladies by neglecting to remove his hat. Seeming to be somewhat embarrassed, the wizard places his finger to his mouth, and blows upon it. Instantly, the derby leaps off the magician's head, flying into the air.

An examination of the hat is sure to be called for. The spectators, however, are greatly amazed to find the derby is entirely unprepared.

Secret: Two plain pins and a piece of elastic is all that is required. A pin is tied firmly to each end of the elastic. Stretching the elastic, the pins are driven directly opposite one another into the band of the hat. The derby is then placed upon the head, as illustrated. The hat should fit rather tightly. In the act of blowing the finger, which is merely a bit of by-play, the wizard has but to frown, thereby relaxing the muscles of the forehead, which produces sufficient slack to cause the hat to fly upward, and off the conjurer's head.

All that remains to be done is to remove the pins and elastic secretly.



Enchanted Goblet

THE wizard brings forth a large, transparent glass goblet. This container is seen to be filled with milk.

The magician then borrows a handkerchief, which he throws over the goblet, and places it on a table. To the amazement of the spectators, the goblet is brim-full of wine when kerchief is removed.



The goblet is a specially prepared one, with hollow stem, and an inner glass lining. Some milk is poured in through the stem, while the glass is inverted. A cork prevents the milk from leaving. The inner lining is filled with wine, concealed from view by the milk in the outer shell. When covering the goblet with the handkerchief, the cork is secretly removed, and the forefinger pressed over the hole.

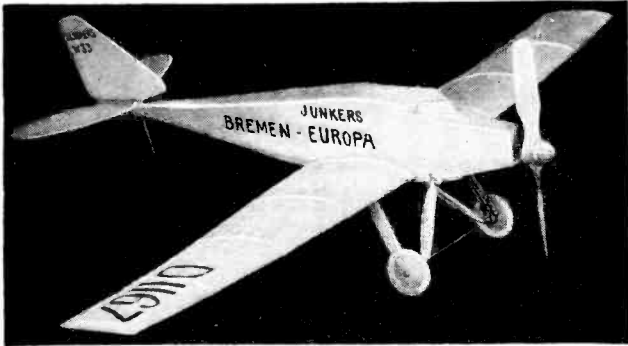
The glass is placed over a trap in the magician's table, the inside of which contains a tin cup, into which the milk freely flows, while the goblet is still covered.

Build and Fly

this Model "BREMEN" Plane

Veteran of Trans-Atlantic Voyage Lives Again in Model Form. Complete Details for Construction and Flying Given in These Pages

By Armour F. Selley



Here is the "Bremen" model constructed by the author himself. It flies, too!

WHETHER you're fifteen or fifty, there's an awful lot of fun in store for you in building this new model airplane. Remember the famous Junker plane—the *Bremen*? Of course you do. Remember the two German noblemen and the brave Irish Captain Fitzmaurice, who attempted a flight to America from Germany? And of course you remember that after almost three thousand miles of flying through the most difficult weather conditions, the plane was finally forced down on a tiny fishing island off the coast of Labrador. Well, now you can build the same ship which made this wonderful voyage, in miniature of course, and *actually fly it*. Follow these plans, our blueprints and our instructions, and you will have no difficulty in making this scale model of the famous Junker *Bremen* plane.

The first thing to do if you purpose to construct this plane is to carefully read over the directions given below and to study very carefully the "Key to Parts," whose numbers correspond with the numbers on the opposite page. All the component parts for the construction of this plane are available in kit form, but if you desire to do this part of the work yourself you will find the instructions complete enough to do so. And our parting shot, before we hand you the construction details, is that you use ambroid for cementing purposes. It is much neater and much more satisfactory than common glue.

Fuselage

THIS is constructed by joining together the two formed sides supplied in the set. Compression struts (3) should be carefully cut away according to the dotted lines on the drawing, to reduce weight. Also enlarge the drilled holes in anchor plate (12) to lighten the weight. Join the cross struts (7) and cabin brace (14) to fuselage sides with model nails. When all cross members are in place, coat each joint with ambroid, square up assembly and allow to dry. Form cabin roof (15) according to drawing and bevel front edges. Fit and glue it into place, bracing front point with cabin brace (13) as shown. Cut out two celluloid windows according to template (16). Bend to form a right and left window and glue into place.

Cut nose piece (1) according to template. File out $\frac{1}{8}$ " notches at the corners for longeron seats and at the top of center hole file a $\frac{1}{4}$ " square socket to take propeller hanger (19). Drill two $\frac{1}{32}$ " holes for wire clip (26). Apply ambroid to front fuselage struts and longerons and set nose piece into place.

Fit and glue reinforcement pieces (11) in place to form wing spar socket spaces (9) and (10).

First drill and file out hole in rear motor stick support (4), then glue to upper and lower horizontal cross struts.

Tail block (5) is supplied with two holes for stabilizer (35). Drill an $\frac{1}{8}$ " hole at right angles to the others, as shown in Fuselage, Top View, of drawing. This is to accommodate tail skid (41). Taper block to fit between the longerons and nail as well as glue into place.

Covering: Outline on bamboo paper with a pencil the side to be covered and cut roughly to size. Apply white glue to the longerons, attach paper evenly and trim. Cover first the bottom, next the top and then the sides.

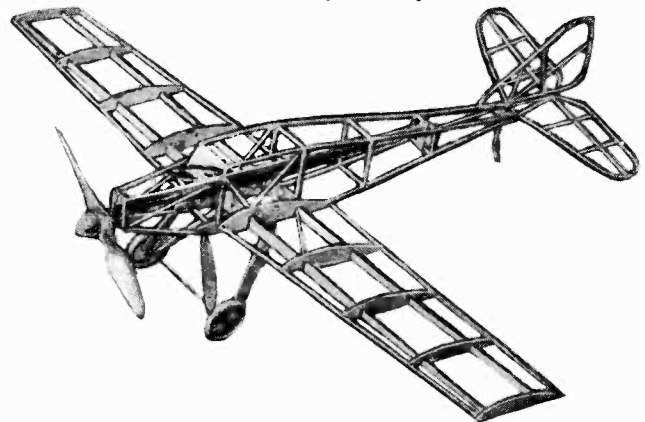
Doping: Apply coat of dope, thinned according to directions.

Motor Unit

THIS is a separate unit, built so that it may be removed from the fuselage. Stick (21) should be cut to the exact length of drawing and reinforcement pieces (24) and (25) attached to each end with ambroid. It is important that the rear reinforcement pieces (25) are placed exactly as shown, in order to form a stop against the rear motor support (4). Drill a $\frac{1}{16}$ " hole in motor stick for motor hook (23). Insert and bend as shown. Square front end of stick to fit propeller hanger (19). Insert wire through hanger and form wire clip (26) to fit the two $\frac{1}{32}$ " holes in nose piece (1).

Carve propeller (17) according to directions and attach spinner with glue. Hold propeller in place on shaft (20) with small wood screws (44), inserted through the flange. With spacer bushing (27) in place, insert shaft (20) through hanger (19).

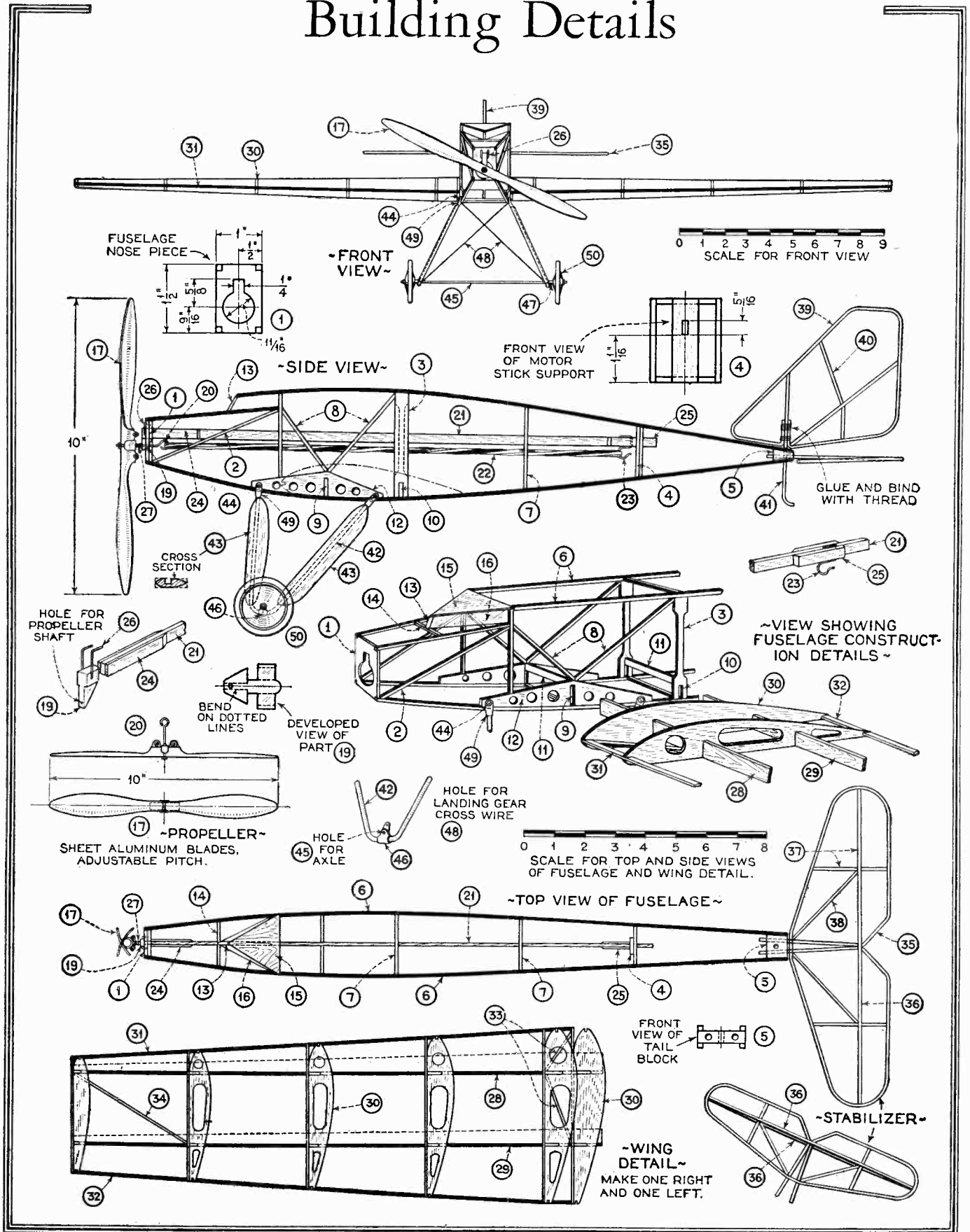
This skeleton view of the "Bremen" model plane shows the simplicity and soundness of its design.



Use a motor of 12 or 14 rubber strands, depending upon the weight of the model. This must be determined by test flights. Loop rubber evenly before attaching to hook (23) and propeller shaft hook (20).

Now that the fuselage has been considered, the motor unit taken care of, let us turn our attention to the landing gear. (Continued on page 1051)

Here Are Simple and Complete Building Details



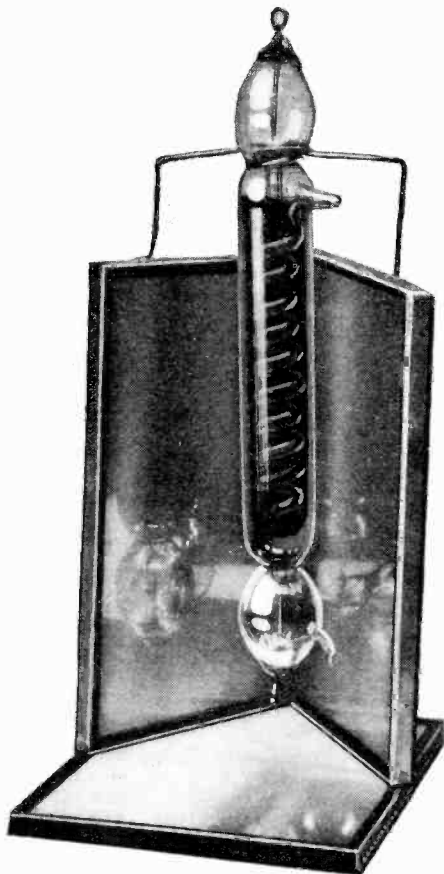
Follow the above drawings carefully. Note the "key numbers"; they are vital to the success of construction. All the material is available in kit form if so desired. Every part is drawn to scale. The top, side and front

views are all shown, besides the detail of the wings, fuselage and propeller. The model was built first, the plans were then made, the plane was built according to the plans; so that success of construction is insured.

Have Some Fun With Cold Light!

Do You Know How to Make a Lamp Glow—Without Current? Can You Obtain a Light—Without Heat? Read This Article and Find Out How to Perform This and Other Interesting Experiments With "Cold Light"

By Raymond B. Wailes



A Geissler tube of the fluorescent liquid type mounted between three mirrors, one horizontal and two vertical, gives fine effects.

LIGHT without heat is almost as inconceivable as fire without smoke. The man who has burned his fingers on a hot electric light bulb or singed those same digits on a kerosene or gas flame knows full well that there is plenty of heat with light. But the twin phenomena of chemistry and biology—phosphorescence and fluorescence have long puzzled and amazed students of the laboratory, for they have found that certain chemical substances—organic and inorganic—will give a varying degree of illumination with a negligible amount of heat. In fact this type of light is the most efficient known, as it does not lose its energy through heat losses. The fascination of playing with these substances in the laboratory or home is enhanced greatly by the remarkable colorations of the light and the scintillating effect of certain crystalline substances. And in addition, the experiments are simple and of moderate cost.

A speck of fluorescein dissolved in water made weakly alkaline with an alkali, such as sodium hydroxide or lye, will cause the water to fluoresce beautifully. If viewed in the dark immediately after exposure to the light it will be found that it no longer glows, or fluoresces, hence it has no phosphorescent properties, for only phosphorescent bodies glow or emit luminescence after the source of light has been removed. Fluorescein can be made to phosphoresce very brightly, however. Heat several crystals of citric acid in an evaporating dish and drop in a speck of fluorescein. Stir with an iron rod. Extinguish the flame and darken the room. The fused mass will phosphoresce brightly with a decided greenish glow. The writer has been able to read print held an inch away from the glow.

Oyster shells and sulphur heated together produce calcium sulphide of the phosphorescent type. All calcium sulphide is not phosphorescent. Only the kind listed as luminous calcium sulphide in chemical price lists should be used for a pretty little experiment which the writer discovered.

This experiment was performed with the so-called blinking lamps which light half the time and are extinguished the other half of the time. By making a weak gum arabic solution, or varnish, coating the bulb of the light and dusting on luminous calcium sulphide, the lamp is able to emit light continuously. When the filament is hot the usual light is thrown out. When the blinking button in the base of the socket cuts off the current, the phosphorescent calcium sulphide glows with its characteristic bluish light, of course not as bright as the normal brilliancy of the lamp. The effect is rather novel, particularly when an extra strong luminescing substance is used and the lamp is of low wattage. A cloth can be tied over the mouth of the uncorked bottle of luminous calcium sulphide to make a sifter with which to coat the lamp.

Another curious substance is *salophen*, which can be purchased at drug stores. When a bit of this white substance is crushed or rubbed with a hard object, little flashes of light will be emitted. A few crystals placed in a test tube and another test tube slightly smaller than the first thrust inside the larger tube and rotated, will produce hundreds of little scintillations. This

crystal - luminescence is called crystallo-luminescence. Calcium sulphide coated on a card will soon cease to phosphoresce if taken into a darkened room. If the card is heated, it will begin to glow again. Several different kinds of wire such as copper, iron, brass, etc., laid on the coated card can be used in a rather novel experiment, nicely illustrating heat conductivity. The wires all come together at one of their ends, while the wires themselves are spread fanwise. If the common touching spot of the wires is (Continued on page 1050)



A blinking lamp coated with luminous calcium sulphide gives very interesting effects due to phosphorescence.



Preparing a fused mixture of fluorescein and citric acid in air-evaporating dish. This mixture gives bright phosphorescence.

Make *that* Wet Cellar Dry

By Josef W. Von Stein

Waterproofing Is the First Step in Making Your Basement a Livable One

"SAY, Bill," said Harry, tendering a light to Joe's cigar, "I was telling Joe the other day about the good luck that we had in refinishing our walls."

"I'd like to come over to your home some evening Harry, to see what your refinished walls now look like," said Joe. "Incidentally I'd like to have a look at that watery cellar of yours."

"If you really want to see something rare you ought to see Bill's duplicate of the famous Luray Caverns of Virginia," said Harry.

"Really?" queried Joe, turning to Bill. "Why don't both of you try to waterproof your cellars? I'm having my cellar waterproofed; and believe me, I'm going to get some mighty good use out of this extra floor."

"That's all very well for you, Joe," said Bill. "You're building. But don't forget our homes are already finished."

"Exactly," replied Joe, "and that is no reason why you must tolerate damp or wet cellars. The trouble with both of you is that you don't realize how comparatively simple it is to obtain a perfectly dry extra floor of living quarters."

"I wonder if you realize that air from the cellar is constantly rising through all the rooms of the house. It isn't surprising therefore, that damp or poorly ventilated cellars are generally the direct cause of that peculiar musty odor prevalent in some homes."

As Joe stopped momentarily to re-light his cigar, Harry asked, "Do you mean to say that we can transform our cellars into habitable quarters with no outside help?"

"You can—with a little energy—and at a moderate cost. That is, if you aren't adverse to

getting a trifle grimy. Of course, there are organizations who will do the work, if you so desire. For example, the other day I had a talk with one of these concerns. If I remember correctly, their name is 'The New York Waterproofing Service.'"

"But when you speak of our doing the work ourselves, Joe, do you mean that Bill's problem is identical with mine?" asked Harry, perplexed. "You know Bill has merely a damp cellar, while I have to wade through a lake."

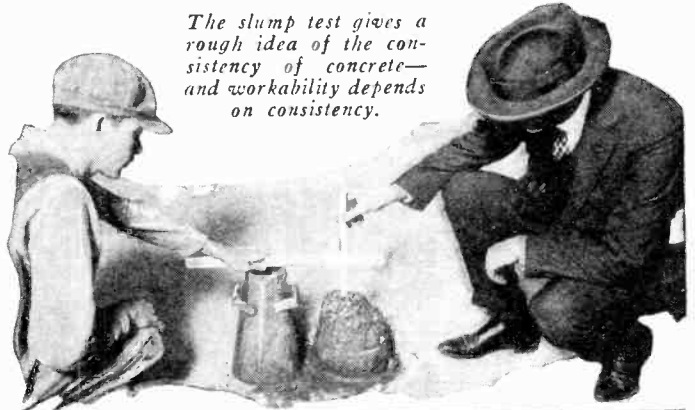
Joe shook his head. "No. The exact manner of treatment depends, of course, upon the manner and amount of seepage. Remember, though, that the concrete mixture must be of the right consistency. You can be sure of getting definite and concise data on this point from the Portland Cement Association. They've a manual on this subject."

"Generally speaking, there are two distinct ways of treatment. One type entails treatment from the outside of the walls; it is the one I am using. The other type—and the one I believe you will find more convenient for finished houses—entails treatment from inside."

"But I thought that there are innumerable methods of waterproofing cellars," Bill interrupted.

"You mean that there are various different treatments that fall within these two major classifications," corrected Joe. "For example, some methods entail the use of a simple Portland cement mixture applied in various ways; while other treatments

The slump test gives a rough idea of the consistency of concrete—and workability depends on consistency.



Here are stiff, medium and wet mixtures of concrete after the slump test.

involve the use of such mixtures combined with some patented waterproofing compound, such as are manufactured by a number of concerns."

"Do you recommend plain Portland cement or the waterproofing combination," inquired Harry.

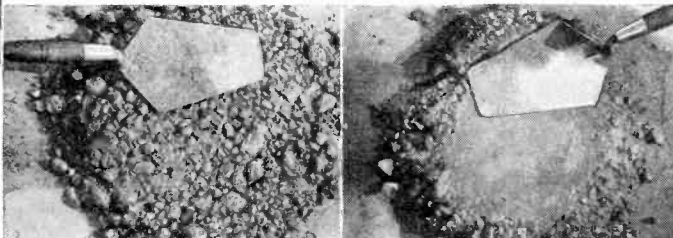
"That, Harry, is a matter of personal preference, as far as I have been able to discover," advised Joe.

"You might write to the Anti-Hydro Waterproofing Company, and the Sandusky Cement Company who manufacture a full line of waterproofing powders and pastes as well as the well-known 'Medusa' White Portland Cement Company."

"I, personally, am in favor of three concrete methods. One method I am having applied in my own individual case; another method of treatment is for damp walls; a third method is for cellars having (Continued on page 1055)



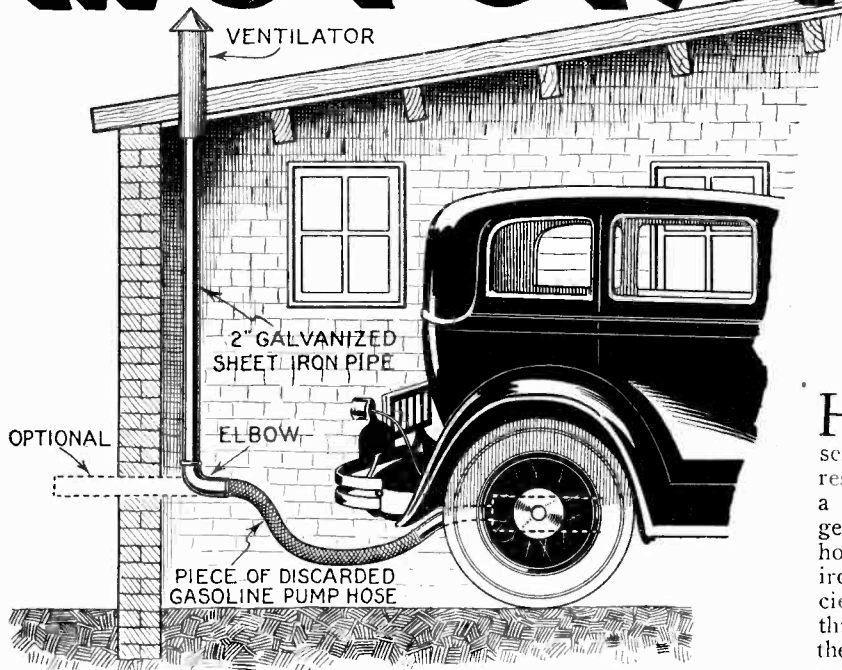
The mixture above shows an excess of cement-sand mortar. The yield of concrete here will be low and probably porous.



The mixture shown at the lower left contains insufficient cement-sand mortar to fill spaces between pebbles; to the right of it is shown a correct mixture—it will give the maximum yield of concrete. On masonry walls with a coarse texture a scratch coat can be directly applied.



MOTOR HINTS



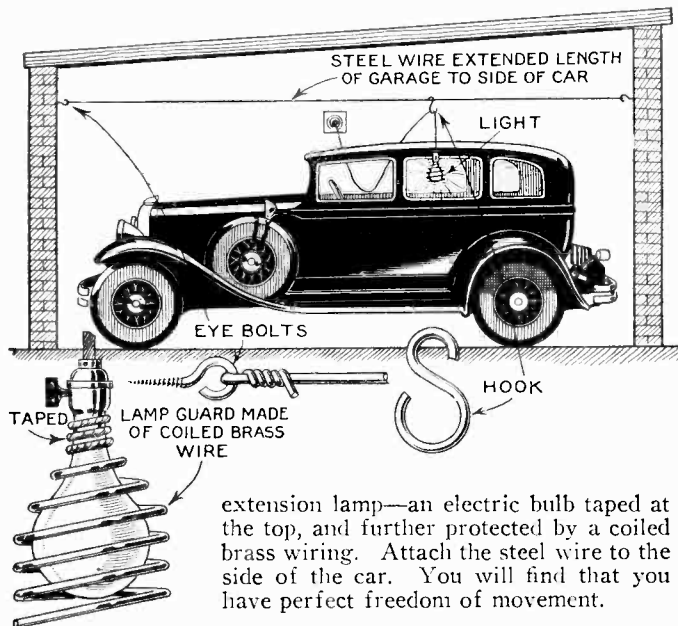
By George A. Luers

Eliminate All Danger of Carbon Monoxide Gas

HAVE you ever worked in your garage for a few hours, and come out with a heavy, dizzy sensation? *Deadly* carbon monoxide gas was responsible for your groggy feeling; yet a few minutes of work will eliminate its dangers. Merely attach a discarded gasoline pump-hose to the exhaust pipe, join to it a galvanized iron pipe (about 2 inches in diameter is sufficient)—and have an exhaust ventilator extending through the roof. A still simpler way is to run the galvanized pipe through the wall of the garage and lead it up to the roof.

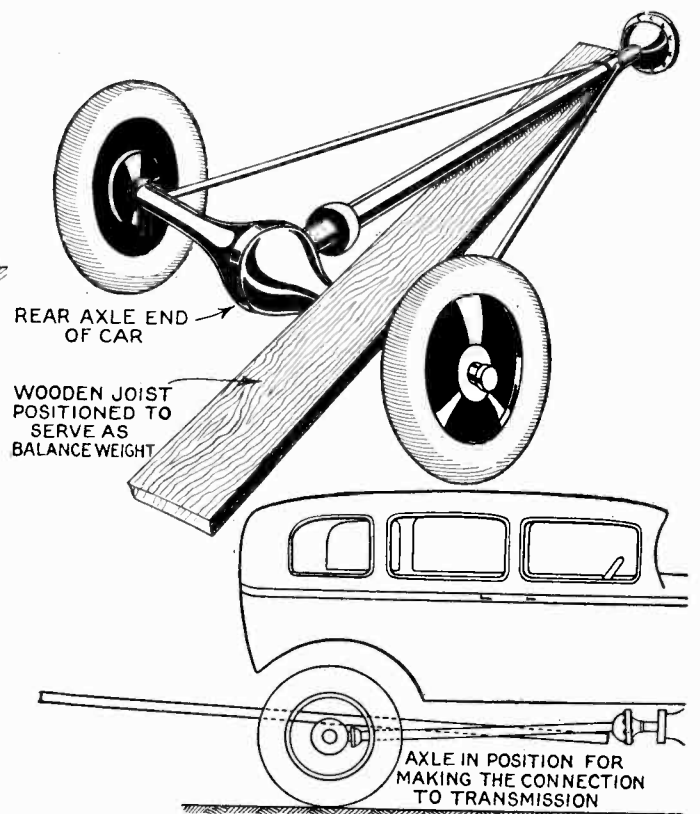
Make a Safe Extension Light

WORKING in a dark garage with a fixed light is impossible. The lack of support provided the usual extension light makes it impracticable. Pick up a few odds and ends and fix the extension light so that it will be serviceable into the farthest corner—and safe. Provide a tight wire whose length equals that of the garage—to it attach a hook, adjustable the full length. This hook will hold the



How to Replace the Rear Axle

HOW often we've wished some one would think up a way of connecting the joints at the transmission, while assembling the rear axle. We never realized that a common, ordinary beam of wood serves admirably. Just counterweight the axle assembly with a beam—rest it on the axle housing, one end under the drive tube. Leave enough of the log overhanging to balance. Then you can move the axle assembly readily, and the universal joint connection freely fits into position. One of the most difficult jobs in keeping the car fit will have lost its terrors.



DO YOU KNOW—clutch spinning which makes it difficult to engage gears is controlled by the transmission? If light gear oil allows the clutch to spin, a heavier lubricant in the transmission will act as a clutch brake.

Sound Detecting Is Job for Real Sleuth

By Walter Raleigh

WE fuss and fume over the radio loud speaker, the impatient automobile horn, and the builder's crescendo. Yet no one as yet has invented a method of measuring the volume of noise—a method which would be satisfactory to both scientist and layman.

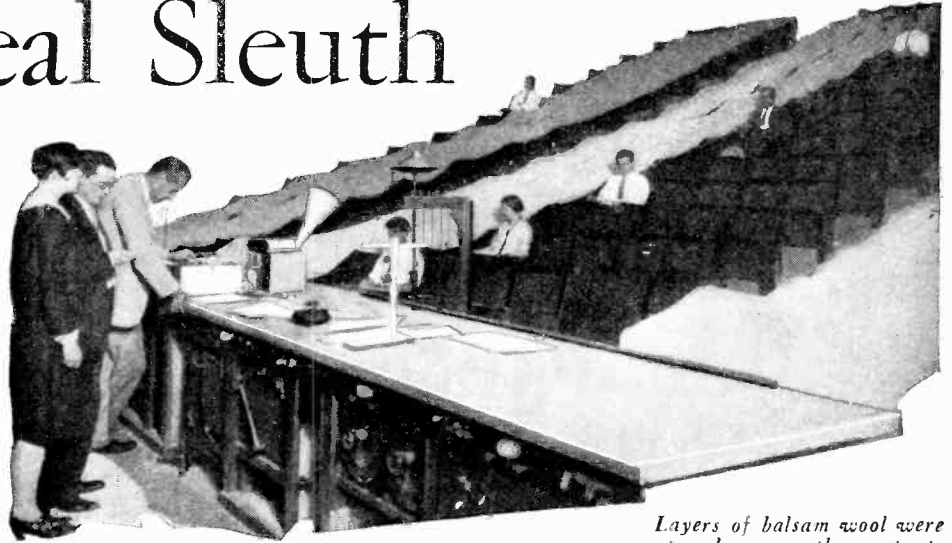
We need a simple, accurate noise gauge. Our protests have become too much a matter of opinion. The difference between sound, noise, racket and music depends too much on viewpoint and education.

Science has used audiometers to measure sound, but these must be used by trained investigators. No policeman on his beat can pull one out of his coat pocket when he hears a late party making whoopee, and gather data to decide for him whether to make arrests or resume his beat. Moreover, the officer would have to trail the unlucky noise to its source—a task harder than that which falls to a bloodhound. For sound can do phenomenal things!

Sounds have a way of increasing or decreasing in intensity. The pitch of a sound has much to do with the effect of that sound on the ear. A rasping sound of low volume may be more disagreeable than a much louder musical one. To be practical, the portable sound indicator would have to correlate all these factors and give an automatic answer.

It is not so easy!

Dr. R. F. Norris, of the Burgess



Layers of balsam wool were spread across the seats to control the voice reverberation period, when phonetic experts co-operated in intelligibility tests with Dr. Andree, of the Burgess laboratories. Dr. Andree is at the acoustimeter.

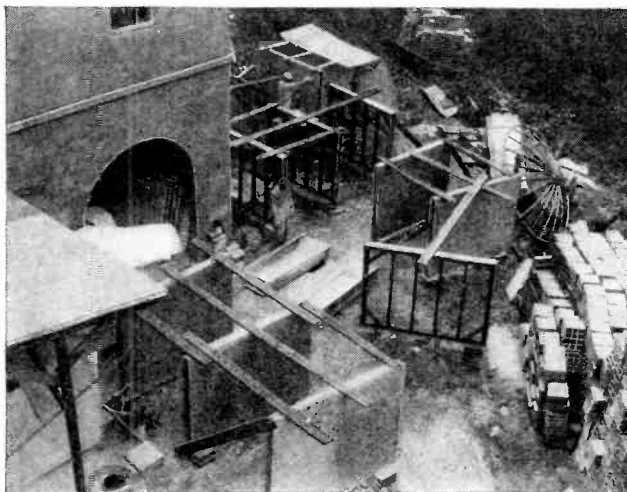


With an iron bar, an oscillator, and a Derby hat Dr. Norris makes musical sounds fill the air.

Laboratories in Madison, Wisconsin, has discovered how sounds carry to unexpected places. Shaft-ways for elevators, dumb-waiters or ventilation devices act as speaking tubes. Even the simple framework of a building, a

single joist, can transmit melodies or noise just as a telephone wire can do. And once transmitted, sound travels strangely. A watch can not be heard at a distance of more than eight to ten feet, under normal conditions. But hold the same watch at the end of a long iron or metal rod and it sounds as though it were held to the ear!

Dr. Norris showed us a strange-looking apparatus consisting of a long rod and a Derby hat. At one end of the rod, which was held rigid, he placed an oscillator. The vibrations set up in the rod by this device resembled those made by the blows of a tiny hammer. At every beat the rod would move a bit away from the hammer and then swing toward the (Continued on page 1044)



Modern building science has devised packing by which dance floors are made sound proof. Spaces are left between structural parts to prevent bothersome sound-travel beneath the floor. In pursuit of knowledge about the sound-carrying qualities of building materials, the Bureau of Standards makes and breaks numerous houses like the one shown at the left.

THE SAFETY

Readers' Opinions and Comments



Does Ouija Board Work?

YOUR article in the January issue referring to the subject of the Ouija Board is very interesting.

Some years before the war ended my brothers cut out a piece of cardboard in



the shape of a heart; two matches were put in at each lobe of the heart and a pencil was pushed through the point. The right hand of the two individuals was then placed on the heart and these persons were told to think in unison. We found that if you do not doubt the ability of the instrument, it will answer any or some of the questions asked of it. If you doubt, it will not write out the answers to the questions. When we asked how long the war would last, it wrote out "four years." Many other questions were answered with the same uncanniness. If you doubt my word you might refer to the Reverend Mr. Rogers of Knox Church here who will attest to my veracity.

J. L. FRANKLIN,
Owen Sound, Ont., Canada.

(The construction of the heart-shaped devices which you describe was sold many years ago under the popular name of the Planchette: Some of these Planchettes were equipped with wheels on the two rear legs and a pencil near the point of the heart-shaped wooden plate; others had smooth wood runners. As a general rule, it is a good deal easier to get a tangible message with a Planchette than it is with an Ouija Board and a message can even be obtained when both individuals operating the Planchette are blindfolded. Nevertheless, the statement we made in the previous article still holds in the present case. The Planchette is primarily controlled and operated by one or both of the individuals whose fingers are on the wooden plate. Ask for an answer to a question, to which neither of the operators knows the correct reply, and the Planchette will not operate. Write a message on a piece of paper, seal it in an envelope and then ask either or both of the operators, or the Planchette itself, to answer the query and the Planchette will not function. Neither the Ouija Board nor the Planchette can lay any claim to the performance of things supernatural. They both belong to the same class.—EDITOR.)

Exercise Helps Weak Eyes

I NOTICED an article in the November issue by you to the effect that weak eyes cannot be helped in people over 25 years of age, by the use of special exercise. I beg to disagree with you. I have seen cases of weak eyes helped by exercise and to such an extent they were able to discard their glasses or "eye crutches" permanently. I am not attempting to dispute the fact that

eyes impaired by accident cannot be remedied, nor can eyes that are weakened by old age be helped to any noticeable degree, but I do maintain that weak eyes can be improved to a very great extent by exercise, not for the eyes alone, but for the muscles throughout the entire body.

No doubt you are acquainted with the chemical process within the body known as metabolism, which is the tearing down of old cells and building up new cells. That explains why a man who works hard all day doesn't progress in muscular strength. He simply tears down as fast as he builds up, while exercise builds up to a certain point and stops there.

When you say a man over 25 can't improve weak eyes by exercise, you might also say this is true of the muscular system.

It is true the body matures at a certain age, but I have known cases of men developing their bodies into athletes after the age of maturity. The same principle applies to weak eyes which is after all a muscular organ. Let's hear some more about this subject next month.

CHESTER FULK,
Toledo, Ohio.



(The exception never proves the rule; obviously, any reasoning applied to a man building up the muscles of his body and tearing them down by exercise can also apply to the eye. If metabolism works such hardship on an individual who uses his muscles all day, then that same metabolism works an identical hardship on the eyes, which are used more than any other muscles of the body, with the possible exception of the heart and the diaphragm. We have held that any eye exercise carried on for a period of ten minutes to thirty minutes would be of no material benefit to an individual who then proceeds to make the same mistakes that he has been trying to rectify, over an extended period of twelve to eighteen hours a day. This is particularly true of individuals over 25 years of age who find it necessary to use their eyes, even though the other muscles of their body are sluggishly employed, if at all.—EDITOR.)

A. M. A. Versus Diagnostic Machines

HAVING read your answer to E. Meistring of Albuquerque, N. Mexico regarding the Radionic machine, permit me to say there is not anywhere in the world a medical man who would use, or advocate the use of any machine such as the Radionic or the Pathoclast machine for the purpose of diagnosing, even though the accuracy of this same machine should be demonstrated to him to his entire satisfaction. Any time an M.D.

admits any method or machine, which will help humanity to regain or maintain better health, its origin must be discovered in the laboratories of that profession.

I, as the daughter of a trained nurse, with two sisters trained nurses, can tell you much about the doings of the A.M.A. It is too bad that poor unfortunate sick people seeking health advice should write to you and have you give them advice which you have obtained from men who are directly opposed to anything they have not had a hand in discovering.

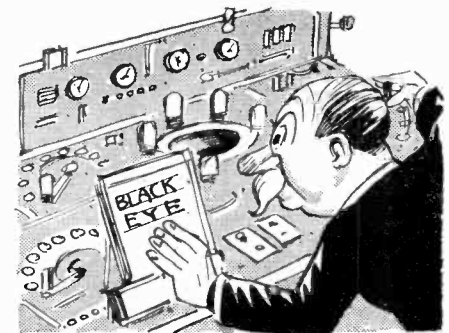
I have had a personal experience with a complete Pathoclast diagnosis, and have gained my health through the advice of the men using the same and the sane and sensible drugless methods of healing. I have spent ten years in following the guess work of the so-called scientific medical profession, but am glad to say I was awakened to the absolute folly of their methods.

I would suggest you investigate, for your own self enlightenment, the subject of diagnosing by the various machines before you give a biased opinion to the public.

ERNA PALMER,
San Francisco, Calif.

(Actual experience has taught us that many members of the medical profession are willing and even anxious to improve on their methods of diagnosis. They will take up any machine which bids fair to become perfect, if not already perfect, and they will develop this machine to a stage of perfection. The medical profession is today using thousands of different devices, mechanisms, appliances and machinery which were not devised by any member of their profession. They would do the same with a diagnostic machine, providing that one were produced that did the work. To recount an experience, this writer was called up by some of the best known medical men in the field, who received the surprise of their lives when a diagnostic machine gave absolutely correct diagnoses in three test samples submitted to the operator of that machine. A second test was arranged by us. On this occasion 24 samples of blood were given and not one correct diagnosis followed. A third test with 12 samples also proved totally worthless. The reason for the latter two failures might be ascribed to the fact that this writer suspected a certain reporter of being closely allied with the sponsors of the machine and ordered him excluded from the hospitals where the test samples of blood were taken.

You may rest assured that SCIENCE AND INVENTION Magazine for one, will see to it that every diagnostic machine, submitted by inventors, is given a fair test. Such machines should preferably be devoid in their circulars of absurd verbosity.—EDITOR.)



VALVE

Will Be Welcomed by the Editors

The Imaginary Death Ray

WOULD be pleased to have you advise me what you know about any kind of a wireless device with which a person can shock another severely to the point of death over a considerable distance without coming in direct contact with him or through the use of wires, etc.

That such a discovery as this has been made I am positive. I have heard that the Department of Justice frequently makes use of such an instrument as this in persecuting anyone they are after. An ex-agent has informed me of many startling things that can be done with this device such as covering a person's body with electric burns and blisters, etc., all from a distance. Since I have heard from others of this discovery having been made and have spent some little time trying to obtain information about it, I have little cause to doubt the foregoing.

What I am interested in is in finding out all I can about the matter and being so far away from the States, I hardly know just where to make intelligent inquiries. Inasmuch as I have read many articles of a scientific nature in various periodicals for years that you have written and as you are so well informed on all late scientific matters, I thought that perhaps you might be able to help me.

I make this request because you are in the position to be hearing of new discoveries constantly that I perhaps would never know of, so far away as I am down here.

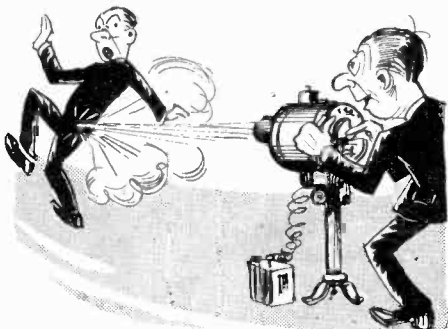
DR. HARRY E. A. EVANS,
Callao, Peru.

(Periodically in the newspapers throughout the country one will read a story about someone having invented a death ray machine. Such machines are supposedly used for the purpose of destroying enemy fleets and are supposed to produce burns when at a distance from the individual operator of the mechanism.

Nevertheless, every investigation of such claims has proven that the mechanisms do not exist.

About three years ago we conducted a very important investigation into this idea to determine whether a death ray machine could actually be built. We came to the conclusion then that there was nothing known to science today that was capable of projecting a ray which could produce a burn at a distance with the exception of the arc lamp.

Operators exposed to the rays of such arc lamps would get a burn the same as sunburn. Electric burns and blisters cannot be produced by any other agency. X-rays could also conceivably be pressed into the service,



but they could not produce any disastrous results at any great distance without the tube being focused on the individual and there is no way known today in which X-rays can be focused. The so-called odic ray and the various other forms of death rays simply do not exist.—EDITOR.)

The Theronoid — the Electrical Health Belt—Again

I AM enclosing some literature on the Theronoid that was sent to me, and I am sure it will interest you and your readers, as it is about, if not the same, as the Ionaco, the device you exposed a short time ago in your wonderful magazine. I am one of your most interested readers.

HOWARD MICHAELSON,
Zumbrota, Minn.

(You are correct in your surmise. The Theronoid is very similar to the Ionaco. As a matter of fact, Mr. Phillip Ilsley is President, Treasurer and General Manager of the Theronoid Corporation, and was at one time employed by Gaylord Wilshire, promoter of the Ionaco. He later operated the Ionaco offices in Duluth, then in Cleveland, after which he split with the Ionaco Company and organized the Theronoid Corporation.



The Theronoid is an appliance in the form of an oval approximately 18 inches in diameter, large enough to encircle the body, consisting of a coil of wire covered with imitation leather. The appliance is attached to the electric light circuit and made to sell for from \$40.00 to \$75.00. The company claims that it is of value in the treatment of many ailments. The Theronoid produces a fluctuating magnetic field which is as valuable a curative as was the Ionaco. Our readers will remember that SCIENCE AND INVENTION Magazine stated that the Ionaco was wholly worthless, and that magnetism has no curative value whatsoever on the human organism.

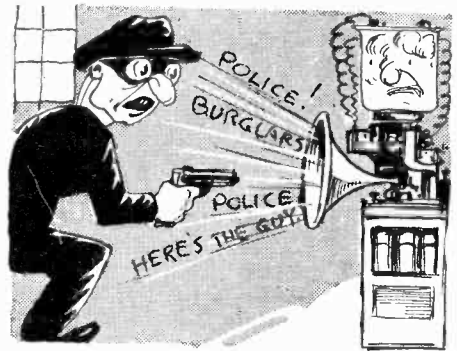
On November 19th, 1927, several months after the article on the Ionaco appeared in this publication, the Federal Trade Commission issued a formal complaint against the company which contained the following allegation: "In truth and in fact, said device when applied to the human body has no curative or therapeutic value, action or effect." The Ionaco device was also the subject of action by the Post Office Department but the action was withheld when the company agreed to cease business. Since that time many imitations of Ionaco have appeared on the market. Why action against



one organization cannot be immediately applied to others of similar or identical ilk is something which we may some day be able to determine.—EDITOR.)

Far Fetched Science and the Sureté

I AM sending to you an article from the Seattle Post Intelligencer, "How Science Unravels Crime Mysteries in the Foreign Detective Police Laboratories of the French Secret Police."



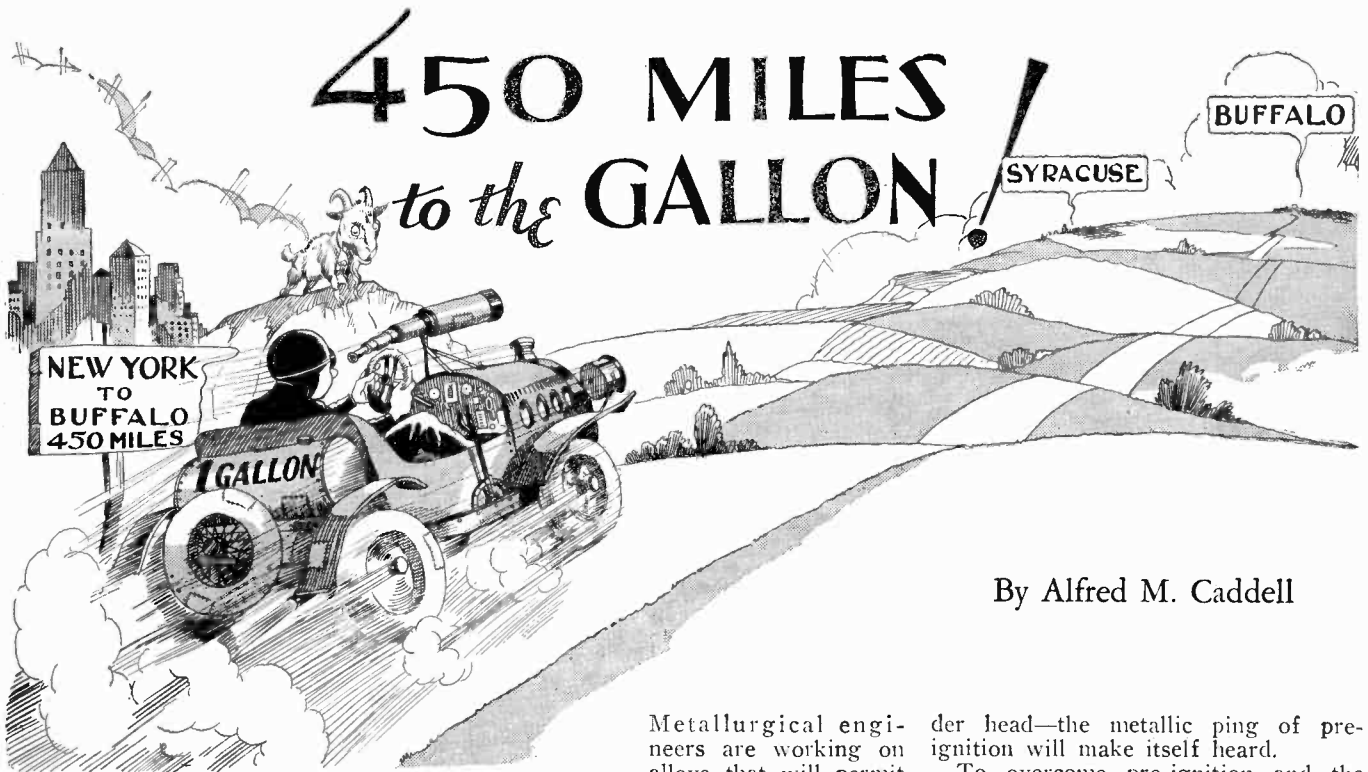
After looking this over I cannot see where one single bit of science shows up, the two operatives went out and got the wrong man. That I think was intended to compare with our own system. Then the scientific detective unfolded a tale that if presented by an American detective in an American Court, the detective would be turned over to a sanity commission. In the first place, granting all was so, did not the operatives let the criminal kill the woman and then get away from them in the end, when an American detective would have burst in and taken the criminal when the woman charged him with murder and they overheard it, and thus save her life also?

Would you kindly publish a comment on this article in your next issue—Could Brains Float in Jars, Living Brains with Electrical Nerves, and Talk Out of a Horn? And do you consider that the Surété system is better than our own?

WM. SIMMONS,
Kelso, Wash.

(Far-fetched science seems to be the bone of contention of some of the feature writers for Sunday newspapers. It is absolutely ridiculous and absurd to assume that brains could be kept alive in jars and that hundreds of thousands of electrical connections could be made to the nerves and those nerves in turn be made to operate loud speakers. The nerves of man merely control the muscular structure of the vocal cords. They also control the movements of the mouth and the movements of the diaphragm, so that individual sounds, words and phrases can be produced by those muscular structures, all operating in perfect coordination or in unison. No device has ever been conceived which could even remotely produce such an effect.

No, we do not think that the Surété system is better than the American system for the tracking down of criminals. Even the American system would be much better if all of the graft, or let us say much of it, were eliminated.—EDITOR.)



By Alfred M. Caddell

A PIPE DREAM!" you may say. No, a mark for American inventive genius to shoot at. Such a mileage per gallon may be impossible in any automobile known today, but there is no telling what may be accomplished when automotive engineers, metallurgical chemists, fuel and lubricating experts, road engineers and Mr. and Mrs. Driver get their heads together. The five per cent efficiency now obtained from gasoline reaches only a short distance up the ladder of possible performance.

The heat power latent in a gallon of gasoline is tremendous. T. A. Boyd, of the General Motors Corporation Research Laboratories, declares that gasoline contains far more potential energy than nitroglycerine or TNT—that the potential energy in a gallon would lift the Woolworth Building five and one-half inches above its foundation. Expressed in motor terms—the heat energy produced by burning a gallon of gasoline would perform the work done in raising a Ford touring car 10 miles vertically in the air, or in propelling it 450 miles along a level paved road at 20 miles an hour. An invisible, hair-like thread of the vaporized liquid suffices to drive a motor car. Yet this thread contains enough energy to do work equivalent to more than twenty times that obtained in the present four cycle engine, such as used on our cars and airplanes.

But the average motorist thinks in terms of 15 to 20 miles per gallon, for that is about all he gets.

How to obtain more miles per gallon of gasoline is one of the outstanding problems of motordom. Automotive engineers are trying to solve it with high-speed, high-compression engines, the increased compression of which results in greater expansion and a more powerful working stroke.

Metallurgical engineers are working on alloys that will permit an even and quick absorption of superfluous heat, which must be carried away to prevent injury to the motor. Fuel technologists are striving by means of "fuel alloys" to increase gasoline efficiency. Lubrication engineers are working toward oils and greases which will reduce the percentage of power lost through friction. Road engineers are laying smoother and more durable banked-turn roads, and a good deal of valuable information about economic driving is finding its way into the minds of motorists. Soon, therefore, we may expect to see five per cent efficiency increased to eight and ten per cent—which would mean a doubling of the miles per gallon.

Prevention of Pre-Combustion or Knocking

A MAJOR obstacle to the attainment of higher mileage per gallon has been the tendency of the gas-air mixture to ignite before the peak of the combustion stroke has been reached. Pre-ignition seems essentially to depend on the fuel, but it can be aggravated by increased compression, an over-heated, carbonized motor (the red-hot carbon serving as a perpetual-firing spark-plug) or by reduced engine speed combined with an advanced spark.

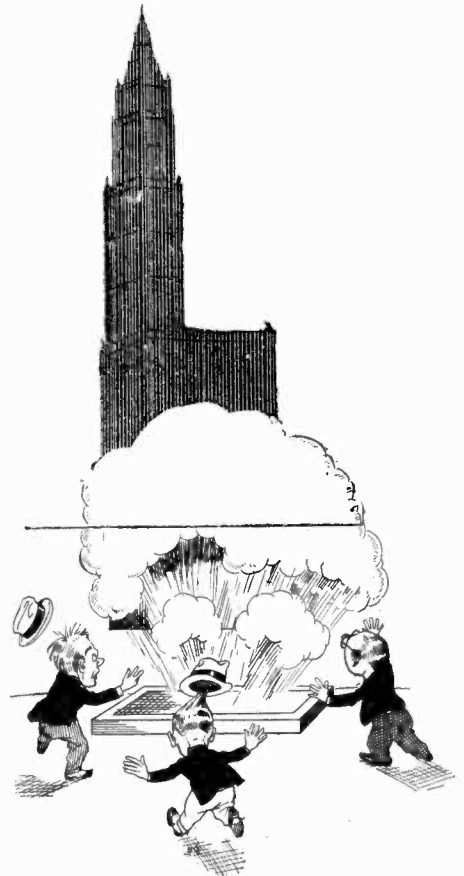
Various theories have been advanced regarding the cause of pre-ignition in the fuel itself. It is known that kerosene will cause knocks resounding like an anvil chorus and that some gasolines will cause worse knocks than others, while some grades will not knock at all under a 6-to-1 compression or less. But the moment engineers attempt to increase the compression in the firing chamber—that is, to lessen the space between the piston and cylin-

der head—the metallic ping of pre-ignition will make itself heard.

To overcome pre-ignition and the power loss which results, fuel technologists have been alloying gasoline with petrol, alcohol, ethyl tetrachloride and various other compounds (to delay combustion until the peak (?) of the stroke has been reached).

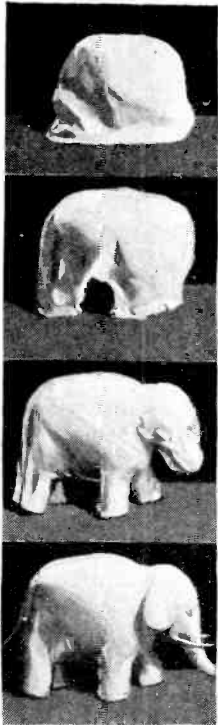
Could we achieve even a fair increase in compression with gasoline fuels, eliminating pre-ignition, mileage per gallon would be increased 100 per cent.

(Continued on page 1038)



Toy Figures Come to Life for Home Movie Makers

By Don Bennett



In the author's first completed film of the "stop-motion" type, a tiny elephant comes to life out of shapeless clay.

LONG winter nights give the amateur movie maker an excellent opportunity to get his films in shape and make the necessary titles for them. But unedited films won't last all winter, and it's a trifle early as yet to make titles for next summer's productions. So here's a winter movie idea.

Browsing through the "five-and-ten" the other day, we were struck by the variety of small toys that are offered for sale. Soldiers, Indians, toy cars and trucks only an inch or so in length, toy houses, dolls and a hundred and one other things. Suddenly an idea smote us hard. We dug down for dimes and bought two boxes of modeling clay. Hurrying home, we got out the camera and the lights, a roll of film and a tripod. We tightened the camera on the tripod and firmly chocked the tripod legs.

Then we kneaded the modeling clay into a soft ball and started molding an elephant. (An elephant is so

ungainly a beast that mistakes in modeling are hardly noticeable.)

The elephant finished, we placed him about fifteen inches from the camera, focused, and placed the lights. We forgot to mention that the camera was placed upside down on the tripod.

Carefully marking the place where his feet were located, we started shooting, a frame at a time. After shooting about thirty frames (single shot), we took a modeling tool made from a wooden meat skewer and started altering Jumbo's facial adornment. Pushing a little of the clay down at a time, and shooting a frame after every push, we gradually closed the tip of the trunk. After about five frames, the trunk was flat across the end. Then with a finger-tip we pressed on the end of the trunk, compressing it by degrees, shooting a frame at each change. We continued this until the trunk was just a mass of clay on the front of the head. While the trunk was getting shorter, we began to merge the ear on the camera side with the head. At length only the tip of the ear was free, and this finally was smoothed down against the head. We did the same with the tusks, rolling them up and finally

smoothing them into the mass. Then, still by degrees, we reduced the head to shapelessness.

We decided at the same time to pull a trick with the tail. As we changed the head we removed this member from the body and pressed it on again a little higher up, until it

reached the middle of the elephant's back. Then the body started to disintegrate. The legs gave way and became very thick and squat. The hind quarters and shoulders dropped down. All the time we kept the tail swaying back and forth. The elephant finally became just a mass of clay, with no identifying shape. The bottom of the pile started to spread out as if flowing. Finally it was a mere puddle. Last of all, the tail

slipped down and merged with the rest of the clay.

We shot about twenty more frames with no movement of the clay and called it a night. The footage meter read 50, indicating about two thousand exposures. The results on the screen made our efforts doubly worth while. Since the film had been made with the camera upside down, when reversed it produces the illusion of an elephant growing out of a mass of clay.

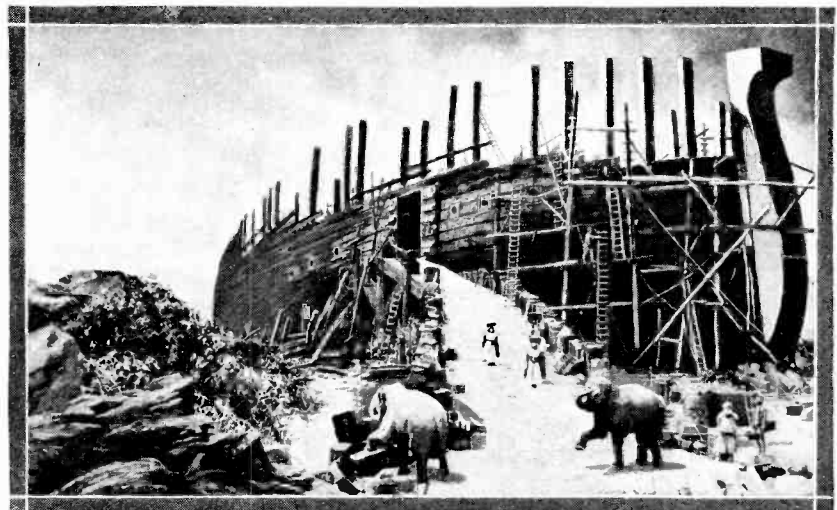
Later we tried a similar experiment with a modeled dog's head.

The same method of animation (*Continued on page 1042*)



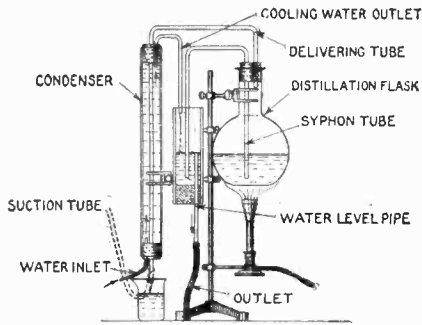
The elephant venture proved so successful that Mr. Bennett repeated the process with a modeled dog's head.

Professional Movie Producers Use "Stop-Motion" and Toy Figures to Present Spectacles Otherwise Costly and Difficult to Film. Mr. Bennett Tells You Here How to Utilize This Process "on Your Own" With Satisfying Results.



"Stop-motion" combined with double exposure—toy figures and a life-size ark—saved the producers an enormous bill of expense in the filming of "Noah's Ark."

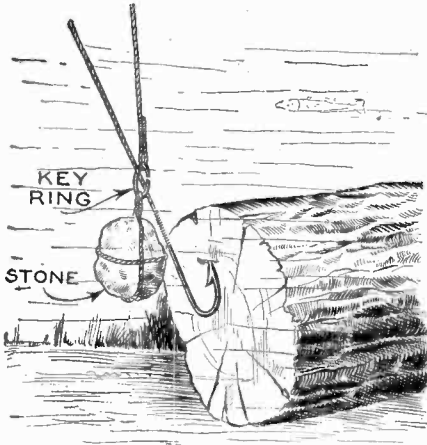
WRINKLES



Continuous Distillation

YOU laboratory experimenters can easily have distilled water all day long. Merely set up the distilling apparatus as shown in the illustration above. Start first with cool water, then insert a piece of rubber into the end of the condenser tube. Suck the air out of the apparatus until the outer air pressure compels the water to flow into the flask.—*Joseph J. Beczko.*

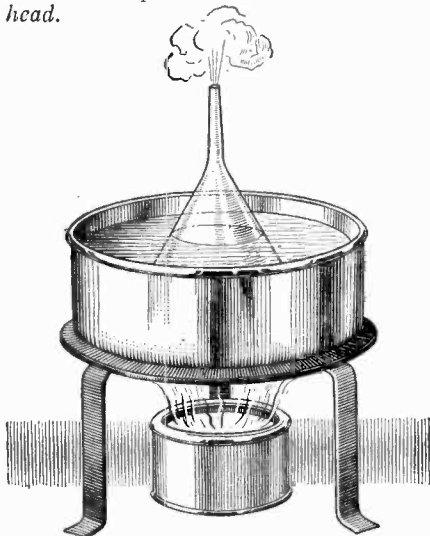
Anti-Snagging Fish Hook



IT is easy to prevent a sharp fish hook from lodging in some underwater log by attaching an iron weight to the line. This can easily be attached by splitting a key-ring and tying the weight to the ring which is then slipped over the line—*G. M. Crane.*

Easy Way to Clean Glass Funnel

PUT water into a beaker or saucepan to a depth of about three inches. Boil but keep the flame on and place the funnel upside down—*R. C. Woodhead.*



Household Tips

WHEN putting up bathroom fixtures on a plaster wall, use a hand drill and bore a hole for the screws. If the screws are started into the plaster without first making a hole, large pieces will chip out.

When having the roof of the house reshingled, caution the workers to cover the soil pipe vent that leads to the sewer. Pieces of the shingles often drop into open pipes, causing stoppage that requires expensive repairs.

A home-made incinerator is easily made by cutting the head out of a steel barrel, and it will be a cheap and efficient incinerator. The slight draft caused by the fire causes the fire to burn slowly, thus heating the barrel to a temperature above the kindling point of paper. The papers and trash burn completely. In the fall use it to burn leaves and weeds. When it rains, turn it bottom side up, to exclude snow or water.

A rust-proof paint which will resist all atmospheric changes is composed of 5 pounds of tallow and 1 pound of turpentine melted together. Melt separately 18 oz. of sulphur, 5 1/3 oz. of caustic potash, and 1 oz. of copper filings. Mix this with tallow and turpentine while hot and apply with brush just as you would paint.

To keep corners clean, also the space back of radiators, taken an old discarded broom and shape it to a point with the garden shears. Keep this handy in the kitchen for corners and for scrubbing out corners.—*Mrs. H. E. Chisman.*

Speedy Way of Removing Metal Burrs

IT is a tedious job to file or scrape the burrs from around a number of small holes in small pieces, and they must be taken off for a neat-looking job.

Emery paper, wrapped around a bolt about 4" long, with the head hacked off, can be held in a drill chuck. If the emery paper is wrapped opposite the direction of rotation with a piece of friction tape around the bottom, those burrs can be taken off without any trouble.

If a drill press isn't available, an electric drill held horizontally in a vise will do as well.—*A. O. Flinner.*

Separating Metal Parts from Dirt

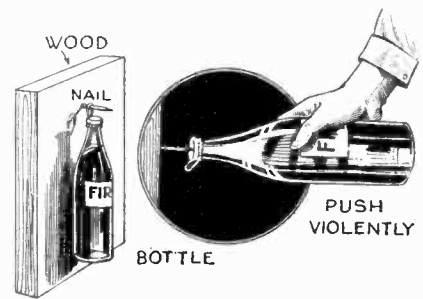
A SIMPLE way to separate dirt and dust from small metal parts, screws, nuts, etc. Pour the parts on a sheet of coarse sandpaper and shake the parts off—the dust will remain on the paper.—*William Scharpwinkel.*

For Cleaning Various Substances

Alabaster.—Use strong soap and water.

Black Silk.—Brush and wipe it thoroughly, lay on table, "display" side up; sponge with hot coffee strained through muslin; when partly dry, iron.

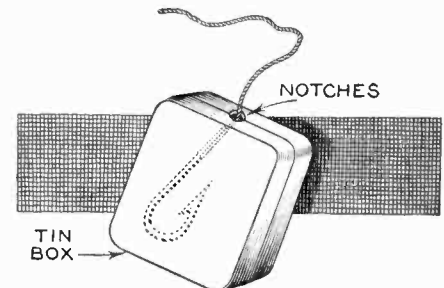
New and Simple Fire-Fighter



MOUNT a carbonated water bottle on a piece of wood. Drive a nail through the back. In case of fire, take the bottle from the nail, and hold it so the cap touches the nail. Press heavily on the bottle, and a stream will issue from it.—*Robert H. Crath.*

Prevent Fish Hooks From Dulling

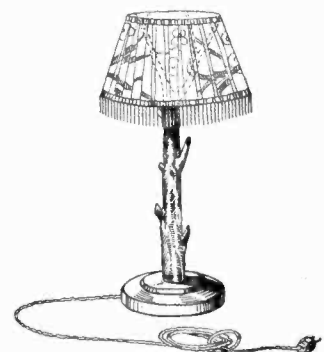
AN ideal and simple way of preventing hooks from dulling is to enclose them in a tin box. Cut a slit in the box so that the hook is allowed to



protrude as shown in the sketch. This method prevents the hook from rusting and saves the annoyance of unfastening the knotted line to the leader.—*G. M. Crane.*

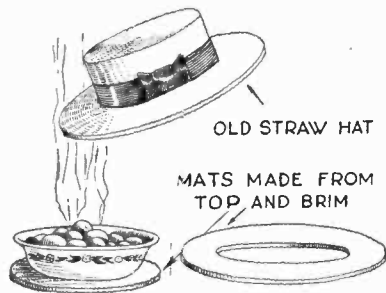
Rustic Table Lamp

A NOVEL rustic lamp can easily be made from a limb of a tree. Merely cut the base to the desired size and then insert the limb through a hole in the base, first drilling or boring a hole to accommodate the wiring.—*Paul A. Gallien.*



and RECIPES

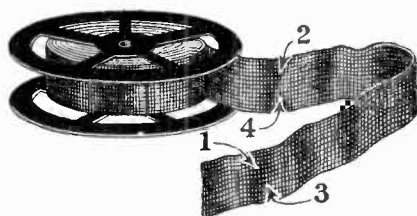
You Can Still Use the Old Straw Hat



THE brim and top from an old straw hat will make excellent mats for use in the household. The inner edges should be sown so as to prevent fraying. The appearance of these mats may be greatly enhanced by the application of a coat of lacquer or varnish.—*Dale R. Van Horn.*

Lengthening the Life of a Typewriter Ribbon

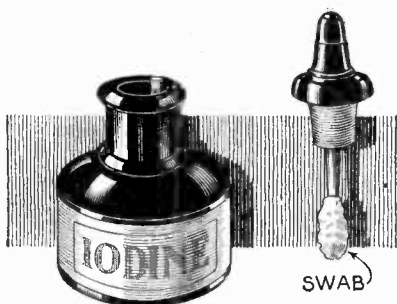
NOT only the front but the back of a typewriter ribbon may be used. I always use it like this. 1, the upper-row of the front side, 2, the upper row



of the back side, 3, lower row of the front side, 4, the lower row of the back side. In this manner the life of a typewriter ribbon is doubled.—*Kiyosi Kawahara.*

Handy Iodine Bottle

I HAVE found that an old bottle such as usually contains India drawing ink can be used for a handy container for Iodine. I merely wash the bottle in hot water and remove the label, then I remove quill used to fill drawing pens and insert a swab of cotton made from a match. The cork makes an ideal handle and does not allow the Iodine to stain the fingers, and the container renders the Iodine safer to leave around.—*Leslie F. Carpenter.*



To Remove Stains or Grease from Oil Paint.—Use bisulfid of carbon, spirits of turpentine, or if dry and old, use chloroform. These and tar spots can be softened with olive oil and lard.

Stains, Iron Rust, or Ink from Vellum or Parchment.—Moisten the spot with a solution of oxalic acid. Absorb same quickly by blotting paper or cloth.

Rust from Steel.—Take half ounce of emery powder with one ounce of soap and rub well.

Fruit Spots from Cotton.—Apply cold soap, then touch the spot with a hair pencil or feather dipped in chlorate of soda, then dip immediately in cold water.

Grease from Silks.—Take a lump of magnesia, rub it wet on the spot, let it dry, then brush the powder off.

Iron Rust may be removed from white goods by sour milk.

Scorch Stains from White Linen.—Lay in bright sun.

Mildew.—Moisten the spot with clean water; rub on it a thick coating of castile soap mixed with chalk scrapings; rub with end of finger, then wash off.

Oil Marks on Wall Paper.—Apply paste of cold water and pipe clay, leave it on all night, brush off in the morning.

Paint Spots from Clothing.—Saturate with equal parts turpentine and spirits of ammonia.

To Cleanse House Paper.—Rub with a flannel cloth dipped in oatmeal.

Black Cloth.—Mix one part of spirits of ammonia with three parts of warm water, rub with sponge or dark cloth, clean with water, rub with the nap.

Furniture, for Finger Marks.—Rub with a soft rag and sweet oil.

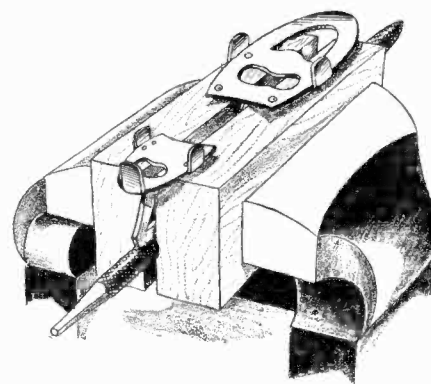
Chromos.—Go over lightly with a damp linen cloth.

Zinc.—Rub with a piece of cotton cloth dipped in kerosene, afterwards with a dry cloth.

Hands from Vegetable Stains.—Rub with a slice of raw potato.

Window Glass.—Paint can be removed by a strong solution of soda.

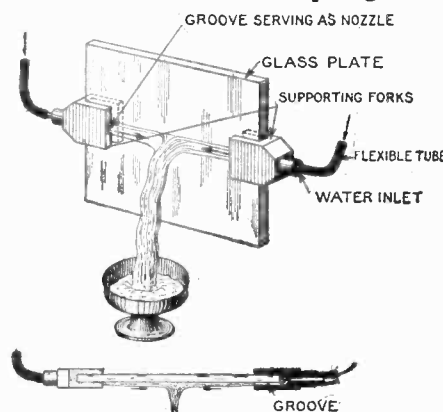
To Clean Tinware.—Common soda applied with a moistened newspaper and polished with a dry piece, will make it look like new.



Grind Your Own Skates

A ONE-HALF inch round file is placed in grooves in two hardwood blocks clamped in a vise as shown. To sharpen, move the runner back and forth between the blocks, pressing it against the file.—*A. C. Wilson.*

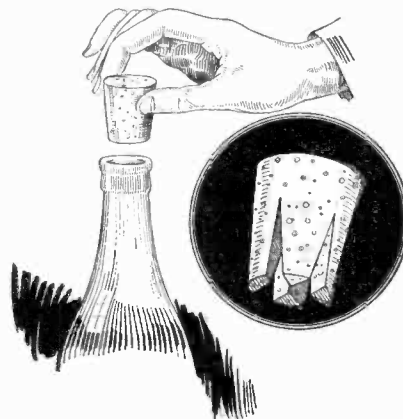
The Miraculous Spring



A PIECE of thick glass plate is provided with two supporting forks on each end. On the inner side of one leg of each fork a groove is worked out and connected with a flexible water-tube. Turn the water on, the two opposite jets of water will meet at the middle part, and a third jet seemingly coming out of the glass.—*Joseph J. Boczkoj.*

Big Corks for Little Bottles

HOW often it happens that a bottle is to be corked, and the only corks at hand are too large for its neck. The usual thing done in that case is to cut down a cork, with the result that it fits the orifice in question but very imperfectly.—*Albert Blechman.*



\$5.00
will be paid each month for the best wrinkle or recipe submitted to the editors and which they accept and publish in these columns. All other ideas accepted and published in this department will be paid for at regular rates. Address your ideas to—*Editor Wrinkles and Recipes.*

Let's Laugh

ALL jokes published here are paid for at a rate of \$1.00 each; \$3.00 is paid for the best joke submitted each month. Jokes should be scientific. Write each joke on a separate sheet of paper and add name and address to each sheet of paper.

LABELS NEEDED



SLOANS — I feel stiff all over.

ARNICA — What's the trouble?

SLOANS — We bought futuristic furniture a couple of weeks ago, and I just

found out I've been sleeping on a bookcase all the time.

—N. Stanislo.

MIGHT CONDENSER

HORSE SALESMAN—Yes, my lad, this is a fine steed.

RADIO SALESMAN—Yeah, I know it isn't a phoney plug, Jack, but do you think I can transform 'er so that she'll spark across the ground instead of being left at the binding post?

—Louis Andrews.

A MULE WOULDN'T HAVE STARTED



UNCLE TOM— Now, tell me, Johnny, how did your father die?

JOHNNY— Well, he was eating some horse meat when someone hollered "Whoa," and it stopped in his throat.

—B. Frescki.

FOREIGN SLANGUAGE

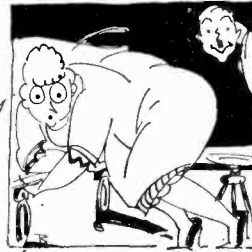
POET—Good morning to you, my dear constructor of tremendous hypotheses. Isn't this an endearing morn?

SCIENTIST—Huh—wha—? Oh, good morning to you, my dear genus biped vertebrata homo intellectus. Yes, the morning is indeed transcendental!

—Louis Andrews.

SHE NEVER BELIEVED HIM

First Prize \$3.00



A husband, after learning that WORK is the product of a force acting and the distance through which it is exerted, arrived home and saw his wife struggling in vain to move the piano.

WIFE—John, I've worked very hard this afternoon to move the darn thing!

HUSBAND—No, no, dear, don't make me laugh; you did not perform a single foot-pound of WORK.

—A. Pantilio.

EVOLUTION

"Some time ago," said the pompous doctor, "when I started the practice of medicine, I was very poor. I used to sit in my office day after day, writing for patients. I sat, indeed, like Patience on a monument."

"And now," suggested the young doctor deferentially, "you have monuments on all your patients."

—Mrs. A. C. McKinley.

A SPEEDY INCUBATOR

Mandy was boiling an egg for her new mistress' breakfast. Her mistress was in her bedroom playing with her canary while she was awaiting the initial meal of the day. Mandy was as yet unaware of the bird's existence.

Coming back from answering the door-bell, Mandy rushed to the kitchen and encountered the bird flying about in the hall.

"Ma Lord," she shrieked, "I done boil de egg too long!"

—Lillian E. Miller.

CAUGHT WITH THE GOODS

A man was fishing in private waters, when a policeman crept up behind him and dropped his hand heavily on his shoulder.

"Here, you!" he snapped. "Fishing ain't allowed here."

"Ah!" replied the fisherman readily, "but I'm not fishing, constable. I am just teaching this worm to swim."

For a moment the policeman was puzzled; then suddenly his face broadened to a grin.

"Oh!" he snorted, "then you come along with me. Bathing ain't allowed in the pond without costumes, and that worm ain't got one on."

—J. Wallis.

GET A MAGICIAN

BOB—This vanishing cream is a fake.

LILLIE—Why, how come?

BOB—I've used it on my feet every night for the last three weeks, and they are still as large as ever.

—Fred Berry.

THIS IS ONE, TOO

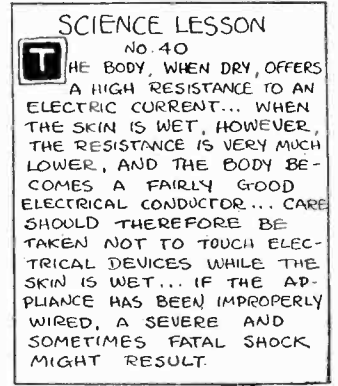
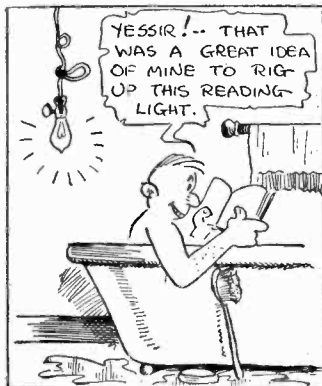
The teacher was conducting a class in English composition:

"Our next word is "anecdote." An anecdote is a short, funny tale. Now, who can give me a sentence using this word? Willie, can you?"

"Yes'm, teacher: A rabbit has an anecdote," said Willie.

—Louis Andrews.

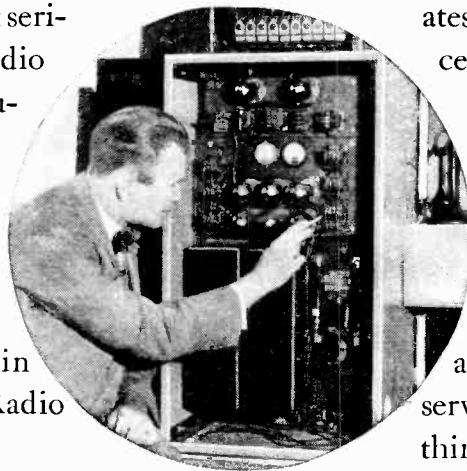
Scienty Simon—Scientist



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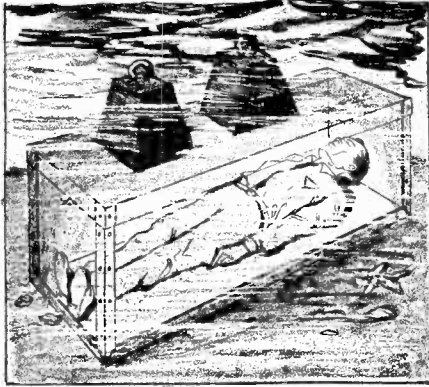
Name

Address

How Does He Live?

(2347) Elsie St. Clair, Portland, Oregon, writes:

Q. Recently, in a theatre, I saw a stage performer placed in a coffin. The coffin was sealed, completely covered with sand, and yet, after forty minutes, the man emerged from the coffin very much alive. How was the trick performed?



A person can live and breathe for two hours in a coffin this size, sealed and submerged in water.

A. There is no trickery performed; the man actually lived and breathed inside of the coffin. This same trick was performed by Houdini several years ago under somewhat different circumstances. At that time one of the members of the staff of SCIENCE AND INVENTION computed for the great master of magical mystery the length of time a man could live in a submerged coffin. It was found that Houdini could live at least two hours in this cabinet. It was found that the human body absorbs about 1½ cu. ft. of oxygen per hour, while the coffin contained about three cu. ft. of this precious gas. Houdini was sealed in a coffin which was then submerged in an indoor swimming pool. He remained under water for more than an hour and a half without feeling any bad effects from the stunt.

Pep for the Motor

(2348) F. C. Deland, Daytona Beach, Florida, writes:

Q. Will you please give me some information regarding superchargers, their merits, and whether or not they may be used on all types of motor vehicles?

A. Superchargers are now used successfully on racing cars and airplanes. They can be considered practical for private cars, motor coaches, and trucks. If superchargers are installed, considerably smaller engines can be used, as the supercharger pressure will take care of the higher velocity and distribution of mixture at the higher engine speeds when excess power is required. While testing a car equipped with a supercharger it was found to accelerate more rapidly than other cars. The supercharger increases the power output per cubic inch of piston displacement. It is estimated that with an efficient engine and supercharger, the average car ought to develop about 25 per cent. more power. Research work on a supercharged passenger car showed an increase of 18 to 20 per cent. at 3,000 revolutions per minute.

Recording at Home

(2349) L. Saunders, Dallas, Texas, writes:

Q. Can you give me some information concerning the recording of phonograph records and how this may be done with an electric pick-up?

A. Black records made especially for home recording purposes are available as



well as special recording needles. An ordinary phonograph electric pick-up could be used to vibrate the stylus. This unit should be energized by the power output of a high-grade transformer coupled audio amplifier or its equivalent. The input to the amplifier may be speech or music supplied through the detector tube of an ordinary radio receiver or a microphone input transformer. When using a microphone, the microphone input transformer must be used in place of the usual audio frequency transformer in most cases, as the ordinary microphone has a much lower impedance than the detector tube.

The Singing Sphinx



The singing or whistling sphinx emits a musical note by the passage of the air through the pipe in the arm of the figure.

(0000) Jack Smiley, Boston, Mass., writes:

Q. Some of my friends were recently talking about Africa—its mysteries and its many wonderful sights. One of them spoke of a "singing Sphinx" which was supposed to be located somewhere in the northern part of that continent. He said that at certain periods during the day this huge

The Oracle is devoted to questions of general interest. Write legibly on one side of paper. Send diagrams or sketches on separate sheets. A nominal charge of fifty cents is requested from those who desire a quick answer by mail.

mass of inert stone and brick, built centuries ago, would emit certain musical notes. I did not take much stock in such a story, but his insistence that the tale was true prompted me to write to you for verification of the yarn.

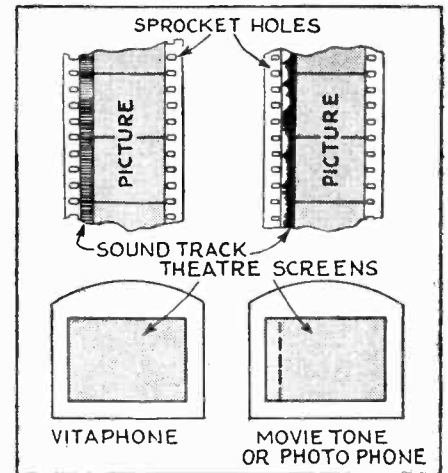
A. The story is quite true, except for the fact that the sphinx whistles rather than sings. This masterpiece of building construction is located in the ancient and ruined city of Thebes in the northern part of Africa. The base of the sphinx is divided into two compartments both containing water. It is so built that the sun's rays strike the left compartment more than the right compartment. The heat from the sun causes an increase in pressure in the left compartment, driving the water up the siphon pipe into the right compartment. This increase of water in the right compartment causes the air to be forced out through a pipe in the arm. The exit of the air through this arm causes the musical note to be heard. When the sun goes down a reversal of the first process takes place through syphonic action.

Vitaphone or Movietone?

(2351) Paul L. Welker, Brooklyn, N. Y., writes:

Q. I know very little about the actual process of making "talkies" but I am interested very much in them. I have noticed, while attending the theatre, that the screen sometimes shows a white strip on the left-hand side, whereas it was formerly completely covered by the motion picture. Could you tell me what causes the screen to appear larger?

A. There are three systems of sound recording which are consistently used. Vitaphone, Movietone, and Photophone. The last two are what is known as the "sound on film" system. That is, the sound impulses are translated into light impulses by means of a light-sensitive or photo-electric cell and recorded on the same strip of film as the actual motion picture. This sound recording is placed on the film to the left of the picture on a "sound track." This track is about an eighth of an inch wide. It is this small



Vitaphone utilizes the full width of the movie screen, but the Movietone and Photophone leave the tell-tale white strip on the left-hand side of the screen.

space which creates the white space on the screen, for of course it is greatly enlarged when it is magnified by the projection machine. This white space is not evident when the "sound on disk" or Vitaphone system is used. In this method the sound is recorded on a disk similar to the phonograph record except that it is larger. The film, in this case is the regular 35mm. with the picture completely filling the screen.



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Seattle, Wash.



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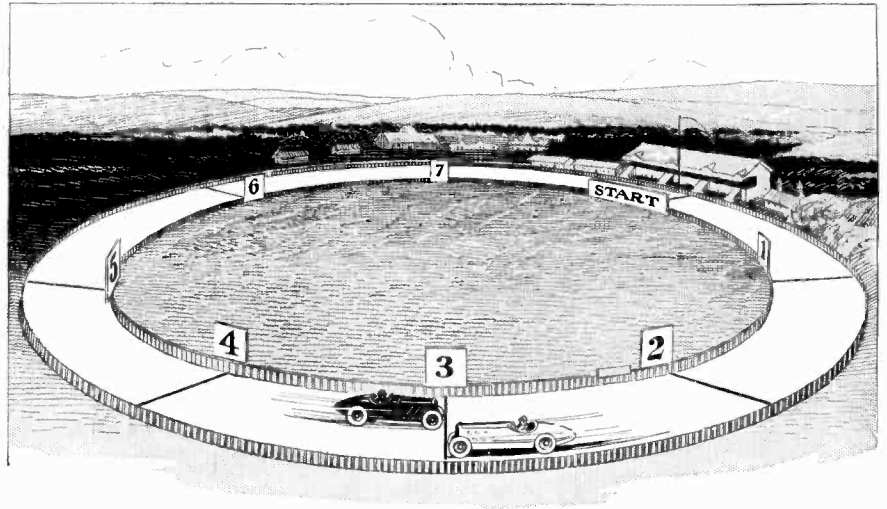
City

Age

Occupation

Solve *these* Brain Teasers and Win a Prize

By *Sam Loyd*



A Puzzling Race

HERE is a problem in circumstantial evidence, the solving of which calls for close inspection and careful deduction of the data.

The sketch presents the salient features of a snapshot taken before the winning car in an automobile race had gone a third of its set journey.

The cars left the starting line simultaneously, and raced in opposite directions around the eight-furlong track, maintaining their respective top speeds throughout the race.

The race was for

Twenty-five Dollars in Prizes

A FIRST PRIZE of \$10 will be awarded to the person sending correct answers to the two puzzles accompanied by the best expressed analysis of the *Puzzling Race*.

A SECOND PRIZE of \$5 will be awarded for the next best analysis and correct answers to the two puzzles.

TEN PRIZES of \$1 each will be awarded to the ten persons who send the next best analyses of the *Puzzling Race*, together with correct answers to the two puzzles.

Answers must be received not later than noon, March 15th, addressed to "Puzzle Editor," **SCIENCE AND INVENTION**, 381 Fourth Avenue, New York City.

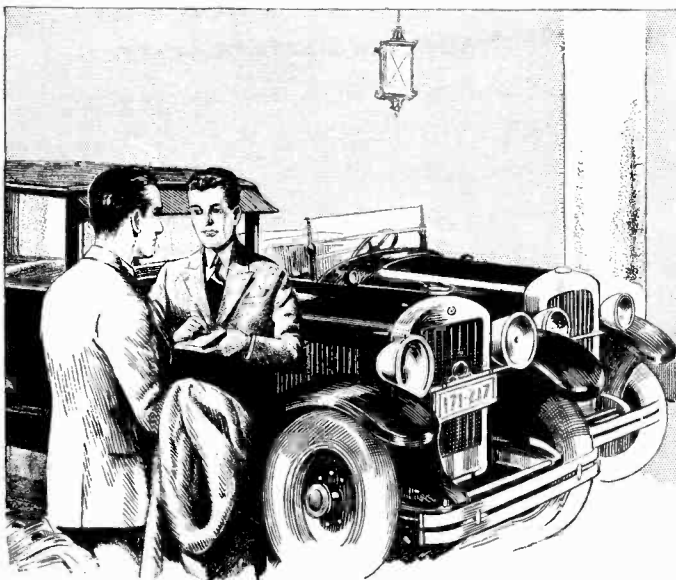
All contestants must abide by the decisions of Sam Loyd, who will examine all papers and award the prizes.

Papers of identical merit, tying for any one of the prizes, will each receive the full amount of the prize tied for.

eight miles, and it was noted that after leaving the starting line, the cars subsequently met and passed each other thirteen times during the time of the contest.

From the pictured and recited facts, we are expected to prove which car, white or black, won the race, and by what distance.

Look at it again and see if you can solve it. It may look easy at first, but after studying it for a while, you will realize that it is one of the best brain teasers of the Puzzle King.



The Used-Car Problem

AN automobile dealer allowed a customer \$1,235, for his two traded-in cars.

Then the dealer sold one of the has-beens for ten per cent below the traded-in price, and the other for ten per cent above the amount he had allowed for it.

"Not so bad," said the dealer, "for in addition to my profit on the new car, five per cent of the cash I received for the two old busses was profit."

What trade-in allowance did the dealer make on each of the old cars?

If every used car salesman could arrange his sales after the manner of Sam Loyd, he would either soon be out of business or retiring on his huge profits. If you can solve this logical successor to the other two brain teasers published in previous issues of **SCIENCE & INVENTION**, you will prove yourself to be a real dyed-in-the-wool puzzle fan. We think you will find it more difficult than the palindrome published in the January issue or the Jack London puzzle published in February. And by the way, the winners of the January puzzle will be published in the April issue, the winners of the February prize in the May issue, and the successful solver of this brain teaser, in the June issue.

Seven Famous Americans Send You an Important Message

DR. HENRY SMITH WILLIAMS:
Editor *Historian's History of the
World* (25 vols.),
author

"*The Story of Modern Science*,"
etc., and one of America's fore-
most men of letters, says:

"I am writing to tell you how
much I enjoyed your book on Vol-
taire. There have been many
lives on Voltaire, but, your nut-
shell presentation can take the
place of most of them. I wish
it might be in 25,000,000 homes
as a liberalizing document."

DR. WOODBRIDGE RILEY,
Professor of Philosophy—*Vassar
College*, author "*Men and
Morals*," etc.

"Just as soon as I received
*Voltaire, The Incomparable In-
fidel*, I sat down and read it and
did not stop reading until I had
finished. Joseph Lewis has given
the very spirit of this great
thinker's mind in a most re-
markable manner."

DR. E. BOYD BARRETT,
author

"*The Jesuit Enigma*," etc.
"*Voltaire, The Incomparable
Infidel*, is exceedingly interest-
ing and stimulating reading. I
enjoyed this book immensely."

W. M. J. FIELDING,
author

"*The Covenant Within Us*," etc.
"*Voltaire* is certainly packed
with illuminating material con-
cerning the life and activities
of the great Frenchman. It will
do much to make the specific
work of Voltaire more widely
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tainly be of value in permitting
the reader to get an idea of the
personality and influence of Vol-
taire."

FULTON OERSLER,
co-author

"*The Spider*,"
"I enjoyed Joseph Lewis's
hymn to Voltaire. He packs a
great deal of information into a
small compass. He has made a
miniature full of stimulating and
dramatic power."

HERBERT ASBURY,
author

"*Up From Methodism*," etc.
"I haven't read a book in
years that interested me so much
as *Voltaire, the Incomparable
Infidel*. Mr. Lewis, I think, has
done full justice to the man
whose life is an inspiration to
all who fight for freedom from
religious persecution."

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What the American Hebrew says of "Voltaire, the Incomparable Infidel"

It is a source of sincere regret that the author confined this fascinating work to a mere one hundred pages. It is surely deserving of at least five hundred.

He presents an unforgettable picture of conditions prevailing in the Church in France in the 17th and 18th centuries; conditions of intolerance, ecclesiastical bigotry, persecution, gross superstitions, ignorance, and murder in the name of the Church, which called forth Voltaire's activities, satires, and attacks. . . . The author spikes as cleverly as did Mark Twain in his "Connecticut Yankee" many of the ignorant acts, superstitions, persecutions, and intolerable bigotry of the Church of the 18th Century.

The sketch of Voltaire's teachings is succinct and inspiring. . . . The chapter in which the author portrays Voltaire's denunciation of all war waged for religious or national purposes is a classic. . . . Regarding Mozart's gross and bigoted remark about Voltaire's death, the author states: "A man may be a great musician and still be a bigot and utterly ignorant of the very fundamentals of human freedom." The description of Voltaire's death-bed scene is unusually effective.

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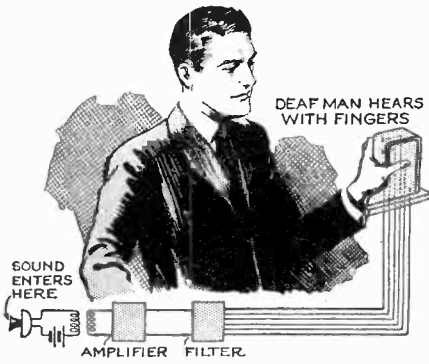
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Yankee Brains *at* Work



Sound That Can Be Felt

No. 1,733,605, issued to Warren C. Jones. This invention relates to the tactual interpretation of sound vibrations. Its object is to enable a totally deaf person to interpret sound. It comprises a system for breaking up the speech spectrum into a number of distinct bands, bearing an octave relation to one another. A number of vibratal members on a sounding board transfer electrical vibrations to the fingers.

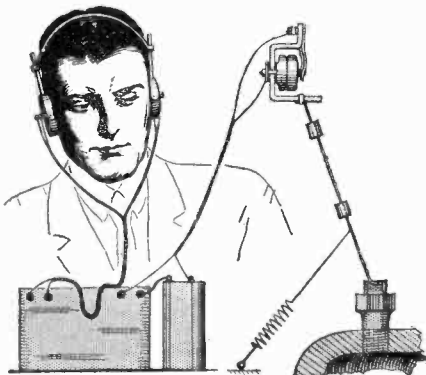
Rainbow Lights



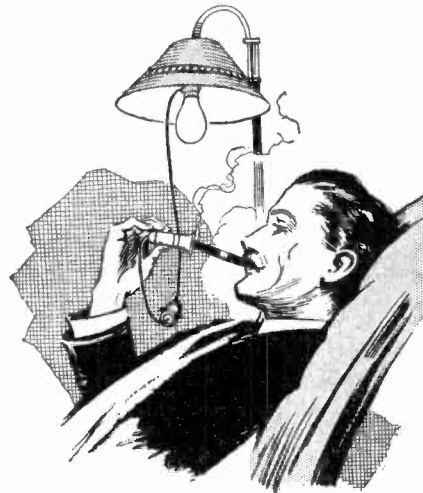
No. 1,728,234, issued to Herman J. Fanger. The object of this invention is to produce luminous effects through the passage of electrical currents of high potential through a tube containing an inert gas. It comprises a rotary member for mixing inert gases so that a multicolored lighting effect is produced.

Knock Detector for Gas Engines

No. 1,725,872, issued to Rolland J. Lawrence. The object of this invention is to procure an audible means for determining the characteristics of a carbon knock in an internal combustion engine. The apparatus consists of an electrical oscillating circuit, a taut cable and a head-piece to be connected to the cable.



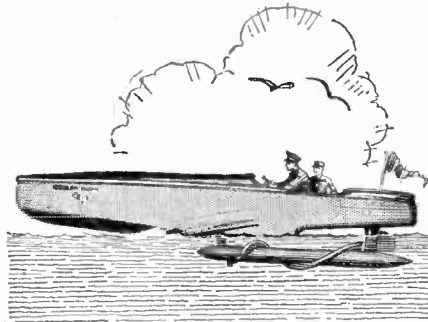
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Combination Cigarette Lighter and Electric Light

No. 1,728,049, issued to Albert W. Franklin. The principle of this invention is to provide a cigar or cigarette lighter energized by electricity, and so arranged that the lighter may be controlled independently of the light source. The invention comprises a plug-and-socket electrical light fixture, a three-wire cable connected to the fixture, a cigarette lighter connected to the cable and a switch for controlling the socket.

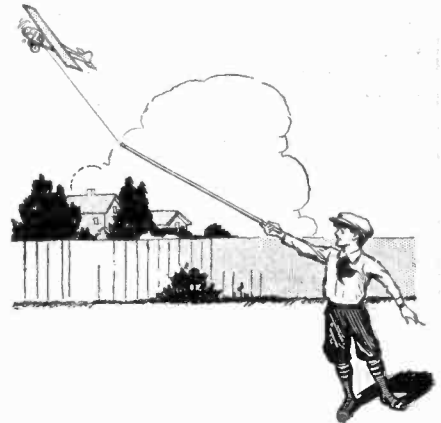
New Speed Boat Propeller



No. 1,731,493, issued to Rex Harris. The object of this invention is to provide a long helical propeller which will tend to raise the hull of the boat sufficiently so as to decrease materially water friction and resistance. It consists of a pair of long longitudinally extending helical propellers, struts extending downward from the hull to support the propellers, and a rudder post extending downwardly from the hull and joining the longitudinal struts.

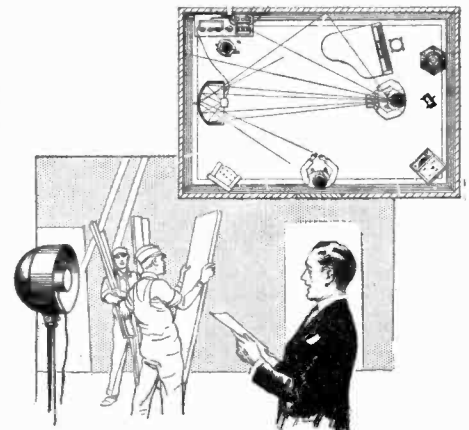
Toy Airplane

No. 1,728,245, issued to Benjamin C. Merritt. The purpose of this invention is to provide a toy in the form of an airplane which can be whirled around in the air in a circle and will fly in such a way as to simulate the flight of an airplane. It consists of three cords connected to the body and wing of the plane and meeting at a point away from the plane where they are connected to a rod by which the toy can be manipulated.



Directional Microphone

No. 1,732,722, issued to Charles W. Horn. The object is to provide a microphone which will respond and pick up the desired sounds, rejecting extraneous noises. It consists of a parabolic sound reflector, a sound responsive element mounted at the focus, a cylindrical shield surrounding the microphone and a felt covering on the exterior of the reflector and shield.



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W. C. Durant

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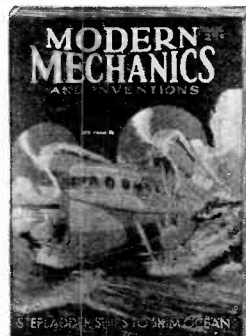
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CONDUCTED BY JOSEPH H. KRAUS

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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.

Coding System

(1206) Anthony Joss, Auckland, N. Z., has designed a system of code work which he claims to be practically indecipherable. He sends several samples of code messages.

A. 1. There are many ways in which a code system can be developed that will be practically indecipherable and wherein the code might be changed at a moment's notice.

The slide rule principle is but one of these systems. The letters A B C D are set up on one scale and other letters or combinations thereof are set up on the other scale. Shifting the rule permits of a complete change.

The circular slide rule is even better, wherein there are two discs concentrically arranged and the letters appear in any order on one of the discs, but follow a sequence on the other. Shifting the rule changes the entire code. In modern systems it is not necessary to code letters. Everything is taken care of by automatic typewriters which code as they write and decode as they rewrite. A simple camlike device permits of this coding and decoding. These cams could be changed as often as the person using the machine thinks it advisable.

We do not believe that you can finance a code proposition of any type and make money therefrom. There are few commercial uses for such an article, and we consequently advise no action.

Perpetual Calendar

(1207) Edward Fegan, Cincinnati, Ohio, asks:—

What do you think of an idea of a perpetual calendar to be attached to a pen or a pencil.

A.—About four or five years ago an organization placed an article of this nature on the American market. While it is true that there was no magnifying glass which accompanied the product so that you could read the dates more easily, the figures were quite legible and no great difficulty was entertained in reading the material under the celluloid protective piece. While such an idea seems to be quite favorable from a novel aspect, for some reason or other it does not meet with a very ready market. It generally makes the pen more bulky, and usually necessitates resetting either daily or monthly. Some day a manufacturer will develop a really practical perpetual calendar that can be applied to a fountain pen or that can be used for office purposes. We have seen many that come quite close to hitting the mark. We do not believe that your suggestion falls into this classification at all, and would advise no action.

Three Ideas—One Good

(1208) George Walter Barrush, Pittsburgh, Pa., writes:—

What do you think of an apparatus that will transmit recorded sound a fraction of a second after it is picked up by the reproducer. This for the purpose of giving the effect of depth in reproduction.

2.—A cordless electric iron, the nature of which the editor of this department does not disclose at the present time.

3.—A window shade roller to which the window shade can quickly be attached without the use of tacks and from which the shade can be as easily removed.

A 1.—This idea is very old. By employing the telegraphone principle a vast change of time as possible between the moment that the sound is picked up, to which it is transmitted to the audience. The longer the distance between the recording magnet and the reproducing magnet and the slower the tape moves the longer is the time interval.

A 2.—We think that the idea of the cordless electric iron is very good. The only difficulty with a project of this nature is that it will probably cost too much to operate. Nevertheless, it might be worth your while to experiment with this suggestion. It opens up several new applications of a known principle which might be applied to other articles. The idea exists in a different form today but it has never been applied to household utility devices. If you can cut down the cost of manufacture and the cost in using the appliance we believe a good market can be secured.

A 3.—The window shade roller idea is very old.

Hinge for Swinging Door

(1209) Howard Woods, St. James, Manitoba, Canada, has developed a new type of hinge for doors which permits the door to swing from either side.

A.—It would be quite difficult to market your hinged door unless you supplied the door complete, together with the hinges. The nature of the construction you employ makes this necessary. Then again there are very few places where the door need swing from either side of the door-jamb. This further limits the market. However there is one distinct advantage in your system and that is that it will permit of instant removal of the door from its hinges. The question is where can such a thing be used and where would it pay.

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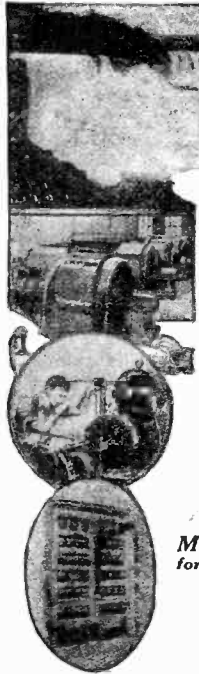
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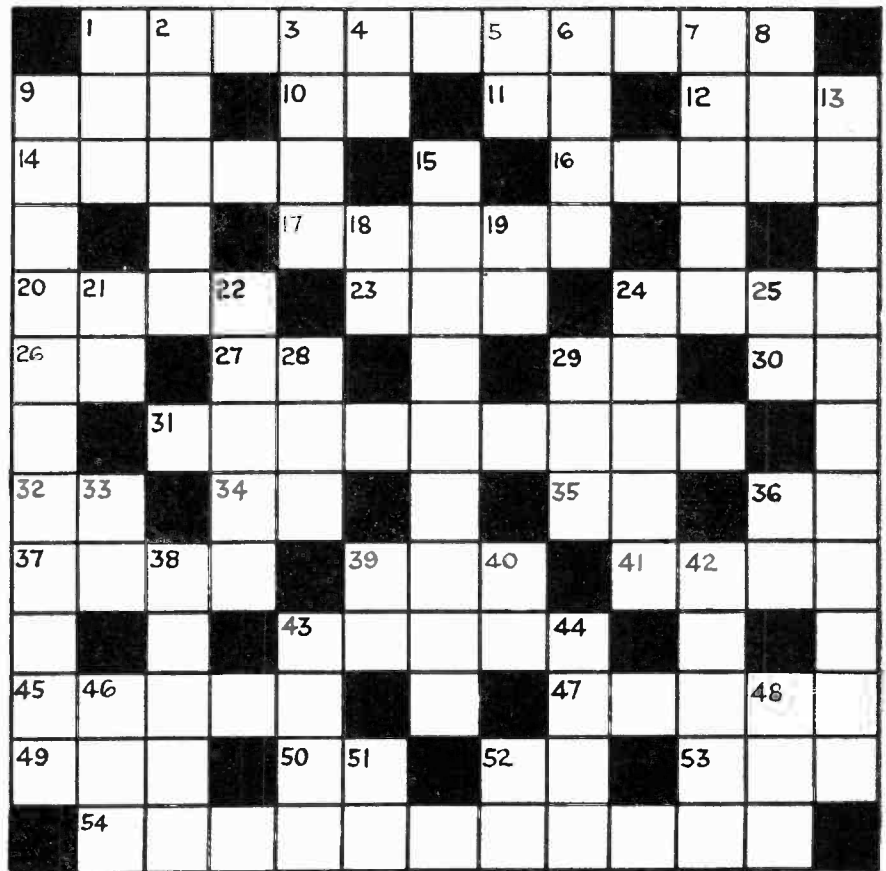
ACROSS

1. A very popular tire because of its shock-absorbing qualities.
9. Abbreviation for a figure of six sides. Many of the nuts used in motor car construction are six-sided, and the abbreviated form of the word is the trade name for them.
10. An indefinite article meaning "one" or "any."
11. Chemical symbol for a metal worth \$20.67 an ounce—too expensive for automobile work. (Write all letters capitals.)
12. A part of a circle; a principle in construction well known to motor-car engineers.
14. There appears to be more of this kind of irresponsible driving cars about the streets than there should be.
16. An afterthought sentence added or attached to the contract signed by both parties when you purchase a car on the installment plan.
17. A certain variety of automobile horn.
20. One of the "eyes" of an automobile.
23. Sometimes encountered in bad roads; often difficult to get out of if too deep.
24. The wherewithal one gives up at the service station when one stops for "gas."

45. The only known way of getting into a car.
47. An Irish patriot of other days. Many a good son of Erin is named after him.
49. Rear axle rod or rods; a standard trade abbreviation.
50. A scholastic degree conferred by colleges.
52. One of the notes of the musical scale which your "siren" sometimes hits.
53. The plural of the thirteenth letter of the alphabet.
54. Any automobilist will know that these are a part of the ignition system.

DOWN

1. A place welcome at night to a driver who has been at the wheel all day.
2. A self-evident truth—namely, that the saturation point in motor car production has not yet been reached.
3. The inhabitants of one of the new Central European countries created by the Treaty of Versailles. This country boasts of 2,224 motor cars at last accounts.
4. An adverb denoting position. Also a preposition denoting lying on the top.



26. One more than a century run of your car.
27. The standard dictionary abbreviation for "each."
29. Universal lubricant; an abbreviation.
30. One of the best-known abbreviations in our vernacular. It means that everything is "all right."
31. That part of a motor car which connects the driving shaft with the motor.
32. A neuter pronoun; a thing.
34. Abbreviation for the name of the river under which the Holland Tunnel takes your car from New York City over to New Jersey.
35. That part of the day before twelve o'clock, noon.
36. Chemical symbol for rhodium; a metal of the platinum group. (On the solution diagram the small letter of the symbol is written as a capital.)
37. A word meaning "a large number," or "numerous." It might well be applied to the number of automobiles one sees in evidence everywhere.
39. A walled-in excavation useful in repair shops and garages where a man can get under his car and work without ying flat on his back.
41. A river and city in Brazil whence comes the best rubber that goes into the construction of your tires.
43. There are two of these to every car. One is connected with the drive by a differential. Not so with the other.
5. One of the American continents which registers 25,630,000 motor cars, all told; an abbreviation.
6. The highways are full of these and some are very sharp. It is well to "go slow" when approaching them.
7. Wireless. A few automobiles are said to be equipped with it.
8. A somewhat poetic way of saying "before."
9. A most valuable quality in a car; all dealers claim theirs is particularly good at it.
13. That part of the motor to which the connecting rods are attached; plural.
15. The raw materials from which the "gas" is refined.
18. The chemical symbol for Iridium; a metal worth many times the value of gold. (Write all capitals.)
19. In Latin or French this word means "and."
21. A well-known symbol meaning that everything is "first-class."
22. A little coin with which you can't buy much of anything.
24. A device for holding parts together; a valuable adjunct to a garage or machine shop.
25. The number of the digits, provided you count zero as one of them.
28. A necessary element; free at all service stations.

(Continued on page 1033)

29. The country in which we live. Twenty-four and a half million of the world's thirty-two million motor cars are registered here.
33. Chemical symbol for tantalum; a rare metal. (Write all capitals.)
36. An abbreviation for our standard means of transportation. The automotive industry has played havoc with its previously well-established methods of doing business.
38. A prefix meaning "nitrogen." One of the elements in the "air" that is pumped into our tires.
39. The standard dictionary abbreviation for "please exchange."
40. Chemical symbol for "tellurium," a rare metal. (Write all capitals.)
42. One who takes aim.
43. An ancient Asian country west of Babylonia. It is now a part of Syria. Its people knew not the motor car.
44. A necessary adjunct to an automobile if one would be comfortable. Some cars have two; some seven or more.
46. National Automobile Congress; an abbreviation.
48. Devices used by printers in measuring the space occupied by the type when setting up copy of automobile catalogs.
51. A venerable seat of learning situated at Providence, R. I.; abbreviation.
52. Abbreviation for a Southern state, of which Baton Rouge is the capital. It has a registration of 264,000 motor cars. (Write as capitals.)

(Solution on page 1049)

Shall We Fly by Rocket?

By Prof. Robert H. Goddard

(Continued from page 983)

might successfully be fired to the moon? My answer is that it can be accomplished in the present generation, because the short flights I have obtained in Auburn, Massachusetts, with liquid propellants have shown how such rockets can be constructed to operate successfully. Liquid hydrogen and oxygen, which would be necessary as propellants, must be used in the same way I have used liquids in these tests. I doubt, however, if a rocket will be sent to the moon for many years, simply for the reason that the public will remain unconvinced as to the possibilities of the rocket method until a very great height has actually been attained by a small rocket. Furthermore, conjecture concerning reaching the moon, while keenly interesting, remains, after all, merely conjecture; there is much to be done, and much to be learned from the flights of smaller rockets concerning air-density, pressure, temperature.

Also, the adaptation of rockets to more familiar means of transportation opens up a tremendous field for research. While my chief interest always has been, and continues to be, the attainment of great altitudes for purely scientific purposes, I realize that rocket planes having speeds many times greater than the present record speed for airplanes are possible, but I do not look for such developments within the next five or ten years, even though the principles that must be used have been shown to operate experimentally in the liquid-propellant rockets I have already mentioned.

This is a matter which will probably not be considered a live issue until very high and rapid flights have been obtained by small liquid-propellant rockets.

As for transoceanic airplanes traveling at high speeds in the thin air at great elevations, I believe this will be done in the future. The ordinary airplane cannot, however, take advantage of this mode of ocean crossing to the same extent as the rocket plane, for the ordinary airplane engine is ill adapted to operate in thin air, whereas the rocket operates just as easily and with much increased efficiency.

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Radio Speaks from Clocks and Books

By Volney D. Hurd

(Continued from page 993)

to the arm of your favorite chair can be built and this little receiver installed therein. The speaker may be included in this table or installed across the room and you can tune at the chair and hear the tone from across the room, which is as it should be.

If you have a grandfather's clock, this receiver can be hidden in its generous depths. This chassis may be made to take the place of a drawer in a buffet and you can control the music with your meals. If you have a favorite phonograph, this chassis will slip into a bit of the space used for record storage.

How many times have you wished to have your winter set at your summer home? These days so many summer places have electricity. You couldn't have a bulky cabinet moved down but this little chassis could be slipped out and a small speaker taken along and your summer radio problems solved. With many of the hotels in the country using alternating current this chassis could be built into a suit case for the travelling man and he would have good music wherever he landed.

In fact, there are so many ways such a chassis may be utilized that it would take much more space than we have to enumerate them all.

From a straight receiver viewpoint, this year is seeing the placing of many varied types of cabinets on the market by first class furniture manufacturers which are designed with small openings for just this type of installation. These run from small apartment miniatures to huge impressive period types. If grandeur is desired some of these larger models, with a chassis slipped in and a good speaker in place, will give a most impressive effect which is not at all lessened when the set is turned on and the dynamic speaker pours forth the quality obtained with shield grid R. F., power detection, resistance coupled audio, and a real power tube.

Build Your Own Tilt-Top Table

By H. L. Weatherby

(Continued from page 999)

the turned surface and the hexagon will give lines on which to square and center the mortises. Before boring for the two mortises located on the corners, the corner wood should be chiseled off, giving a flat surface on which to work.

The turning is straight spindle work. Due to the size of the piece it should be turned slowly to start with and the speed increased as the work becomes round, with probably a maximum speed of not more than twelve to eighteen hundred revolutions per minute.

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with a pivoting arrangement must be devised. This may be done in a variety of ways, but the method suggested will probably be about as satisfactory as any.

A rectangular piece of wood 2"×5"×6" is securely fastened to the top of the post with screws. This piece must be rounded on the front end to permit the top to tilt. Two cleats 1"×2"×15" are fastened to the under side of the top, running across the grain of the wood in the top, one on either side of the piece that is fastened to the post. Hard wood dowels are glued into the piece attached to the post and turn freely in the cleats. A locking device is attached to the top at the opposite end from the pivoting arrangement. This may consist of a small bolt, such as used for locking doors or an elbow catch.

Finishing

TO finish the table in keeping with the period in which it originated, an oil finish will be easily applied and will bring out the grain of the wood as varnish will not do. Boiled linseed oil is used and rubbed in. Use the oil thinned with about three parts of turpentine. This is rubbed on, using cotton waste or rags and the surface is rubbed dry. Three or four coats at twenty-four hour intervals should be applied, each one rubbed hard and dry. This means hard work, but the success of the job depends upon the hard rubbing. Be careful to always burn up the pieces of oil waste, since these are particularly liable to spontaneous combustion.

Is It Going to Rain?

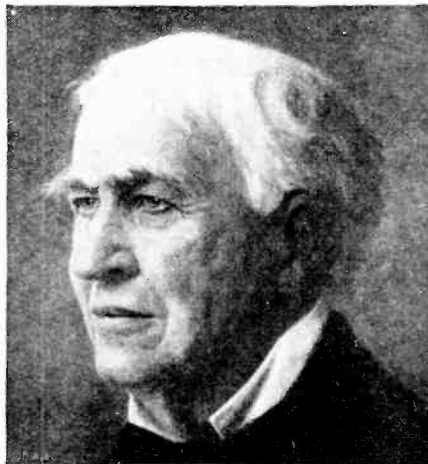
(Continued from page 1007)

"storm glass" or "paroscope" is a thermoscope rather than a hygroscope. The more or less flaky appearance of the liquid it contains depends upon temperature. This instrument has no value whatever as an indicator of coming weather, despite the extravagant claims once made in its behalf by Admiral Fitzroy, the first director of the British meteorological service, who devotes an entire chapter to it in his well-known "Weather Book."

The "weather plant," known to botany as *Abrus precatorius*, acquired notoriety in the nineteenth century. An Austrian named Nowack claimed to be able to predict from the positions of its leaves and branches a variety of mundane events, including earthquakes and mine explosions. Taking his vegetable wonder to London, he interested the Prince of Wales, and secured a letter of introduction to the authorities at Kew Garden. Here the alleged prophetic powers of the plant were investigated. Eventually Nowack's claims were pronounced absurd.

One of the most popular weather prophets in the Old World—especially in Germany and Switzerland—is the tree-frog or tree-toad. Kept in a jar of water with a little ladder, the creature is supposed to climb or descend according to the weather in prospect. Ofttimes a leech is used. As it can creep up the side of the jar containing water, no ladder is required.

A truly remarkable instrument, shown at the Great Exhibition of 1851 in London, consisted of twelve jars, each containing a leech. A bell rang whenever one of the imprisoned martyrs clambered to the top of his jar. The inventor, Dr. Merriweather, called this merry weather wonder the "tempest prognosticator." He published a book about it, and advised the government to establish storm-warning stations, equipped with "prognosticators," along the British coasts!



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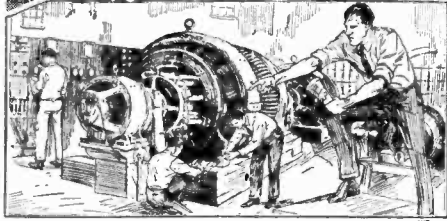
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Prepare to Welcome Feathered Friends

By Dr. E. Bade

(Continued from page 1004)

consists of pine, fir twigs or of thorns fastened together. Such a place is necessary to keep the natural enemies of the birds at a distance. If they are not kept away, then the birds that take advantage of the bounty offered will fall an easy prey. At the same time the characteristic of some of the smaller birds must be taken into consideration. They do not like to fly over long stretches of open ground but prefer to flit from shrub to bush and from bush to tree towards their feeding place.

On this feeding-place the corresponding food of the birds should be available. Bread crumbs and broken boiled potatoes are eaten by the sparrows. Others may eat this food, but it does them more injury than good. Berries and almost all kinds of seeds, such as fruit and mellow seeds, sunflower seeds and hemp seed, all are excellent bird food. Mix the seeds and give it to the birds on an old Christmas tree. Pour the mixed seeds in melted tallow, stir thoroughly and brush the melted mass upon the twigs of the tree. The tallow hardens on the branches and surrounds the seeds and keeps them from falling down to the ground. The birds visit the tree and eagerly pick out the seeds from the tallow. When the tree is covered with snow, the snow is easily shaken from the tree without at the same time shaking off the seeds. If a tree is not used, a small shelter must be made, one that is covered overhead. At the same time it is wise to provide drinking water a few times a day on the colder days.

Although a good part of the nesting facilities of the birds have been destroyed, they can easily be replaced by providing bird houses. Naturally the type of house must be adapted to the kind of a bird that is to nest in it. Simple boxes with a hole and hung any old place are practically without value, the birds refuse to use them. Even correctly built bird houses are not used for nesting purposes if they are incorrectly located.

Bird houses should be built of wood and the entrance hole should be just large enough so that the desired bird can slip in easily. Then, too, the size of the bird governs the size of the house which it will use. A small bird requires a small house, a large bird a large house. When attaching the bird houses to trees be careful to see that they hang vertical and that they do not have an independent motion of their own. Attach them firmly with nails or screws to a thick branch. Never use a thin pole, especially not if it is exposed to the wind and free of underbrush. Before attaching a bird house, see to it that the entrance hole does not face the direction of the prevailing winds.

In the larger gardens it is advisable to provide thick shrubbery for the nesting places of those birds that will not build in bird houses. At times the birds will not take advantage of such nesting localities during the first year. This is due to their distrust, but winter feeding will overcome it quickly, and will also attract the summer songsters, for the birds have a language of their own and they will quickly congregate where they are not molested.

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Curtiss "Tanager" Wins \$100,000 Safety Prize

(Continued from page 985)

showed that to get the best lift out of the automatic slots, mechanisms which had been used up to this time were inadequate and a new type of roller support was developed. This installation is entirely automatic and is easily adjusted so that all slots over the span open simultaneously. The slots start opening at about twelve degrees angle of attack of the airplane and open gradually to their maximum position at sixteen degrees angle of attack. They are provided with buffers, so that there is no sudden opening nor jar in the ship caused by the operation of the slot.

"The flaps in the back of the wings are operated by a crank in the cockpit, this being the only added control. All other controls are normal. About ten turns of the operating crank are required to manipulate the flaps, and when not used, the crank, which is at the pilot's right hand, can be turned back out of the way. The ends of the flaps are provided with cloth shields which come into operation when the flap is down, reducing the tip vortices or air disturbances at the end of the flaps.

Unusual Landing Ease Obtained

"THE Tanager has been landed repeatedly from a height of 200 feet by rolling the stabilizer all the tail heavy, pulling the stick all the way back and holding this position until the landing is effected," continues Mr. Osborn. "This condition will throw many ships into a spin. When the controls are in these positions, the Tanager settles in a landing attitude and lands itself with no greater shock in the cabin than accompanies a normal landing. This method of landing could be used from any height, it is believed, as the ship does not gain speed, but continues in a normal glide in the landing attitude. There is no tendency to fall off on either wing, nor to oscillate about any axis, and all controls are effective."

The cabin of the Tanager is designed to accommodate three persons in a single row, but for ease of ballasting for the Guggenheim contest only two seats were installed. Dual controls are provided. There is a door on each side of the ship opening with the hinge at the top. These doors facilitate entering and leaving the ship, and are safer for emergency use than the usual type of door. The engine is a stock Curtiss Challenger, of the type used on the St. Louis Robin, which established a world's refueling record of more than 420 hours.

Ship and Shore Linked by Phone and Radio

By George R. Brown

(Continued from page 990)

A transmitter, operating on a wave-length of 34.0 meters was installed on the *Leviathan*. Much time elapsed before the apparatus was completely installed in both the transmitting and receiving stations in New Jersey. During that time many exhaustive tests and experiments with transmitting and receiving apparatus, interference with the ship's telegraph service, and the extraneous noises which occur on the phone were performed. The culmination of all this intensive and extensive work was the inauguration, on December 8, of the first commercial ship-to-shore-telephone service.

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450 Miles to the Gallon

By Alfred M. Caddell

(Continued from page 1018)

Carburetor Adjustments Most Important

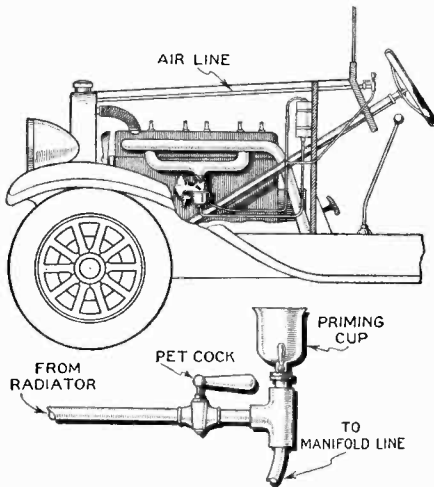
TESTS made at the Government Fuel Yard by the Bureau of Mines revealed that motorists operate their cars with too rich a mixture. This results not only in less mileage per gallon but in excess carbon and a consequent multitude of motor ills.

The efficiency of various carburetor settings was determined by the analysis of samples of exhaust gases. Then new carburetor adjustments were made to achieve economy without the least sacrifice of flexibility of operation and power. In all but one case the original mixtures were too rich for efficient operation.

The tests showed that the carbon dioxide indicator used for testing the exhaust gases gave a positive indication of the carburetor adjustment. The indicator in question is entirely practical and should prove invaluable to companies having ten or more large trucks in service.

A Simple Gas-Saving Installation

AS one of the multi-million automobile-aires, the writer conducted experiments on several makes of cars and proved most conclusively that miles per gallon could be increased one-third simply by permitting moist air to enter the intake manifold after the motor had been warmed up. The system has been tried on the Ford, Buick, Willys-Knight, Pierce-Arrow, Studebaker, Essex, and Hupmobile cars, thus providing ample opportunity for observation and check. As one example of the results obtained, an old 1918 Buick, which formerly did about 12 miles to the gallon, was stepped up to 18. On a 530-mile run, slightly less than 30 gallons were consumed. The car was loaded to capacity, carrying six passengers and a camping outfit.



The system is simplicity itself, consisting of a petcock and copper tubing, with the necessary connections. A copper tube runs from the top of the radiator—about three inches above the water-line—to the dash. Here it passes through a petcock, from which another copper tube extends to the line running from the vacuum tank to the intake manifold. In the case of the Ford, a hole was drilled in the intake manifold, permitting moist air to mix with the gas-air vapor as it is drawn into the cylinders.

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It is surprising how a motor thus equipped picks up in revolutions without the addition of any gas-air mixture whatever. Besides increasing motor speed, and consequently motor power, the device reduces the amount of carbon deposited in the combustion chambers. Because of the complete combustion, no doubt, one motor was found practically carbon-free after a year's use. The system works well with all grades of gasoline.

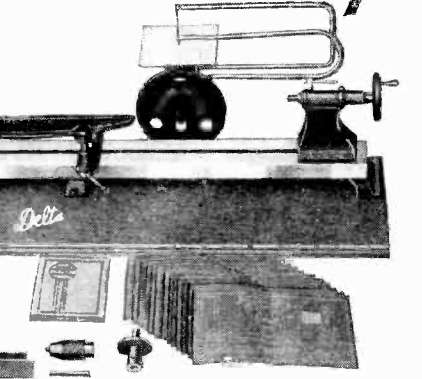
Unquestionably, greater mileage per gallon may be obtained by any motorist who keeps his carburetor properly adjusted, or who permits moist air to dilute the gas-air mixture after a motor has been warmed up; who attends to proper lubrication, proper inflation of tires, etc. Speaking of diluting the gas-air mixture, it will be recalled that there are several automatic devices on the market purporting to accomplish this automatically. However, it is the writer's experience that such devices, not knowing when the motor is warm enough, can scarcely be expected to perform as satisfactorily as the human intelligence or thermometer which tells the heat condition of a motor. If carburetors are set to provide a rich mixture for starting and cars are run on this mixture continuously, a saving in gasoline is hardly possible with such automatic devices, but if moist air is permitted to enter by hand control a considerable operating efficiency will result. Carburetors should be adjusted with air on after the motor has become thoroughly warmed.

Another saving in gasoline may be effected by priming a cold motor with about half a thimbleful of a mixture of gasoline and ether, mixed in proportion of one part motor ether and two parts gasoline. The volatility of the ether permits instant firing of a cold motor, which thereupon picks up the less volatile gasoline vapor and presto! the motor is under way. This slight detail saves choking the gas. Not only does the excess of gasoline mean lost money, but it washes the lubricant from the cylinder walls and finds its way to the crank-case, where it dilutes the lubricating oil and destroys its lubricating qualities. A gas-saver and a cuss-saver, the little priming cup, which may be installed in the air line leading from the dash, is one of the best minor attachments anyone can put on his car.

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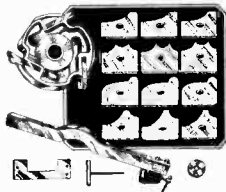
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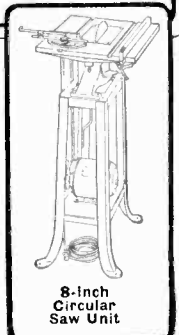
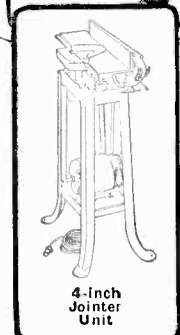
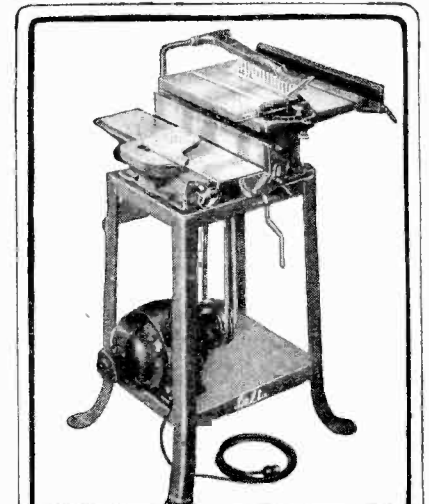
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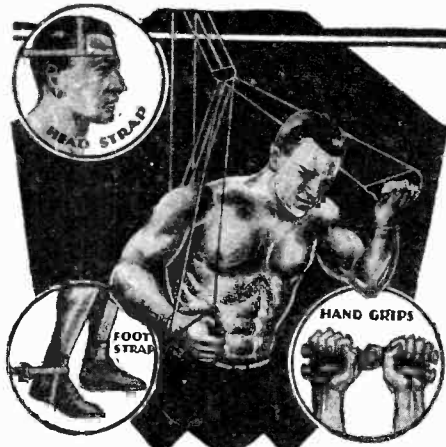
Therefore, the editors of this publication say, "Just come in and show us—merely SHOW us—a working model of a perpetual motion machine and we will give you \$5,000.00. But the machine must not be made to operate by tides, winds, waterpower, natural evaporation or humidity. It must be perpetual motion."

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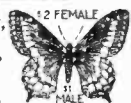
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Have a Basement Playroom

By S. Gordon Taylor

(Continued from page 987)

necessary to dryness and comfort. Where such arrangement is not practical, the same result may be obtained by installing a small ventilator or exhaust fan of the type used to ventilate kitchens. Or air-ducts may be extended from a grille in the partition to one of the windows in a different part of the basement.

In most basement conversion plans, good illumination is important. This phase of the problem also includes wiring and convenient outlets for lamps or other electrical appliances. Rigid conduit is best fitted for basement wiring, because it affords the utmost protection for both the wiring system and the structures. Lighting fixtures present no particular problem. Requirements in the basement are identical with those on the upper floors, and floor lamps may be used for lighting game tables or other features.

There is probably no portion of the house that offers greater opportunity for ingenuity in planning than does the basement area. Almost every phase of the design and treatment of basement space opens opportunities for the practical imagination. The handy-man will find real enjoyment in planning the basement for recreational or other purposes; and contact with his local building material dealer or with manufacturers will furnish him with data on the equipment and supplies necessary to carrying out his ideas. From these sources, too, he can obtain much helpful counsel on built-in wall cabinets, partitions, wall treatments and other features of his basement plan.

Book Reviews

THE BEGINNING OF CHEMISTRY, by Harriett Blaine Beale. Stiff cloth covers, 5" x 7 1/2". 245 pages, illustrated. Published by Coward McCann, Inc., New York City. Price, \$2.50.

In this book, the author has endeavored to tell in a simple manner, the story of chemistry and present this science in such a way as to arouse the child's interest, as well as prepare him for the subject which he must later study in school. He will become familiar with the terminology and gain a clearer knowledge of this science. The subject is made both understandable and fascinating, and has been intended for reading by children of pre-high school age. For adults desiring to know the fundamentals of chemistry, no better book could be chosen.

RADIO TELEGRAPHY AND TELEPHONY, by Rudolph L. Duncan and Charles E. Drew. John Wiley & Sons, Inc., New York, 950 pages. Illustrated. Price, \$7.50.

The authors of this up-to-the-minute book on the subject of radio have accomplished the aims of all popular scientific text books. In other words, they have treated a highly technical subject in a manner easily understood by the layman. The work is a veritable encyclopedia on modern radio. It covers completely and concisely everything in radio from the elementary to the most advanced. Motor generators, starters, storage batteries, vacuum tubes, receiving sets, A. C. operated receivers and tubes, commercial receivers, rectifiers, antenna design and construction, commercial broadcast transmitters, short wave transmission, arc transmission, radio direction finders and broadcast equipment give an idea of the many subjects covered

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Here's the Second Step in Glider Construction

By Licut. A. A. Reynolds

(Continued from page 1003)

ing two bolt nuts and two turnbuckles. The stabilizer framework is constructed first. A spruce stabilizer spar $\frac{3}{4}$ "x2"-x8'-3" long, is shaped as shown in the drawing of the stabilizer spar. $\frac{1}{4}$ " x $\frac{5}{8}$ " grooves are cut in its edges to admit the ends of the battens, and a $\frac{3}{4}$ " x $\frac{1}{4}$ " groove is cut at its center to admit the larger center battens. The ends of this spar are tapered as shown in the drawing. The ends of the battens are all nailed and glued in their respective grooves and triangular spruce blocks are inserted between them and against the spar, where they are fastened with glue and nails. $\frac{3}{4}$ " half-round strips are fastened at both tips of the spar and to the free end of the $\frac{3}{4}$ " x $\frac{1}{4}$ " center rib battens. This forms the stabilizer leading edge.

Each of the $\frac{1}{4}$ " x $\frac{5}{8}$ " rib battens are next attached to this leading edge. Strips of muslin are glued around the leading edge and onto the battens to strengthen their joints. Spruce blocks are cut to shape and glued and nailed between the top and bottom rib battens, as shown in the top and end view of the stabilizer drawing. The two $\frac{1}{4}$ " holes shown at the ends of the $\frac{3}{4}$ " x $\frac{1}{4}$ " center rib batten are for mounting the stabilizer and should not be drilled at this time. The metal fittings F. 4, should be bolted into position on the back surface of the stabilizer spar with $\frac{1}{4}$ " machine bolts. The free end of these metal fittings should project downward, as they are to be the fastenings for the two mounting wires later. Six hinges are bolted into position as shown in the drawing. The center hinge on each side should be as near the horn position as possible, to bear the control cable strain.

The right and left elevator frameworks are built next. Two elevator spars are cut $\frac{1}{2}$ " x 2" x 3'-11" long. The ends of these spars are tapered as shown in the elevator drawing. It is best to build both elevator frameworks at this time, so that all parts will be exactly alike. $\frac{1}{4}$ " x $\frac{5}{8}$ " grooves for the rib batten ends are cut in the spar edges, as shown in the elevator spar drawing. The four top and four bottom elevator rib battens are glued and nailed into these grooves on each spar. Triangular spruce blocks are fastened between these batten ends and against the inside surface of the spars. $A\frac{1}{4}$ " x $\frac{1}{2}$ " trailing edge is next fastened to the free ends of these battens using triangular wood blocks and glue. Muslin strips are glued over this trailing edge onto the batten ends. Wood blocks are next cut to shape and fastened between the top and bottom rib battens about half way from the trailing edge to the spar. This is shown in the elevator drawing end view. $\frac{3}{4}$ " half round strips, tapered at the trailing edge ends, are fastened between the spar and trailing edge of each end of each elevator. Muslin strips should be glued over each of these joints. The horns should be fastened next, one on each elevator spar, as shown in the drawing. Wood blocks and triangular plywood gusset plates should be used at these horn attachments to make them very solid and secure. Two No. 30 piano wires are mounted as shown in small holes drilled in the blocks against the spars and trailing edges. No turnbuckles are necessary as the wires are simply drawn taut and secured. Each elevator is next lifted and placed against the stabilizer spar so that the exact places

(Continued on page 1043)

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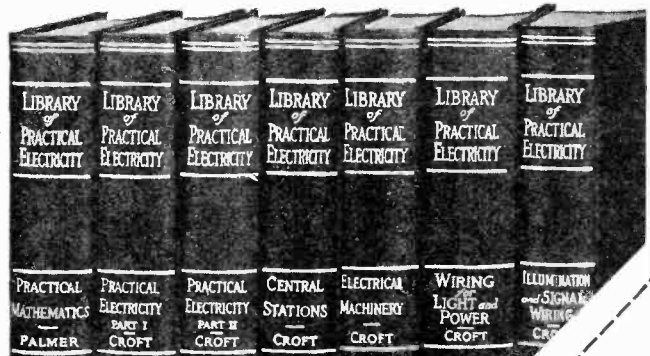
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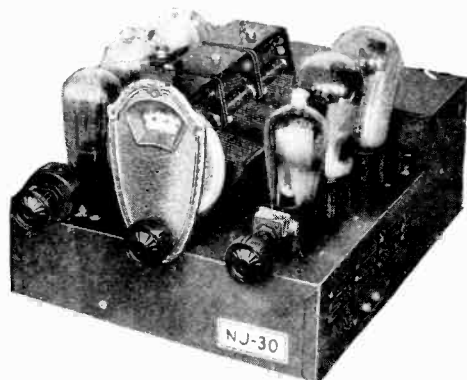
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Toy Figures Come to Life

By Don Bennett

(Continued from page 1019)

can be applied to jointed dolls and other figures. Professional studios often employ it to save the cost of expensive sets. Storms at sea are usually produced for the films in this fashion. Last year an article in SCIENCE AND INVENTION told how a model was used in depicting the sinking and rescue of a submarine. It would have been impossible to have photographed this as it happened, disregarding the item of expense. Models and a full-sized ark were used in combination for the photograph of Noah's Ark accompanying this article.

Possibly you remember "The Lost World." That was the finest piece of model work ever achieved. The models used in that picture were not over twenty-four inches high. Yet in some scenes they towered above the human actors. Double exposure was employed to gain this effect.

With a little ingenuity you can make a film playlet with jointed dolls and miniature sets. Select a story in which the action is simple, and costume your actors to fit. Construct a set to scale and furnish it with miniatures of everything the full-sized set would have. Light it with small lamps (200-500 watts) giving particular attention to the backlighting. Place the camera so that the set is viewed from the same angle as if it were full size. Then film your story as indicated in the first part of this article, making single frame exposures and moving the dolls slightly after each one. For example, a character is to make an entrance through a door. The door is opened in four or five frames. The first exposure is with the door just ajar, the second with the door swung to about ten degrees, the third at thirty degrees, the fourth at forty-five and the fifth at sixty. This is usually as far as a door is opened. You story will control the speed. If you wish the door to open slowly, move it about five degrees at a time; if you want it to fly open, open it twenty degrees at a time.

When a doll character walks, each step should occupy about eight frames. Because the feet must be raised from the floor part of the time, you will find it desirable to weight them with lead so that the doll may be balanced on either of them. If this device fails, support the dolls with a fine piece of thread, similar in color to the background.

Where a title is to be inserted, allow four frames of film with no movement. In one of these frames insert a card with the word title and the number of the title on it. This will guide you in editing, later.

If you wish, you can produce train and motor car wrecks in miniature. Or you can have a first-rate "traffic jam" for a couple of dollars.

Here is a suggestion for a film in which inanimate objects become animated. Place a number of miniature trucks so that the camera cannot see into the body. Then proceed to discharge from it a load that normally would take ten or fifteen trucks to carry. It is a variation of the old slapstick act in which ten or fifteen people get out of a small car. The truck could contain cases marked "Scotch," in reality little blocks of wood with pencil lines marking the cracks between boards and the lettering done in India ink. When thirty or forty of these cases have left the truck, sliding down a board to the ground and

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off to one side out of the picture, have a few caskets climb into the truck and then roll the truck out of the scene. Only about five of the boxes would be needed, as they could be used over and over again. First let the end of a box show beyond the edge of the body of the truck; then move it a little at a time until it is in a full view and sliding down the board. Then introduce a second box in the same way, all the time moving the first box down the board.

The ideals which will present themselves to you as you become experienced in stop-motion," as this kind of work is called, are literally innumerable. And the results will delight the entire family.

APOLOGY

We inadvertently failed to mention that the frontispiece illustration in the February issue was a product of EWING GALLOWAY.

Here's the Second Step In Glider Construction

(Continued from page 1041)

can be marked for the elevator hinges to mesh with their mates on the stabilizer.

In assembling light framework of this kind it is well to remember that the nailing is not as important as the gluing. The nails simply hold the joints in position and the glue gives the permanent strength. Have plenty of fresh *casine glue* ready and coat each joint liberally. Do not wipe away any excess glue that may squeeze out of a joint.

Building the Tail Section

THE tail section is next built. This is a light framework of spruce strips fastened together with plywood gusset plates and its function is to hold the rudder, stabilizer and elevators, in their proper place back of the wings. Notice that all strips that slide lengthwise in the direction of flight are left square, and all strips that slide sidewise in the direction of flight are streamlined. To streamline a strip you simply round over its leading edge bluntly and plane down its trailing edge to a knife-like appearance. The blunt leading edge can occupy one-third of its width and the knife-like trailing edge can occupy the remaining two-thirds of its width. See the cross-section drawing of a streamline. All the strips for the tail section are cut from 1 1/8" x 1 1/8" spruce to the various lengths shown in the drawing of the tail section. The short upright strip at the front of the largest plywood side is rounded bluntly on its leading edge. The diagonal brace strip running from the bottom of this largest plywood side to the longest upright in front is fully streamlined. The longest upright strip in front is also fully streamlined. Lay all the strips on a level floor and shape each joint to fit evenly.

Using plenty of glue, attach the small triangular plywood gusset plates at each end of the longest upright strip in front; nail these into place. Next glue and nail one side of the largest plywood sides to the rear of the tail section. A 5" x 1/4" machine bolt is next secured through the top strip at the rear as shown in the drawing. This is to be used in attaching the stabilizer later. A 1-1/16" thick spruce block is drilled and slipped over this bolt on the top of the top strip. Stand the tail section upright. By placing the stabilizer framework in position on this

(Continued on page 1045)



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**J. D. SNYDER, Publicity Director, Dept. 160
54 West Illinois St. Chicago, Ill.**

Sound Detection Is Job For Real Sleuth

By Walter Raleigh

(Continued from page 1015)

hammer before the next beat, so rapidly that only the ear or the sense of touch could detect it.

As long as the Derby hat was kept away from the vibrating rod, the only sound produced was a barely perceptible hum. When the crown of the Derby was held against the end of the pole farthest from the oscillator, however, the rod emitted a loud, musical sound.

The explanation is that the Derby hat acted as a diaphragm. The end of the rod was too small to disturb the air sufficiently for the ear to catch the sound, but once the rod was placed against the hat, the volume of vibration increased to the point where it became audible. The same test with a human skull produced even more pronounced results of a similar nature.

Another Norris experiment had to do with two sheet-metal ventilating pipes. One was outlined with balsam wool held to the inner surface of the tube by a punctured metal sheet. The other tube was unlined. A small phonograph was set going and slowly inserted at the mouth of the unlined pipe. There was no noticeable effect upon the intensity of the sound. But when the phonograph was pulled into the lined pipe, the sound gradually faded. All but one and one-half per cent of the volume was absorbed by the lining.

A third way in which sound travels that would be difficult to trace is by reflection. Sound may go in a circle, as light goes in a circle when reflected by mirrors.

To solve this problem of sound tracing and measuring, Dr. C. A. Andree of the C. F. Burgess Laboratories has brought out his acoustimeter. This device measures the intensity of sound and in conjunction with the oscillator furnishes accurate results for a study of room acoustics. The oscillator emits a given note, varying in frequency from 500 to 525 cycles. This note is cut off automatically at regular intervals. At the same time the acoustimeter cuts in for the same period. As the sound dies out, the acoustimeter (or electric ear) measures its intensity area.

Sound and talking films have further increased the need of a thorough knowledge of the way sounds act. If the sound wave to the ceiling traverses a much greater distance than the wave that goes direct to the audience, confusion may result.

On a model which represented a cross-section of an auditorium, Dr. Norris demonstrated with a beam of light how echoes can be controlled. When the ceiling of the hall was curved to a certain degree, a light coming from the speaker's platform was reflected from the ceiling to the middle seats of the orchestra pit. Had it been a sound wave instead of a light wave, a disagreeable echo would have resulted, since the distance traversed was much greater. By flattening out the curved surface of the ceiling the wave was reflected to the rear seats of the balcony where it would be of benefit to the audience.

We are living in the world's noisiest age. Reform is in order. Yet it seems almost impossible to devise an easy, simple and scientific method of enforcing anti-noise laws or eliminating noise. The one way to keep noise out of a room and make it quiet seems to be: line it completely with padded hairfelt. Then (because of leakage) put on ear-muffs!

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Name.....
Present Position..... Address.....

Here's the Second Step in Glider Construction

(Continued from page 1043)

top strip so that the back surface of the stabilizer spar is about $\frac{1}{2}$ " from the end of the tail section a hole position can be marked for the 5" long bolt to pass through the stabilizer center rib at its rear. Another $\frac{1}{4}$ " hole can now be drilled through the top strip of the tail section and the center rib of the stabilizer at its front. Effort should be made to have these holes pass through the blocks between the battens of the stabilizer center rib as this will render the stabilizer attachment very strong. See hole positions in center rib of stabilizer drawing. The rudder is next held in position against the end of the tail section. See that the rudder has enough clearance to work over the stabilizer and mark the position for the rudder hinges, which are now mounted in the upright at the end of the tail section. The rudder and stabilizer are removed and the other plywood side is glued and nailed to the rear end of the tail section. Two metal fittings F. 4, are bolted, with a $\frac{1}{4}$ " machine bolt, on each side at the bottom front of the plywood sides. This bolt must pass through the $\frac{1}{8}$ " bottom strip, as shown in the tail section drawing. Two F. 4 fittings are placed in the top $\frac{1}{8}$ " strip near the center of the plywood sides. Two more F. 4 fittings are placed against the top triangular plywood gusset plates at the long upright position in the center of the tail section.

Make eight dismount clamps F. 14, out of No. 10 carbon steel. Two of these are bolted, one on each side of the bottom $\frac{1}{8}$ " square strip end. Two more F. 14 metal fittings are bolted, one on each side, of the top $\frac{1}{8}$ " square strip end. Mount these F. 14, metal fittings, so that the $\frac{1}{2}$ " hole in its end does not project beyond the end of the $\frac{1}{2}$ " square strips. The $\frac{1}{2}$ " hole drilled through the wood, in order that the $\frac{1}{2}$ " machine bolt, used for mounting at this point, will pass through both metal fittings and the wooden strip.

Details of Main Skid Section

THE main skid section is next to be built. It is best to make the four types of metal fittings, necessary for this section, at this time. The pilot clamp F. 10 is cut from No. 12 carbon steel and bent as shown in the drawing. This fitting holds the ends of the top flying wires which support the wings and should be

(Continued on page 1046)

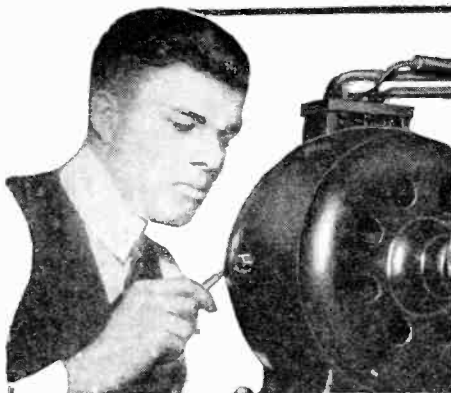
Type Like Lightning 300 Words a Minute

By Mary Jacobs

(Continued from page 1001)

and print the word *sacrifice*. Just as on the regular typewriter, we depress the S key of the automatic keyboard. *Sacrifice* is the first word of the top left column of the square S. Therefore, we will next depress the corresponding first key of the first left section of "blind" keys. Instantly the word *sacrifice* appears—spelled correctly, printed and spaced. We have used 2 operations in place of the 7 for typing the letters on the regular typewriter, and eliminated one for spacing!

Words in the middle column of the square, such as *several*, make use of the middle section "blind" keys, for those in the right column, the right section "blind" keys are depressed.



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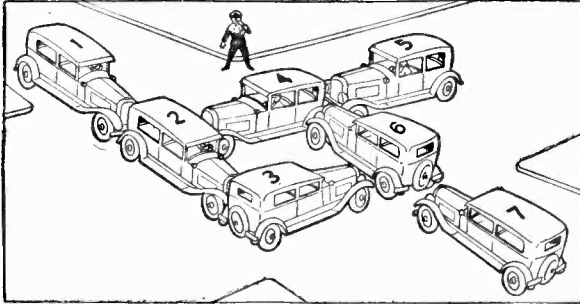
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Here's the Second Step in Glider Construction

(Continued from page 1045)

bent with care. Two F. 4. metal straps are riveted, one on each side into each of the 1/4" holes in the center section of this fitting. The drilled copper rivets which form bushings in the free ends of each F. 4 strap gives a soft bearing to the flying wires which pass through each pair of F. 4 fittings at these four attachment points. Two front flying wire clamps are cut and bent as shown in the drawing F. 8. These are made of No. 10 carbon steel and a pair of F. 4 metal straps are riveted, one on each side, into each of the 1/4" holes in the top bent section of the fittings. These F. 8 metal fittings hold the ends of the bottom flying wires, which connect to the under-surface of the wings. Two rear flying wire clamps are cut and bent as shown in the drawing F. 11. A pair of F. 4 straps are riveted in the 1/4" hole at the pointed end of these F. 11 fittings. Four spar brackets F. 5 are cut and bent as shown in the drawing. The 1/4" machine bolts which hold these fittings pass clear through the woodwork of the main skid section when they are mounted later. The runner or skid is formed by bending to shape the bottom 1 1/4" x 1 1/4" square spruce strip, as shown in the main skid section drawing. This may be accomplished by steaming or by cutting this strip somewhat thicker at its front third, and sawing slots lengthwise through the thicker part. By inserting a quantity of glue into these slots and allowing this to dry while the strip is held in shape, a very strong bottom strip can be formed. Cut and shape all the upright and diagonal struts and streamline the ones specified in the main skid section drawing.

Lay all the timber members on a level floor and mark their ends to cut so that they will assemble as shown in the drawing. The tail section framework can be held in place to help this adjustment for assembly. The long top strip of the tail section should be in line with the cross member at the bottom of the top plywood side of the main skid section. Next cut and shape the two top plywood sides and the two plywood sides of the runner. If it is found necessary to piece the plywood sides of the runner it is best to reinforce such joints, on their inside surface, with 1/4" x 1" wood strips. Using plenty of glue and nails fasten both top plywood sides in place and in like manner fasten one of the plywood runner sides in position. Drill and insert the 1/2" x 3" machine bolt in the top 1 1/4" x 1 1/4" strip at the nose of the runner. This bolt should have a tight drive fit as it is to support the rudder bar later. The remaining plywood side of the runner can now be glued and nailed into place. All the woodwork of the main skid section can now be smoothed up with sandpaper. It is well to sand the main tail section framework at this time also.

Apply a coat of spar varnish to both tail section and main skid section. When the first coat of varnish is dry sand lightly and apply a second coat. Ash clamps about 3/4" x 2 3/4" are next bolted to each side of the runner with 1/4" machine bolts which run clear through the runner. These bolts should be inserted so as to run through the 1 1/4" square strips in the top and bottom of the runner and also through the 1 1/4" x 2 3/4" main upright strut. Place these bolts about four inches apart along the length of the ash clamps. Some builders glue these ash clamps in place and do the bolting before the varnish is put on. The ash runner is next cut to shape and

Here's the Second Step in Glider Construction

(Continued from page 1046)

screwed onto the bottom of the runner. The heads of the screws should be countersunk in the ash runner and the whole bottom surface sanded very smooth. The metal fittings are next bolted to the main skid section. Use the F. 14 fittings on the tail section to determine the exact position for their F. 14 mates on the main skid section. Use the F. 25 fittings on the ends of the wing spars to determine the exact position for the F. 5 fittings on the main skid section. A line extended along the 1 1/8" top strip of the tail section should continue on through the top bolt hole of the front and back F. 5 spar bracket fittings. The glider will control easier if these two F. 5 fittings line up with the top of the tail section.

Construction data are now given for building the wings, rudder elevator-stabilizer (tail section, and main skid section. In the next instalment the wiring, and control system will be explained. Those who may be constructing this glider from data as set forth in these articles will see, upon completion of the work described in this issue, that the machine is rapidly forming into shape. They probably will experience much anxiety to get the little ship together and into the air. This anxiety must be suppressed at this time. The other parts, which are to be explained later in this magazine, are of important size and balance requirements. They must be constructed with accuracy of detail in order that the home glider builder may reap the maximum reward for his effort and time.

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LANTERNS OF GOD, by Robert A. Wait, who is not only a scientist of note, but a writer of extremely good scientific fiction as well. "Lanterns of God," is a fascinating astronomical fantasy, dealing with the troubles of the earth from cosmic and interplanetary forces.

CALLISTO AT WAR, by Harl Vincent. Here is the promised sequel to "Explorers of Callisto," which appears in the February issue, and in which Mr. Vincent—in his best style—continues the adventures of the Tellurians and Lola, the moon woman. There may be much of interest on the other side of the moon. Who knows?

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How Many Minutes Make a Mile?

By Donald H. Menzel

(Continued from page 995)

inch and a quarter.

If, then, I set up my watch as standard for the universe, I can plot fifteen minutes of time as an inch and a quarter, and our picture will look like this.

On an alarm clock, fifteen minutes is a much greater distance—on a tower clock still greater—and so on.

There are many ways of expressing time in terms of space, and vice versa. The thirty minutes in your apt illustration represent the distance traversed by some individual between his home and Times Square.

Suppose we set out to choose a universal clock—what qualifications do you think the ideal timepiece should fulfill?

L.—The ideal clock should keep perfect time.

R.—Let's analyze that statement. What do you mean by keeping "perfect time?"

P.—According to our definition, this requires that the motion of the clock-hand be absolutely uniform—that its velocity be unaffected by temperature, pressure, gravity, motion, and other influences.

R.—Right! But what clock or watch does more than approach those ideal conditions? Even the rotating earth appears to be slowing. There is only one thing in the world I can think of that comes anywhere near our ideal—a clock made of light beams.

I strike a match. Its radiance spreads out into space at a speed of 186,000 miles a second. One of the postulates of relativity is that the velocity of light in a vacuum is always the same no matter how it is measured. Here, then, is an ideal clock. Place two mirrors facing each other across an interval of 186,000 miles. Now start a tiny flash of light winging its way back and forth, like a shuttle-cock, between them.

P.—Hold on a minute. I think that the rate of your clock would vary according as it is moving or is stationary in space. If it is moving, the light ray will have to chase after the mirror in order to be reflected, and the clock will run more slowly.

R.—You are forgetting that it is impossible for us to tell whether or not a given clock is stationary in space. Velocity has significance only when we are able to detect the surroundings of the object in motion. Empty space is not visible, hence it is impossible to measure the absolute velocity of anything. We have gone into this all before. The whole structure of relativity is reared upon this point.


P.—But clocks moving relatively to each other will run at different rates.

R.—That is true. You are, no doubt, about to suggest that we substitute some sort of ideal mechanical clock. Even that does not take us out of the woods, however. The speed of light still comes into the picture. In order to read the clock we must illuminate it, and the light from its face must enter our eye. To put it another way, you see the face of your watch, not as it is now, but as it was when the light left it. Light travels fast, but the transmission is not instantaneous. If the speed of light were one foot instead of 186,000 miles a second, the problem of allowing for the time of transmission would be a very practical one.

You note that the clock on the City Hall tower stands at six o'clock. If you are a very accurate person you may reflect that, since you are a mile away from the clock, it is actually 1/186,000th of a second

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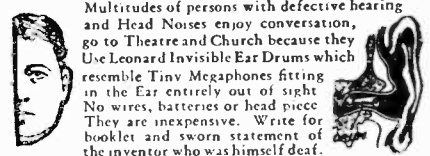
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AGENTS

later, adding the time it takes the light to reach your eye.

P.—I withdraw my objections. I see that no clock I could propose would serve any better than your light-ray clock. Furthermore, if our theories are to be in any sense universal, the universe must be our laboratory. Light rays are the only messengers we have that tell us what is occurring in the depths of space. A new star flashes in the sky. Actually the outburst may have occurred hundreds of years ago. The flash we see may well be called the tick of the clock that recorded the conflagration. In order to compute the actual date of the catastrophe, we must divide the distance of the star by the velocity of light. That tells us how long ago the flash occurred.

R.—It would, but for one thing. The measured velocity of light is always 186,000 miles a second. This is due to the fact that motion so affects our clocks and measuring rods that this answer is a foregone conclusion. But the effective speed of light may be anything. This is a point not always brought out. In our clock tower analogy, if there is anything like an "ether wind" arising from the joint motion of yourself and the tower, the light will be carried toward you in the same way that a high wind speeds the transmission of the sound of a church bell. Since no experiment we can perform can detect the existence of this ether wind "blowing" the light toward or away from you, you will be unable to calculate either the exact time of 6 o'clock on the city-hall tower or the moment that the star's flare occurred.

The unavoidable use of light as a means of transmitting signals completely justifies the type of clock I proposed. Our geometry is built out of cubic miles and light seconds. I shall not take your time, just now, to discuss this geometry in great detail—but let me assure you that the results are indeed weird and startling. One of them is the impossibility of locating, exactly, events in space. A second result is that time's rate of progress varies with motion. As you suspected, the faster a clock is moving, the slower its rate will be. A third we have discussed previously: *any moving object will appear to be contracted in the direction of its motion.*

Let us suppose that aviators, through some remarkable invention, will eventually be able to fly at 161,000 miles a second. If you examine his clocks as one of them speeds past, you will find that they appear to be running at about half-speed. Furthermore, his plane appears to have shrunk to half size along the axis of his motion.

This Discussion will be Continued in Our April Issue

**SOLUTION TO PUZZLE
ON PAGE 1032**

B	A	L	L	O	O	N	T	I	R	E
H	E	X	A	N	A	U	A	R	C	
I	D	I	O	T	C	R	I	D	E	R
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C	O	M	M	U	T	A	T	O	R	S

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▼

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the modern background . . . read them regularly.*

Have Some Fun With Cold Light!

By Raymond B. Wailes

(Continued from page 1012)

heated with a Bunsen flame, the wires will conduct the heat along themselves with varying degrees. The copper wire will conduct the heat along itself very rapidly, the calcium sulphide about this wire will glow, visually indicating that copper has a greater thermal conductivity than the other metals tested.

Some kinds of yellow glassware called uranium glass, or canary glass, phosphoresce with a greenish-yellow hue. Placed in the rays from an arc lamp, the glass glows very much brighter. Ultra violet light from the carbon arc lamp causes the uranium glass to glow. Glass stops ultra-violet light, which is injurious to the eyes. If a pair of goggles or a strip of glass is held between the arc and the glass the effect of screening out the ultra-violet rays to some extent can be perceived. That pair of goggles which will prevent the glass from glowing the brightest is the safest to use in welding operations where goggles containing protective glass are used.

Most of the old time experimenters—those who were brought up on the Electrical Experimenter—will recall the Geissler tube. By soldering three mirrors of the ten-cent-store variety together as shown, the writer has produced a striking display with one Geissler tube of the fluorescent liquid type. One mirror is laid face up and the remaining two stood upright upon this one and soldered in such a position that the reflections of the Geissler tube can be seen the maximum number of times, when it is supported upon a wire hook fixed to the top of the mirrors. A good spark coil will produce beautiful effects. Fluorescent liquid Geissler tubes are usually filled with fluorescein solution.

Quinine sulphate will luminesce under certain conditions. When dried gently on a hot plate it becomes luminous. When the water which has been driven off reenters the quinine sulphate, the phosphorescence ceases. In determining certain factors in the emission of this luminescence, investigators desired that the luminescence could be seen for hours at a time. This was cleverly carried out by spreading quinine sulphate upon a slowly revolving metal disc which was heated at one spot with a burner. The crystals above the burner were always luminescent because of the dehydration, and as the dehydrated crystals were carried around on the revolving disc, they met moist air, became hydrated again and ceased to glow until the disc carried them back to the burner where is luminesced again. Thus luminescence was always in progress above the burner.

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By DAVID V. BUSH



DAVID V. BUSH

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Dept. PA-1093, 225 N. Michigan Blvd., Chicago, Ill.

Build and Fly This Model Bremen Plane

By Arthur F. Selley

(Continued from page 1010)

Landing Gear

LANDING gear struts (42) are made from the formed reed "V's" supplied in the set. Cut the "V's" exactly to size of drawing. Shape and taper edges of streamlines (43) with sandpaper according to cross-section and side view drawing and glue to reed "V's" with grooves inside. Attach tubular fittings (49) to anchor plates (12) with wood screws (44). Apply ambroid to inside of fittings and insert "V" ends.

Open axle fittings (46) wide enough to slip into place on reed "V's" and then clamp together with pliers. Insert axle (45) through fittings (46) and with spacer bushings (47) on axle, attach wheels (50).

Brace and square up landing gear with wires (48) attached diagonally between front fittings (49) and the axle.

Wings

USE the drawing as a layout. Make sure that the straight edge of the spars is on top as the tapered edge **MUST BE** underneath to give the proper dihedral to the wing. The larger wing spar (28) is placed forward and spar (29) in rear position, on drawing. Assemble the ribs, graduating them as shown. Be sure to have 1 inch projection on each spar at the shoulder. Apply ambroid at all joints, square up assembly and allow to dry. Next fit and glue entering edge (31) and trailing edge (32) to rib notches. Shoulder braces (33) and wing tip brace (34) are now fitted and glued into place.

IMPORTANT—Build one **RIGHT** and one **LEFT** wing.

Covering: Outline wing on bamboo paper with pencil and cut roughly to size. Cover under side first. Apply white glue to entering and trailing edges, shoulder and tip; stretch paper evenly and trim.

Doping: Use dope on both sides of the wings, thinned according to directions.

Stabilizer and Rudder

INTO the formed reed outline of the stabilizer (35) fit and glue spars (36) and (37), then stabilizer shoulder brace (38). Make sure that the two lower ends of the stabilizer outline are long enough to insert into tail-block holes.

Into rudder outline (39) fit and glue braces (40). Be sure to bind tail skid (41) with thread and glue. Insert skid through tail block and bend it according to the drawing by holding it over a spirit lamp.

Cover both sides of these tail pieces; apply dope according to directions.

Assembling

INSERT reed ends of stabilizer (35) into tail block (5); this is held without gluing.

Fit wing spar ends snugly into sockets (9) and (10), as no glue is used to hold them in place. If fitting is necessary, enlarge wing sockets. When the wings are in place they should have a slight dihedral angle. Use great care to see that the wings, stabilizer and rudder are not warped or twisted and are in their proper relation to the fuselage. Accurate truing-up of the model is absolutely necessary in order to make successful flights.

(Continued on page 1053)

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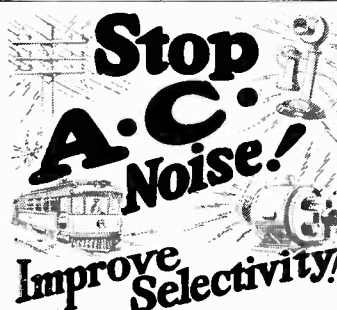
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IN the February issue of Brief Stories Magazine, we have created a department called "LUCKY BREAKS" in which the great and near-great tell just how luck came their way, and how they recognized and took advantage of it. Probably your lucky day is just around the corner. Will you recognize it, when it comes? Will you know what to do? Read "LUCKY BREAKS" in Brief Stories Magazine for March and be prepared. Invest a quarter in Brief Stories at your nearest newsstand, and you may lay the foundation for a million, two million, ten million—who knows how much? Maybe reading "LUCKY BREAKS" will be *your* Lucky Break.

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See How It's Done in MARCH

Brief Stories

NOW ON SALE AT ALL NEWSSTANDS—25c a Copy

Build and Fly This Model Bremen Plane

By Armour F. Selley

(Continued from page 1051)

Flying

WITH the motor in place the model is ready to fly. If properly balanced, it should be slightly nose-heavy when held by a string attached to a pin in fuselage, directly over the main wing spars. If it is tail heavy, balance by adding weight to the nose.

Always fly the model into the wind.

Make a trial flight, giving the motor only 35 to 40 turns and launching from the hand. When the model is adjusted to fly on an even keel, it is ready for a flight rising from the ground.

Wind propeller not more than 125 turns. Select a smooth, hard runway, hold the propeller with one hand and the stabilizer with the other and place model on the ground. Release the propeller and at the same time gently push the machine forward. After a short run it will rise into the air and, if properly balanced, will make flights of from 100 to 125 feet.

KEY TO PARTS

Fuselage

- | Key No. | Description |
|---------|---|
| 1— | Fuselage nose piece ($\frac{1}{8}$ " \times 1" \times $\frac{1}{32}$ " three-ply veneer). |
| 2— | Fuselage nose braces ($\frac{3}{32}$ " square white pine). |
| 3— | Fuselage compression struts ($\frac{1}{8}$ " \times $\frac{7}{16}$ " white pine). |
| 4— | Motor stick support, rear ($\frac{1}{8}$ " \times $\frac{9}{16}$ " balsa wood). |
| 5— | Fuselage tail block ($\frac{1}{4}$ " \times $\frac{3}{4}$ " \times 1" white pine). |
| 6— | Longerons ($\frac{1}{8}$ " square white pine). |
| 6a— | Upper nose longerons ($\frac{1}{8}$ " square white pine). |
| 7— | Fuselage struts ($\frac{1}{8}$ " square white pine). |
| 8— | Fuselage reinforcement braces ($\frac{3}{32}$ " square white pine). |
| 9— | Wing spar socket space front. |
| 10— | Wing spar socket space rear. |
| 11— | Fuselage wing spar socket reinforcement pieces, front and rear ($\frac{1}{8}$ " \times $\frac{9}{16}$ " balsa wood). |
| 12— | Combination wing and landing gear anchor plates ($\frac{1}{8}$ " thick white pine). |
| 13— | Cabin brace, front ($\frac{3}{32}$ " square white pine). |
| 14— | Cabin cross brace ($\frac{3}{32}$ " square white pine). |
| 15— | Cabin roof ($\frac{1}{8}$ " \times 2" balsa wood). |
| 16— | Cabin window (.005 sheet celluloid). |

Motor Unit

- | | |
|-----|---|
| 17— | Propeller (10" adjustable pitch aluminum blades). |
| 19— | Propeller hanger (28 gauge sheet steel). |
| 20— | Propeller shaft ($\frac{3}{32}$ " diameter steel wire). |
| 21— | Motor stick ($\frac{1}{8}$ " \times $\frac{5}{16}$ " white pine). |
| 22— | Motor ($\frac{1}{5}$ " \times $\frac{1}{8}$ " flat rubber). |
| 23— | Motor stick rubber hook ($\frac{1}{16}$ " diameter steel wire). |
| 24— | Motor stick reinforcement pieces, front ($\frac{1}{16}$ " \times $\frac{5}{16}$ " white pine). |
| 25— | Motor stick reinforcement pieces, rear ($\frac{1}{16}$ " \times $\frac{5}{16}$ " white pine). |
| 26— | Propeller hanger wire clip (20-gauge steel wire). |
| 27— | Propeller shaft spacer bushing ($\frac{3}{32}$ " diameter brass eyelet). |

Wings

- | | |
|-----|---|
| 28— | Wing spars, front ($\frac{1}{8}$ " \times $\frac{5}{8}$ " balsa wood tapered). |
| 29— | Wing spars, rear ($\frac{1}{8}$ " \times $\frac{1}{2}$ " balsa wood tapered). |
| 30— | Wing ribs ($\frac{1}{16}$ " thick balsa wood). |
| 31— | Entering edge ($\frac{3}{32}$ " \times $\frac{1}{8}$ " white pine). |
| 32— | Trailing edge ($\frac{3}{32}$ " \times $\frac{1}{8}$ " white pine). |
| 33— | Wing shoulder braces ($\frac{3}{32}$ " square white pine). |
| 34— | Wing tip braces ($\frac{3}{32}$ " square white pine). |

Tail Surfaces

- | | |
|-----|---|
| 35— | Stabilizer outline ($\frac{1}{8}$ " reed). |
| 36— | Stabilizer spars ($\frac{1}{16}$ " \times $\frac{1}{8}$ " white pine). |
| 37— | Stabilizer ribs ($\frac{3}{32}$ " square white pine). |
| 38— | Stabilizer braces ($\frac{3}{32}$ " square white pine). |
| 39— | Rudder outline ($\frac{1}{8}$ " reed). |
| 40— | Rudder braces ($\frac{3}{32}$ " square white pine). |
| 41— | Tail skid ($\frac{1}{8}$ " reed). |

Landing Gear

- | | |
|-----|---|
| 42— | Landing gear V's ($\frac{1}{8}$ " reed). |
| 43— | Landing gear slotted strut streamlines ($\frac{3}{16}$ " \times $\frac{11}{16}$ " balsa wood). |
| 44— | Screws, wood No. 1 ($\frac{1}{4}$ " roundhead, brass). |
| 45— | Axle, 7" ($\frac{3}{32}$ " diameter steel rod). |
| 46— | Axle fittings (28-gauge sheet steel or brass). |
| 47— | Axle spacer bushings ($\frac{3}{32}$ " diameter brass eyelets). |
| 48— | Landing gear cross wires (34-gauge tin wire). |
| 49— | Strut fittings, tubular ($\frac{1}{8}$ " inside diameter brass tubing). |
| 50— | Wheels, aluminum disk, rubber tires (2" diameter). |

In RADIO NEWS for March, 1930

Senatore Marconi, on the twenty-eighth anniversary of his first successful communication across the Atlantic, narrates in detail his experiences on that eventful occasion.

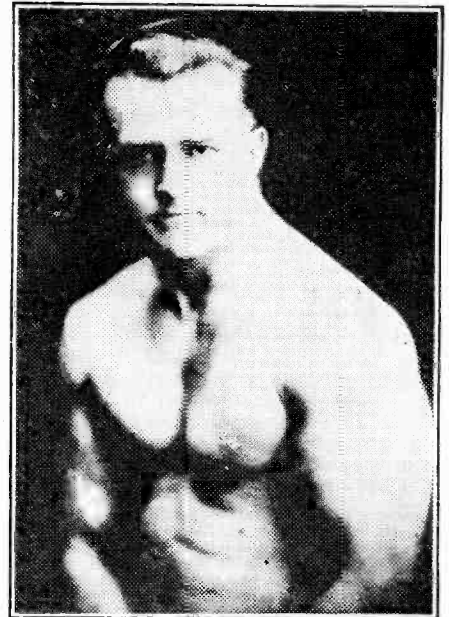
The Boy Scout Four, a receiver employing a popular circuit, is described, full constructional details being given. Here is a receiver designed and built by a Scoutmaster for use in Headquarters or Camp.

Carl Dreher tells of the difficulties encountered by the Sound Engineers in recording talkies where the "mike" must keep pace with the action in moving scenes.

Captain Frank M. Hawks, holder of the East-to-West and West-to-East transcontinental air speed records, describes for readers of RADIO NEWS the radio equipment he carries in his plane, and the important part it plays in his flights.

Two articles on the subject of automobile-radio receivers, one by Graydon Smith and Philip Eyrick and the other by Samuel Egert, outline the latest developments in receiver design.

How to build an audio oscillator; how to build a 245 amplifier-power supply, the description of a new Junior Radio Guide receiver, and the regular technical information departments make the March issue of RADIO NEWS one of outstanding interest and value to experimenters and broadcast fans alike.



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Lindy Gets New Wings

(Continued from page 1005)

their gasoline before the additional burden of ice has been collected.

For ice to form on the wings, it is first necessary that the plane fly through an area of relatively high humidity and secondly, that the temperature be below 32 degrees Fahrenheit. To prevent ice, the wings of test planes are treated with various types of oils, glycerine and preparations. Contrary to expectation, it is found that particles of water meeting with a greased surface, become partially imbedded and are actually held on the wings and freeze there. Other particles of water also freezing, coalesce and a large piece of ice forms on the surface.

Air temperature indicators enable the pilot to know, by the readings of the instrument during flight through cold, humid areas, when there is danger from ice and permit him to alter his course, seeking the warmer air.

The air temperature indicator consists essentially of three parts, the first being a bulb which is mounted in such a position that it will be directly in line with a stream of air. This connects with a tube having a bore of only six-thousandths of an inch and a Bourdon tube. A Bourdon tube is made of seamless copper, is flat, and closed hermetically. The entire tubular section is filled with xylene under pressure. When the bulb of the instrument is subjected to heat or cold, the liquid expands or contracts. The expansion or contraction causes the curved Bourdon spring to distend or become flatter. This action in turn produces a winding or unwinding motion and turns the needle on the dial. Inside of the coil of the Bourdon spring is a compensating spring, the purpose of which is to correct any changes in temperature which may occur at the head of the instrument or in the cockpit of the plane. The compensating spring is a bi-metallic strip, wound in such a way that cooling the head of the instrument causes the spring to bend giving an opposite effect to that of the Bourdon coil.

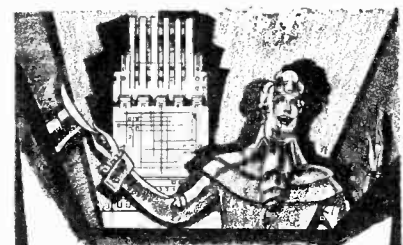
All of the instruments on the dash of Lindbergh's new plane were built by the Pioneer Instrument Co., noted for the construction of instruments for aircraft purposes. The ice warning indicator is a Moto-Meter product.

It might not be amiss to mention that the rear cockpit in which Mrs. Lindbergh will sit is provided with an altimeter and air speed indicator and a rate-of-climb indicator, duplicates of those in the front cockpit.

IMPORTANT

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



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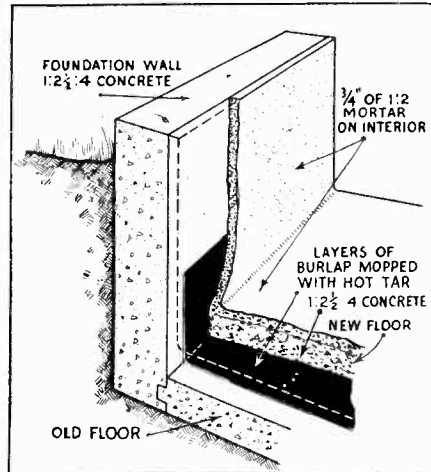
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Make That Wet Cellar Dry

By Josef W. Von Stein

(Continued from page 1013)

an actual pool on their cellar floors. "Suppose I tell you what I think will remedy your individual conditions," went on Joe. "In the first place, if the condition is merely one of dampness, as in Bill's case, it may be sufficient to apply a wall coating, or watertight seal, over all walls and floor, consisting either of Portland cement mixture, or the mixture combined with such a waterproofing compound as I mentioned before. Before applying this inner seal, all wall and floor surfaces must be thoroughly cleaned. If the construction is stone, brick or other masonry, mortar joints should be raked out to a depth of 1/2-inch. If there are cracks in the wall these should be filled with a 1:1 1/2 cement-sand mortar mixed to the consistency of moist earth, and rammed into the crack with a caulking tool or ball-peen hammer. All surfaces should then be brushed with a slush or grout of cement and water mixed to the consistency of thick cream. While this grout is still wet, apply the final inner waterproofing lining. Wherever possible, the application of the coatings should be made continuous until completed. Where construction joints are necessary, they should be carefully cleaned and slushed with the described grout before the additional coating is applied.



Construction suggested when it is more convenient to apply treatment from inside, to prevent entrance of ground water. Thickness of new floor depends on height of water above basement floor in wet weather.

If it is impossible to carry out this work during dry weather, seepage through cracks is sometimes relieved by inserting pipes to serve as seep holes in the wall. These are plugged after the work is completed. The coat must be given a chance to thoroughly dry out before subjecting it to the seepage of water. The thickness of this inner waterproofing seal is dependent upon the maximum head of ground water, which is indicated by the height to which the water has ever risen over the floor of the cellar. If the condition is merely one of dampness or very slight seepage as I believe is your case, Bill, a wall coating 3/4-inch thick carried up to 1 foot above grade may be sufficient."

(Continued on page 1056)

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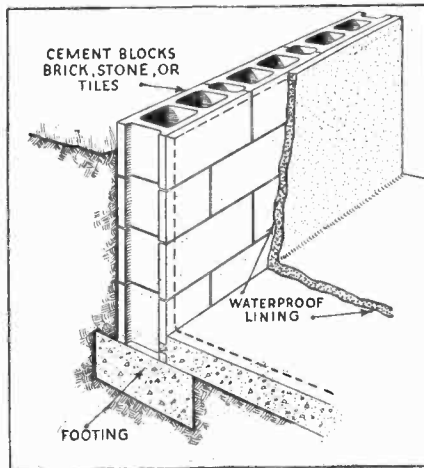
Make That Wet Cellar Dry

(Continued from page 1055)

"But what about the deplorable standing water in my cellar," asked Harry hopefully.

"Your task will be a trifle more difficult than Bill's," he finally agreed. "Your first problem is to get rid of the standing water. You may succeed in this by merely chopping some outlet holes in the floor. On the other hand, if there is a continuous leakage, employ a pump. Or some small local contractor will keep the cellar dry while you do the actual work of waterproofing.

"After you have a fairly dry surface, examine the walls and floor for cracks. Cut them out to a depth of about 2 inches, forming narrow grooves, and fill the spaces with hot tar or a mixture of tar and sand. In order to provide a further seal against the entrance of ground water, a membrane, composed of several layers of tarred felt or burlap mopped with hot tar, pitch or asphaltum, should be placed over the entire floor. Be sure to run these layers a considerable distance upward along the walls, Harry—at least a distance of one foot. This new flooring will depend in thickness upon the amount



Protect cellar against seepage or leaks by applying a water-proofed cement lining, consisting of Portland cement mixture combined with a water-proofed compound.

of upward water pressure you have to contend with."

"How do I figure that?" asked Harry. "Merely remember that, for every foot ground water rises above floor level, a water pressure of 6 1/2 pounds per square foot is developed against the lowest point. If an unreinforced floor is used—and I believe that this type will do quite nicely in your case—it must resist by its own weight the water pressure from below. Considering that concrete 12 inches thick weighs about 144 pounds for each square foot of surface area, the unit weight of flooring becomes 12 pounds per square foot for each inch of thickness. Jot down this fact."

Joe continued, "A 6-inch slab is therefore needed to resist the upward pressure of a 1-foot head of water. Where a plain slab would be excessively thick, a reinforced slab would undoubtedly be more economical. But I don't think you'll have to worry about that, Harry. Such a

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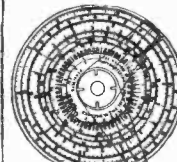


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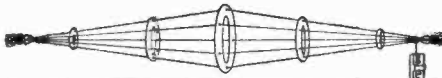
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slab would be anchored to the walls and to intermediate partitions or columns, to obtain the necessary support."

"No, I don't think the head of water in my cellar is great enough to entail this reinforced flooring, Joe," agreed Harry.

"Very well, then," answered Joe. "You can readily determine the thickness you require for the new floor. You ought to make it of a 1:2:4 mix. Be sure to get a good joint with the tarred membrane covering the lower portions of the walls. Finish the job with a uniform coating of 3/4-inch thickness of 1:2 cement mortar or a mixture combined with the patented waterproofing compound."

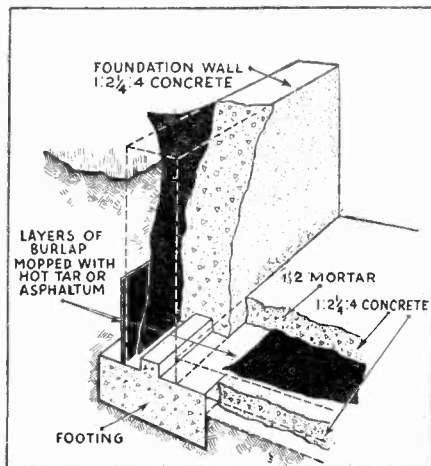
While Joe stopped to light a fresh cigar, Harry asked, "You mean that this finish coat should be applied over the floor, as well as the walls, don't you, Joe?"

Joe laughed. "Certainly, finish off the interior of the walls and the floor with this mortar or waterproof combination coating. And, another thing—be sure that you get a perfect bond where the walls join the floor. I would advise you to see that this joint is covered. And don't put this finishing coat over the new concrete floor too soon. Fresh concrete should be kept moist from 7 to 10 days to produce best results. Therefore, wet the new floor down several times daily during this time. Please remember also that proper ventilation of basements is necessary to prevent condensation of warm, moist air on the colder wall surfaces. Thus, both of you ought to keep your cellar windows open on cool, dry days, but close them when the outside is sultry and the humidity is high. But I guess you won't worry about this condition at this time of the year."

"No," agreed Harry, "but I think we all ought to think about the condition of our beds at this time of the night. I know, it's time Harry was running along."

"We second the motion," chimed in his two companions.

"But let me know how you get along with the new home-making jobs I've suggested," advised Joe as the trio parted for the night.



Exterior treatment against ground water pressure in low ground or similar conditions. 1:2 mortar means 1 pail Portland cement to 2 pails sand. 1:2 1/4 indicates 1 pail cement, 2 1/4 pails sand, 4 pails gravel.

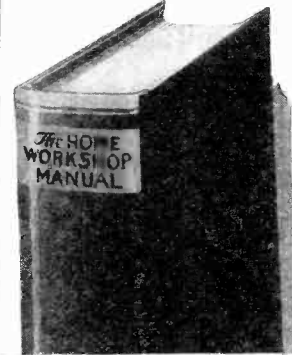
Readers will find "Have a Basement Playroom," Page 986, as well as Mr. Von Stein's article, extremely useful in preparing a plan for the contest announced on Page 980.

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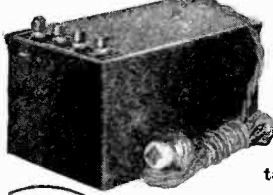
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Cold Light in Perfect Form Found in Fire-fly Species

By William Lemkin, Ph.D.

(Continued from page 984)

then we have two perfectly reversible reactions, involving oxygen and water, both of which are of prime necessity to the phenomenon of bioluminescence.

It appears then that there is present in the photogenic organ of the fire-fly some chemical substance which undergoes oxidation with the production of light. In 1887 the French chemist Dubois discovered that two substances can be extracted from the luminous organ of the animal, both of which are very essential to the process. Since this discovery other workers have precipitated, purified and experimented with these compounds and we now have a fairly clear idea as to their probable structure and the part they play in bioluminescence. The first of these substances has been named *luciferin*, and it is this material which oxidizes with the evolution of light. In a strict sense, we should speak of *luciferins*, because there are as many such compounds as there are types of luminous animals, and each luciferin is specific for that particular variety of organism. The other substance, termed *luciferase*, is a catalyst or enzyme, which, though taking no apparent part in the reaction, and not itself being consumed or changed, nevertheless materially aids in the process, and is a factor which cannot be dispensed with.

On the chemical structure of these two substances chemists are not quite agreed among themselves. Luciferin is a nitrogenous compound, and in all likelihood possesses a composition and a molecular configuration closely associated with the proteins. Luciferase, also containing nitrogen, is to be classed structurally with the albumins. Although neither of them has as yet been synthesized in the laboratory, there is no doubt that this feat will soon be accomplished. The simpler proteins, to which luciferin and luciferase are both related, are now being synthesized with no great difficulty.

The scientist has a pretty clear conception of the chemistry involved in the actual generation of light. Knowing that the process is one of oxidation, one would naturally be led to the conclusion that it is similar to most other such reactions,

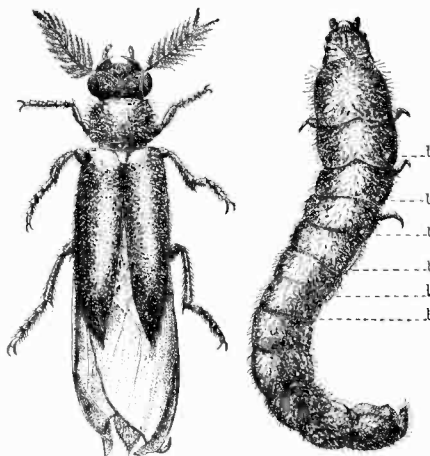
with the production of carbon dioxide and water, and the evolution of light and heat. Experiment demonstrates this conclusion to be three-fourths wrong. The most delicate chemical test can detect not a trace of carbon dioxide or water resulting from the processes involved in bioluminescence. Furthermore, the action is accompanied by no heat manifestation whatsoever. This is a truly "cold light," and nearly 100% efficient.

What happens to luciferin when it is oxidized? Considerable research on this phase of the work, conducted particularly by Professor E. Newton Harvey of Princeton University, has disclosed that the oxidation product is a new material which may be termed *oxyluciferin*, following a nomenclature similar to the one used for *hemoglobin*, the red pigment of our blood. Hemoglobin unites with oxygen as the blood passes through the capillaries of the lungs, forming *oxyhemoglobin*. In the various cells of the body the union between the two is broken up, to furnish the necessary oxygen to the living tissues. In fact, the separation may even be made artificially. If *oxyhemoglobin* is placed under an air pump and all the air is exhausted, it returns to the original hemoglobin. This process is reversible, and will go either one way or the other, depending upon the amount of oxygen present.

In the case of luciferin the action is strikingly analogous to the one just described. With a proper concentration of oxygen the compound is completely converted to *oxyluciferin*. Then, under certain other conditions a regeneration takes place, and our luciferin is again obtained. The chemist has not yet learned to effect and control this reversible reaction with any great ease, but he believes that in the lowly fire-fly, as well as in all other forms of luminous organisms, the change is accomplished with the utmost facility.

During the momentary flash of the insect, luciferin is being oxidized to *oxyluciferin*. In between flashes the *oxyluciferin* is being reduced back to luciferin, to prepare it for the next flash, which process is continuous and reversible, some of each material always being present. The direction of the reaction, whether oxidation or reduction, as well as the velocity of change, are determined by the amount of oxygen present, in turn controlled by the will of the insect.

Can we utilize the secret of the fire-fly to produce practical "cold light?" The problem is a captivating one, and has fired the imagination of many an investigator in this field. The most available and advanced form of light which man is now capable of generating—the incandescent electric light—is only about 2% efficient. That means that, of all the electrical energy expended in producing it, only 2% is converted into useful light rays, while 98% is dissipated in the form of useless heat. The most fundamental principle underlying incandescence is that a tremendously high temperature must first be attained before any light can be given off. On the other hand the luminescence of these light-giving insects and animals consists of nothing but visible light. There is no radiation in the spectrum below the red or above the violet ends. The energy radiated is 100% light and heat.



The male of a South American luminous insect species resembles a fly, the female a worm. Luminous areas on the latter are indicated by the letter "l."

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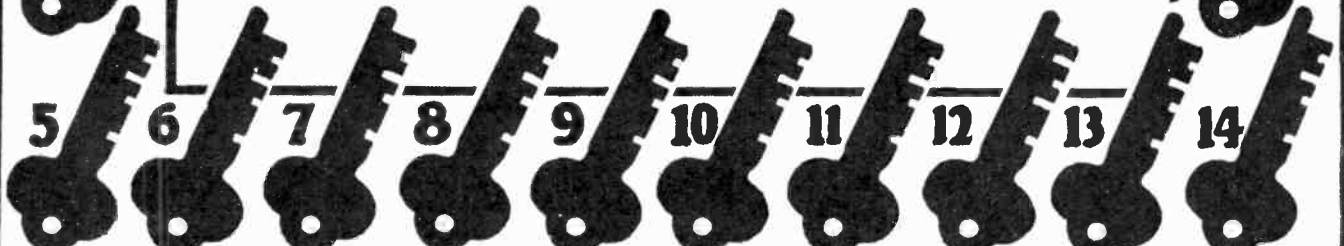
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Aladdin's Lamp in the Laundry

By Mrs. Christine Frederick

(Continued from page 998)

modern machinery and chemicals, is not widely understood. Here are four points to sum up:

1. It is not necessary to soak clothes because wet pieces weaken the suds solution, and long soaking lowers the temperature and contracts the grease in the fibres. If you feel that certain very soiled pieces need soaking, place them in machine with lukewarm water and a small quantity of powdered soap. Operate machine 2 minutes. Never allow them to soak over 3 hours, and soak clothes preferably in a machine, for soaking in a set tub, then removing to a machine, etc., is unnecessary handling. Drain off water and wash.

2. It is not necessary to boil the clothes because the scald-rinse in the machine takes its place. It accomplishes the sterilization and bleaching far better and with less labor. It reaches every part of the clothes in a way which cannot be done in a boiler, with the clothes tightly packed, and no agitation of the water. A few articles, as sanitary cloths, baby napkins, etc., may need occasional boiling.

3. It is possible to both wash and wring at the same time, owing to the swinging wringer. With a little practice you will find that you can wring any previous load while a later one is washing. You may wring from the washer to a set tub, or from a set tub to a basket, or in any combination. Nor do you have to stand in one uncomfortable position all the time; you may swing the wringer and work where you choose.

4. It is possible to blue by machine more satisfactorily than can be done by hand. To do this, wring all loads from their scald-rinse into empty tub or basket. Drain machine, add clear, cool water and the desired quantity of bluing. Add pieces and operate machine 3 to 5 minutes; wring.

I would suggest a definite schedule of washings for efficiency which is far better than the hit-and-miss, higgledy-piggledy way which many housewives use. I arrange the loads in sequence, as follows:

Load 1 (White)—Sheets, cases, face towels, doilies, hard-finish white goods. Water 120 degrees; 1 cup combination soap-soda solution to each load; operate 10 to 15 minutes; scald-rinse (150 degrees) 5 minutes; blue-rinse (90 degrees) 3 to 5 minutes.

Load 2 (White)—Tablecloths, napkins, shirtwaists, brassieres, cambric night or underwear, child's dresses, white petticoats, aprons, handkerchiefs, moderate hard-finish goods. Water 120 degrees; 1 cup combination soap-soda solution to each load; operate 10 to 15 minutes; scald-rinse (150 degrees) 5 minutes, blue-rinse (90 degrees) 3 to 5 minutes.

Load 3 (White)—Cotton or mixed underwear, bath towels, kitchen towels, bedspreads, covers, nightwear, cotton crepes, all coarse meshed goods. Water 120 degrees; 1 cup combination soap-soda solution to each load; operate 12 to 18 minutes; scald-rinse (150 degrees) 5 to 8 minutes; blue-rinse (90 degrees) 3 to 5 minutes.

Load 4 (Flannel)—Night garments or underwear of flannel or outing flannel, petticoats, shirts, small quilts, children's woolen articles, blankets, all flannel finish or partly wool goods. Water 110 degrees; 1 to 2 cups white soap solution to each load; operate 8 to 10 minutes; clear-rinse (110 degrees) 5 to 8 minutes.

Load 5 (Colored)—House dresses, men's shirts, rompers, child's dresses, aprons, all colored or partly colored goods of gingham, chambray, linen, etc. Water 110 degrees; ½ to 1 cup white-soap solution to each load; operate 10 to 15 minutes; clear-rinse (110 degrees) 5 minutes.

If women would attack their laundry problems with the principles of system and scientific management used in business, the same thing would happen in the home—there would be more work done with less labor and time. Nowadays no woman need "break her back" over the washtubs, or even get very tired doing the family laundry.



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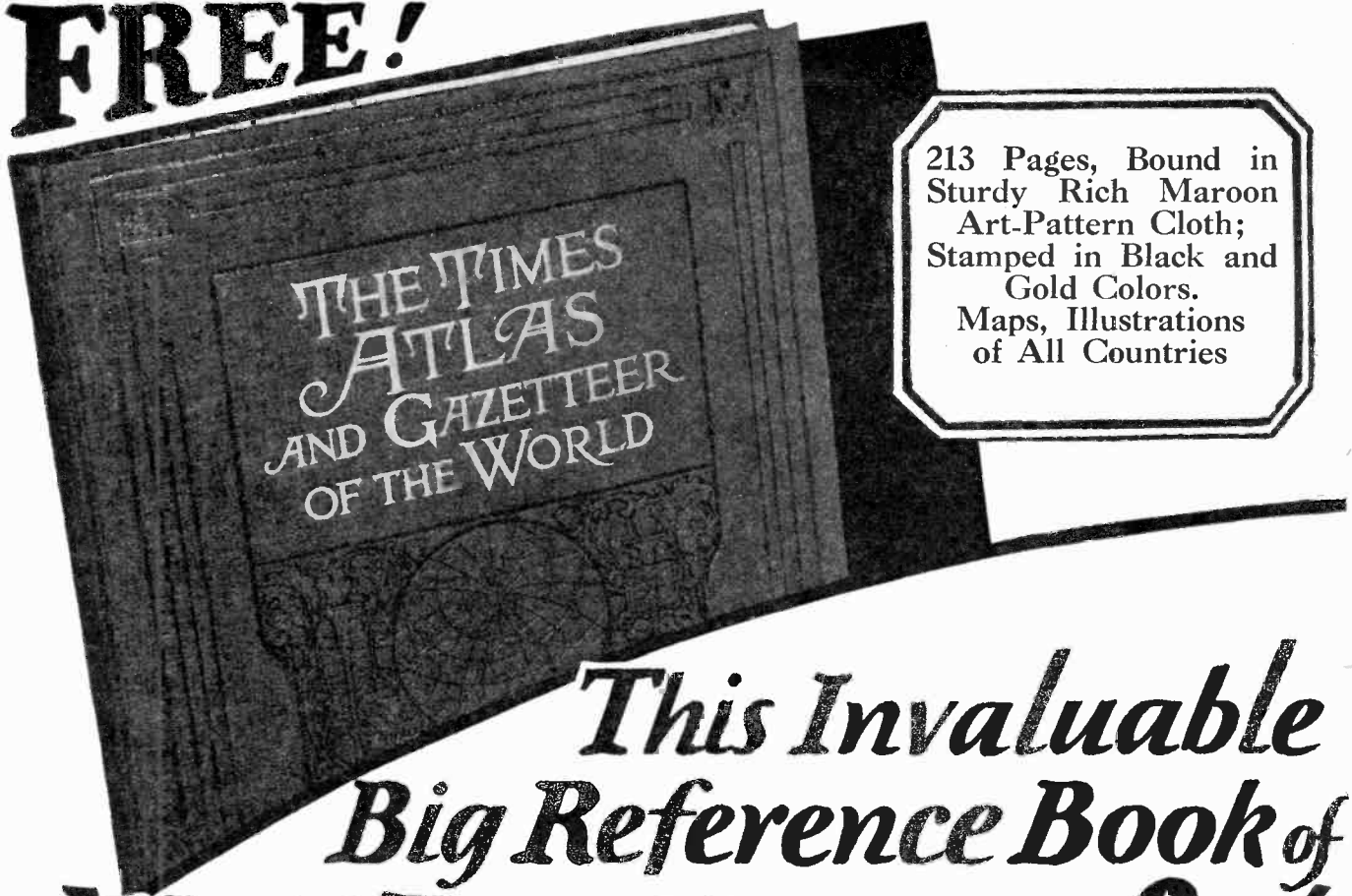
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Diagnosing Securities

By Alfred M. Caddell

Financial Editor

TO most people, discovering a clue to the trend of security values is like searching for a needle in a haystack or finding the beginning of a circle. Yet most definite clues exist and are easily recognized by those skilled in diagnosing the underlying causes which show up as effects in the market quotations.

When a young man desires to become a physician he goes to a seat of learning where the knowledge pertaining to the body and kindred subjects is imparted and after years of conscientious practice he may become skilled in his calling. The same is true of dentistry, architecture, building construction and every other calling which is above manual labor. So most assuredly, the man or woman who would make money with money, whether for brief or long periods, should necessarily be well grounded in the subject of finance.

As in the medical field, a correct diagnosis of a security's value and trend constitutes nine-tenths of the problem of "what to do." With the application of the other tenth—money and courage—a complete success is brought about; contrariwise, all the money at one's disposal, invested unintelligently and at the wrong time, can only mean disaster.

Time is the essence of financial success in the business of making money with money, for inopportune investment of capital may very quickly work itself into a liability instead of an asset.

In a sense, while the maintenance and rise in values have their bases in a widespread national and international prosperity, which, of course, is never equalized throughout the world, a correct diagnosis of any security's value can only be ascertained via a concentrated analysis in any particular field. Public utilities, railroads, communications, entertainment, automobiles, chain-store or mail order merchandising and similar businesses furnish indices by which the earning power of industrial specialties may be measured.

For instance, when the public utilities are booming, the various companies are in an expansive mood, which means electrical and machinery equipment purchases, copper wire, conduits and so forth. When the railroads are going ahead under full steam, new equipment of every sort means earnings to companies specializing in those fields. The growing public's consciousness of the benefits and commercial possibilities of electrical communication is steadily expanding and unquestionably will show continually mounting values well into another generation and possibly beyond that. Entertainment, like food, is a pretty nearly stable commodity, subject more or less to slow changes of fashion. The present-day automobile industry, while representing a popular and now necessary vehicle of transportation, has its basis largely in installment buying.

This, in turn, rests on the steady earning power of millions of people; and the automobile, long since having become a pivot industry, likewise affects, either favorably or adversely, the steel, aluminum, copper, rubber, plate glass, oil and innumerable other businesses. For instance, one fifth of the entire steel output of the country goes into the manufacture of automobiles. Chain-stores and mail-order houses still effect changes in our retail business structure, and specialties of various kinds are in turn affected. What the development of the rayon business has done to the established silk, cotton and woolen industries

and what the development of other chemical products has done to the lumber, furniture and other fields is too well known to require further comment.

The whole subject of investing is indeed an interesting and a scientific one to analyze. To approach the business without having given it the necessary deep study simply means that one is gambling and gambling is the poorest business on earth, for one may speedily lose his entire capital and receive nothing but heart-aches. To approach it with due regard means success in proportion to the study, courage and money applied. The payment of nearly \$6,000,000.000 by American industry to American and foreign investors in the year 1929—the largest payment in our history—is the proof that there is money to be made in the wise selection of securities.

Questions and Answers

Conducted by Alfred M. Caddell

Financial Editor

Information on securities will be furnished readers of "Science and Invention" free of charge by mail and through these columns. A 2-cent stamped, self-addressed envelope should be included in your letter. Address your inquiries to the Financial Editor, Science and Invention, 381 Fourth Ave., New York City.

Question—I note that American Telephone & Telegraph has had a good year in 1929. Are the prospects favorable for continued expansion of this company? H. L. K., Hoboken, N. J.

Answer—By all measurements of an industry's prospects, A. T. & T.'s growth may be considered to be indefinite. The company has been a consistent dividend earner for many years and is near the \$4,000,000,000 mark in valuation. The company's earnings will approximate \$12.50 per share for the year 1929, as against \$12.11 for 1928. Earnings for 1928 were on an average of 11,823,745 shares outstanding, whereas the average for 1929 was about 14,000,000. The A. T. & T. system links 29,000,000 telephones, and connections have recently been established with 9,000,000 telephones in foreign countries. The company is expected to issue rights to subscribe to more stock, and contemplates spending \$700,000,000 in 1930 for further expansion.

Question—Can you tell me anything about the Intercontinental Aircraft Corporation? R. L. M., Muskegon, Mich.

Answer—I never heard of this corporation and can find no record in the financial manuals regarding it. Undoubtedly it is a local company. However, would suggest that you watch your step when you are asked to put money into a new company. Aside from the fact that there are too many companies already in aviation, the most of which have no chance to succeed, a great deal depends on management and the make-up of the directorate. Poor management will wreck the very best of business prospects.

Question—I own 100 shares of Montgomery Ward and have been quite anxious regarding this stock. They say that the company is having a lot of trouble with its chain of retail stores. B. F. G., Clinton, Iowa.

Answer—As in all new enterprises it takes time to iron out the kinks that develop, but to infer that Montgomery Ward is unduly suffering from this cause is entirely erroneous, and we fear is propaganda put out to depress the value of this security, and for that purpose only. There is hardly any doubt as to the stability of this company. The year 1929 not only developed a record sales volume, far exceeding any previous total, but also vastly strengthened the company's basic position in the merchandising field. Two new mail-order headquarters, at Denver, Col., and Albany, N. Y., were opened during the year, giving the company a total of nine strategically located distribution points. Over 250 new retail stores were added to the chain, making a total of 550 retail outlets, adding approximately 1,000,000 customers to the company's list.

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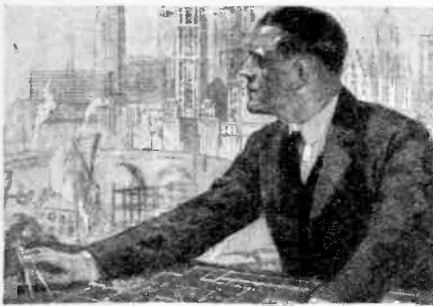
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| <input type="checkbox"/> Electric Lighting | <input type="checkbox"/> R. R. Positions |
| <input type="checkbox"/> Electric Car Running | <input type="checkbox"/> Highway Engineer |
| <input type="checkbox"/> Telegraph Engineer | <input type="checkbox"/> Chemistry |
| <input type="checkbox"/> Telephone Work | <input type="checkbox"/> Pharmacy |
| <input type="checkbox"/> Mechanical Engineer | <input type="checkbox"/> Coal Mining Engineer |
| <input type="checkbox"/> Mechanical Draftsman | <input type="checkbox"/> Navigation <input type="checkbox"/> Assayer |
| <input type="checkbox"/> Machine Shop Practice | <input type="checkbox"/> Iron and Steel Worker |
| <input type="checkbox"/> Toolmaker | <input type="checkbox"/> Textile Overseer or Supt. |
| <input type="checkbox"/> Patternmaker | <input type="checkbox"/> Cotton Manufacturing |
| <input type="checkbox"/> Civil Engineer | <input type="checkbox"/> Woolen Manufacturing |
| <input type="checkbox"/> Surveying and Mapping | <input type="checkbox"/> Agriculture <input type="checkbox"/> Fruit Growing |
| <input type="checkbox"/> Bridge Engineer | <input type="checkbox"/> Poultry Farming |
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| <input type="checkbox"/> Traffic Management | <input type="checkbox"/> Stenography and Typing |
| <input type="checkbox"/> Accounting and C. P. A. | <input type="checkbox"/> English |
| <input type="checkbox"/> Coaching | <input type="checkbox"/> Civil Service |
| <input type="checkbox"/> Cost Accounting | <input type="checkbox"/> Railway Mail Clerk |
| <input type="checkbox"/> Bookkeeping | <input type="checkbox"/> Mail Carrier |
| <input type="checkbox"/> Secretarial Work | <input type="checkbox"/> Grade School Subjects |
| <input type="checkbox"/> Spanish <input type="checkbox"/> French | <input type="checkbox"/> High School Subjects |
| <input type="checkbox"/> Salesmanship | <input type="checkbox"/> Illustrating <input type="checkbox"/> Cartooning |
| <input type="checkbox"/> Advertising | <input type="checkbox"/> Lumber Dealer |

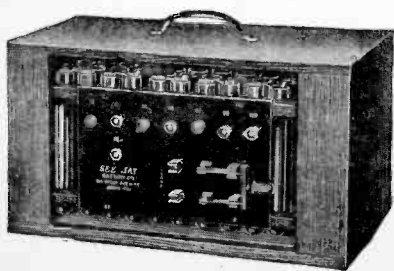
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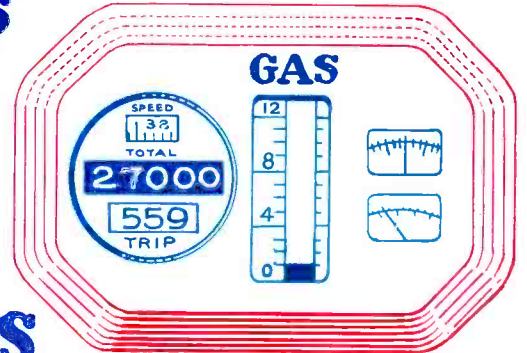
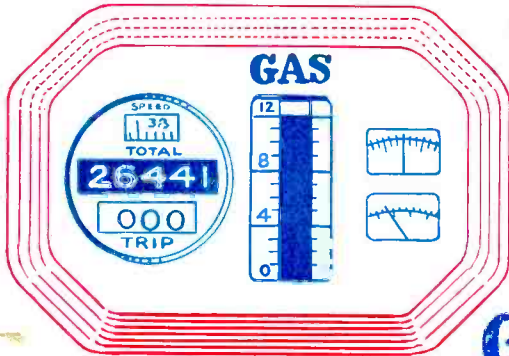
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