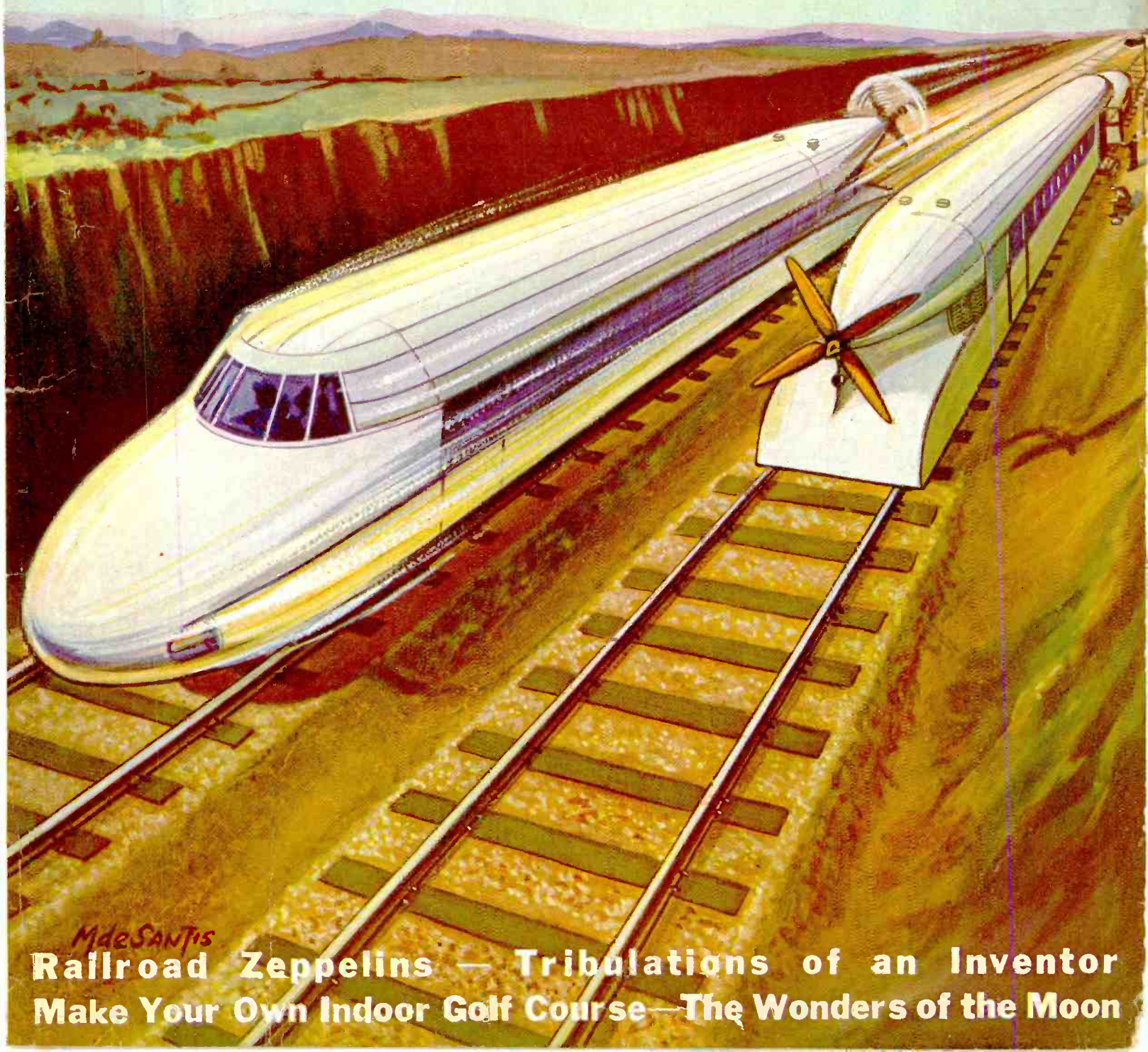
Science and Invention

FEBRUARY

25 CENTS



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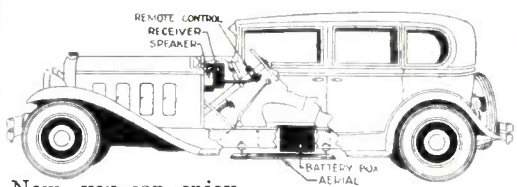

Now, you can enjoy your favorite radio programs as you drive. This new Roamer Auto radio blazes a new trail in its approach to perfection in circuit design.

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FEBRUARY
1931

Science and Invention

VOL. XVIII
No. 10

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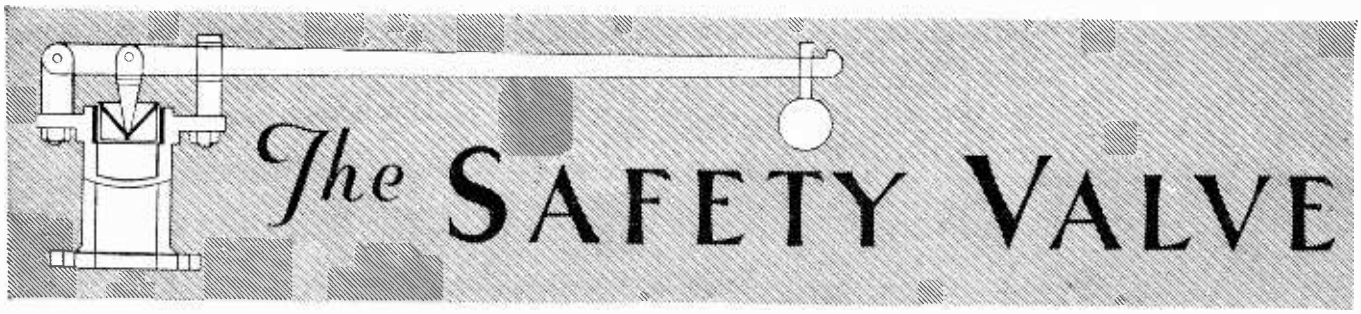


This Department Is Conducted By and For You. Expressions of Opinion or Comments Are Welcome. Please Address Them to Safety Valve Editor in care of this publication.

A Reward for Cold Cure

I NOTE that your magazine carries an offer of reward for perpetual motion and one for certain demonstrations by spiritualists, the first being in the sum of $5.000.00, and the second totaling $21.000.00.

I am wondering if you would make any such offer in relation to the discovery and demonstration of the basic factors of the common cold. Johns Hopkins University has been given a special fund of $195,000.00, and is operating a special clinic for the purpose of investigating this phenomenon, and has failed to uncover anything of value in the past year. The Rockefeller Foundation began the investigation of the respiratory diseases in 1927, by sending men all over the world to trap the common cold and other afflictions of that nature, but they have failed to bring to light the basic factors. So far as we have gone no one has ever been able to fathom the mystery which surrounds this common ailment which leads to other diseases, and the discovery of which would lead to the master-key of the respiratory diseases.

In view of this, I would therefore like to inquire what is your attitude, and why not offer a reward of some suitable amount for something like this, if your rewards are for the purpose of helping humanity? Of course, if you are merely betting that there is no such thing as perpetual motion and spiritualism, then you still have the element of chance in this field, because the basic factors of a common cold have been elusive for centuries upon centuries, and the chance of trapping them is about the same as that of working out perpetual motion.

Please give this matter your earnest consideration. We may start something worth while if you do.

GEORGE A. HOKE,
Hoke-Homa Oil Company,
Stillwater, Okla.

(*Your letter is extremely interesting. Were we in the medical publishing field, we probably would do something along the lines of offering an award for, first, let us say, a method for the control of cancer, a system for preventing common colds, a cure for tuberculosis, leprosy, a cure for syphilis, a positive cure for endocarditis, a positive relief for rheumatism, and an entirely safe anaesthetic.*

We are leaving these developments to our benefactors, to our hospitals, and to institutions of learning.

Our perpetual motion machine contest is intended primarily to safeguard those who would invest in perpetual motion machines. As a general rule, the inventor states that all he has to do is to get enough money to apply for a patent and after that the person who invests in the "gag" will reap rich harvests. Our $5,000 more than covers the amount of money necessary for patenting in the United States and in foreign countries.

On the other hand, if we can actually receive one single authentic demonstration of a spiritualist's phenomena, we might be able to apply the scientific yardstick to it, develop that force, and then announce to the world the discovery of a new force entirely unknown. Unfortunately, for the spiritualists and also for this publication, we have not, as yet, seen any demonstration that was devoid of trickery.—EDITOR.)

More Television

SEVENTEEN issues ago I stopped buying SCIENCE AND INVENTION. I recently picked up a copy and found it greatly improved. You can now consider me as a regular buyer again.

I like long articles and you have quite a few of them. A photogravure section or a colored section of pictures would be a good addition to S. & I. I wish you would have a different colored cover each month as one color gets monotonous.

Please have more articles on television in the future.

JACK DARROM,
Chicago, Ill.

(SCIENCE AND INVENTION *will regularly portray any advances or strides that are made in the field of television. An interesting article on that subject appears in this number.*—EDITOR.)

A Mathematical Department?

I HAVE been a reader of your magazine for several years and now I have a suggestion to make which I hope you will find practical and helpful in increasing the interest of *our* magazine.

Briefly it is this: Why not conduct a mathematical department somewhat on the order of Dunninger's magical articles? The subject matter of this department to be practical short cuts in mathematics, such as the rule for multiplying two numbers of two digits each (as 58 and 28) without writing out all the steps. One digit must be the same in both numbers as the 8 in these. The rule is this: Multiply the units as usual, write down the four in this case and carry the six. Add the unlike digits and multiply this sum by the common digits, adding in the carried figure. Write down the tens digits of this answer and carry the hundreds and thousands (if any) digits. Now multiply the tens digits and add in the carried number. This gives the correct answer and works the same, whether the tens digits or hundreds digits are the identical one. Thus 58×28 is

58 (1) $8 \times 8 = 64$ write 4 — carry 6
28 (2) $2+5=7$. $8 \times 7 = 56 + 6 = 62$

16—2—4 (3) $2 \times 5 = 10$, $10 + 6 = 16$; write 16

Answer is 1624.

The department also to contain mathematical oddities, curiosities, or paradoxes such as Ripley's problem in "Believe It or Not." This is—take a piece of paper exactly 11 × 13 inches. The area of this paper is 143 sq. in. Cut in a straight line from corner to corner. Slide the pieces as indicated 1 in. and cut off the projecting corners formed by the slide. After cutting out this square inch you have a piece of paper 12 × 12 in., with an area of 144 square inches, one square inch more than there was to begin with!

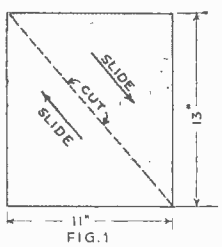


FIG. 1

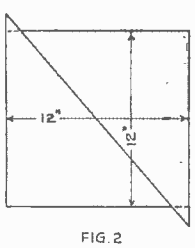


FIG. 2

Contests might also be run for the best explanation of this and other paradoxes.

I know I would like to see such a department and believe many others would also find it very interesting.

Hoping you find the suggestion worth considering, I am

A Booster for SCIENCE AND INVENTION,
C. H. CHITTENDEN,
Santa Monica, Calif.

(*What have our other readers to say about this suggestion?*—EDITOR.)

Shall We Reprint?

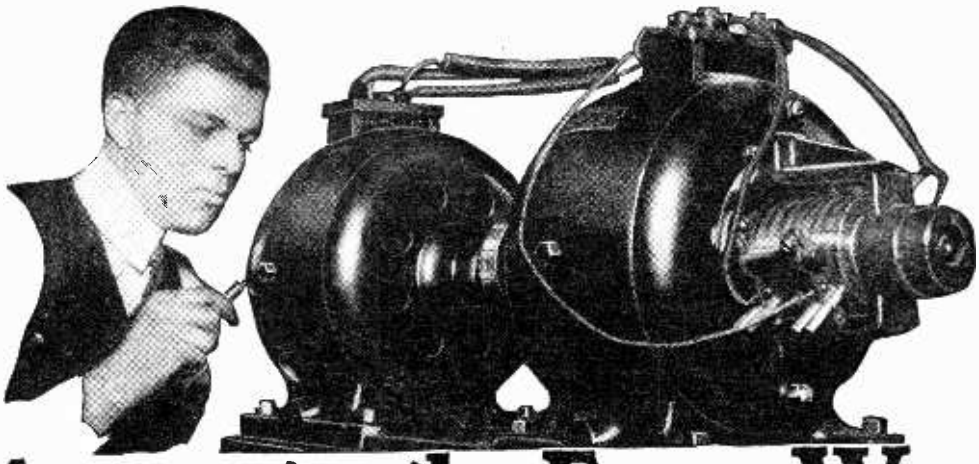
I am a recent subscriber to SCIENCE AND INVENTION, but I certainly will not be without it in the future. Could I afford it, I would like to obtain all the back issues of your magazine.

I would suggest that SCIENCE AND INVENTION Magazine start a section where all the interesting articles that have been published in the past be again republished for new readers.

Let us have more articles along the lines of lives, discoveries and inventions of past great men.

RAYMOND R. MENDETZ,
New York City.

(*We believe that all of the articles published in* SCIENCE AND INVENTION *Magazine in the past have been of interest. If this*
(*Continued on page* 870)



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The Safety Valve

(*Continued from page 868*)

were not the case they would not have found their way into the publication in the first place. Such republication as you suggest would entail a great amount of work, and the data would not be strictly up to the minute.

Unfortunately, the back issues of Science and Invention *Magazine are not available. Our supply of issues more than a year old has been sadly depleted. For those desirous of looking up some of those back numbers, we would suggest that public libraries in any of the larger cities have copies on hand that are always available for reference.*—Editor.)

We're Always Willing to Be Shown!

Editor, Science and Invention:

As I do not believe in gravity nor that the world goes around, that is why I say Perpetual Motion can be made: The mechanical world says it can not be made. Why? Because gravity is against it. Then scientists say it cannot be made. Why? Because they cannot figure it out. It takes thought. Thought is the most sacred thing in the world. Without it we could not move, so thought is everything.

When we went to Sunday School forty-five years ago they taught us if we were bad we would go to hell, and burn forever in fire and brimstone. They do not preach that now. Why? They do not think that way now. So things have changed. Electricity is the coming thing, so is perpetual motion—only it is going to take thought to figure it out. I have a hunch that I can make it, only I just do not have anything to induce me to start, so I decided on this course to force myself to do it.

As I have a real nice farm of two hundred acres, thirty acres a real garden and not a stone on it, a small house, two long stables and a hay shed, all necessary machinery and tools to work it, two prize horses, well mated, beautiful and gentle, also a nice gray team, plenty of all kinds of wagons, sleighs and harnesses, all in No. 1 shape, I will gamble the whole outfit mentioned and a certified check of $2,000.00 that I can make perpetual motion in less than three months, against $50,000.00. I will also do still better than that. I will agree to give the loser one-eighth interest in the invention if I were to win and that would be worth more than his $50,000.00. I know that if I lose I won't have to go to the poorhouse to spend the remainder of my life and if I do I won't live very long anyway, as my health is poor and I am over three score years old. Also, I will agree to build a machine strong enough to run three sewing machines all at once, sewing any and all kinds of cloth, and it is not to cost more than $100.00. I figure $50.00 should build it. So now I will see if there is any real sport in this old world of ours that knows a good thing when he sees it. No more water-power nor transmission lines to build. Just put it in the basement or the attic or any old place it is to run.

I see the editors of "Science and Invention" 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 it must be *perpetual motion.*"

Now if the editors of Science and Invention agree to stick to their promise, which I feel sure they will, I also will take them in on Perpetual Motion and if I fail I will agree to give them $1,000.00 so that they have a chance to win too, but I will trust to Providence.

H. E. Myers,
Kenora, Ontario, Canada.

(If you are willing to gamble with a certified check of $2,000.00 and your farm, so beautifully situated on the Winnipeg River, against $50,000.00, why not gamble $50.00, the amount of money that it will cost you to build the perpetual motion machine, against our standing offer of $5,000.00?

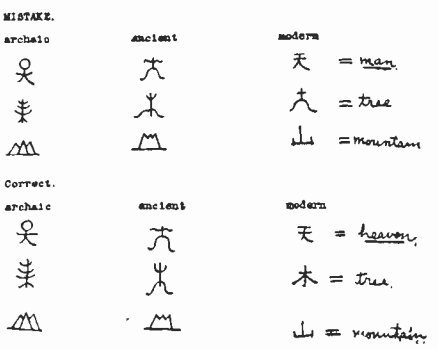
Science and Invention *Magazine has repeatedly posted this offer. In this perpetual motion machine contest, a working model only can be submitted. This can be expressed to* Science and Invention *Offices or can be brought here. Plans and drawings of a machine cannot be entered, but the model must be complete and must operate.*

It is understood of course that in any perpetual motion machine, such natural forces as tides, winds, waves, waterfalls, atmospheric temperature changes, atmospheric humidity changes, natural evaporation, barometric pressure changes, and sun power, cannot be considered as sources of perpetual power. A demonstration of the Brownian movement cannot be considered as indicating perpetual motion.—Editor.)

Some Errors

One day I bought a copy of Science and Invention magazine. It happened to be a July, 1930, issue and after reading it in its entirety, I found some errors on page 210. These are made clear in the diagrams.

Jinichi Ito,
Nakaku, Nagoya, Japan.



(We thank you very much for calling this matter to our attention. The correction is very obvious. We have reprinted your diagram just exactly as given and we are sure the readers will have no difficulty in discovering the error.—Editor.)

Bouquet for Oracle Editor

THANK you many times over for your extensive research on my behalf, regarding the subject of Women in Radio. I certainly didn't expect such whole-hearted cooperation. Now all I have to do is act.

Incidentally, my brothers are "newsstand subscribers" to Amazing Stories and Science and Invention.

Ruth McInerney,
Great Kills,
Staten Island, N. Y.

Figure This One Out

LAST March I happened to pick up an issue of Science and Invention and saw your article. I remembered you as the gentleman who used to write in the old *Pittsburgh Dispatch.* Instantly I became an ardent fan of your column" (rubber stamp, eh?)

I thank you sincerely for the first prize you awarded to me in the October issue of your magazine. I thought you might be interested in a problem that is a pet of mine. I clipped this problem out of some magazine (I do not remember which one) quite a few years ago. As far as I am concerned, you are privileged to do as you please with it. Perhaps you have already seen it.

Three men and their wives buy pigs. The names of the husbands are Amos, Hirman and Jones and those of the wives are Sarah, Gretchen and Marie. If Amos buys 23 more pigs than Sarah, Hiram 11 more pigs that Gretchen, each husband pays $63 more for his pigs than his wife pays for her's, and each one pays as many dollars per pig as he or she buys pigs, find the wife of each husband.

Samuel A. Sloan,
E. E., Pittsburgh, Pa.

(This is a German problem, about 100 *years old. We learned the answer by asking the husbands. Should you solve the problem send in your solution and we will credit you in this department.*—Editor.)

Likes New Developments

Editor, Science and Invention:

Let us have less about aviation and the technical articles as "How to build glider planes." Articles of this kind belong to the aviation magazines. New developments in construction and improvement of airplanes are interesting; I cite for example your article "The Diesel Engine for Airplanes." Articles of this nature belong in your magazine, but in my opinion not those which take the airplane too much in detail, as how to build one or fly one.

Let's have just what your name implies (real), "Science and Invention," and let us know about the people who are making the discoveries and advancements.

Raymond Mendetz,
New York City.

(This letter scarcely requires any comments, except from the enthusiasts of aviation and followers of glider sport.—Editor.)

FEBRUARY, 1931
WHOLE NO. 214

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Editorial

What to Invent

"THERE'S gold in them thar hills, pardner," is a statement frequently heard in the mining districts of this country. True enough. The only difficulty is locating the gold.

The same statement might advantageously be applied to a worthwhile patent. An invention properly protected, correctly financed, making a timely appearance and carefully exploited, is a money-making proposition.

Many budding inventors would like to know of ideas upon which they can work. Ideas, which in our opinion might be considered to be potential money makers are suggestions which when developed would be distinctly beneficial to mankind. So, let us itemize a few.

Besides improvements in motors, and developments which will allow for vertical ascent and descent of airplanes, there is an immediate need for a system that will fold up the wheels of an amphibian, when the plane is about to alight on water, and will lower the wheels to an operating position when the plane is about to alight on land. Such a device should be entirely automatic, thus omitting the human element.

Cold light is a subject upon which physicists have been working. The nearest approach in nature is the firefly, glowworm and luminous deep sea fish. Much current is lost in the form of heat in modern systems of illumination. Curtailing this heat loss and converting all the current into light, or developing a chemical light, cheaply replaceable, will produce an invention of incalculable value.

Electric current is today developed by generators. These generators are either steam or water turbine driven. Current is developed in the electric eel by a muscular action. Why not develop a new source of electrical energy taking our lessons from nature?

The field of chemistry is open to a new enamel. This enamel should be glass hard when dry. It should be as solid as the enamel on teeth. It should be tenacious enough to adhere to any structure and should be difficult to chip off. Along the lines of enamel, we believe an ideal product would be in the form of a tooth covering that could be applied to the teeth by the dentist, who should not have to destroy any underlying structure.

There is a demand for really flexible and, in particular, a really malleable glass. By this we do not refer to non-shatterable or non-breakable glass. We do not refer to glass substitutes such as celluloid. Even here, a cheap method of developing non-inflammable celluloid which will not change color because of age, and which can be used as a substitute for glass, might furnish the inventors with a substantial financial return.

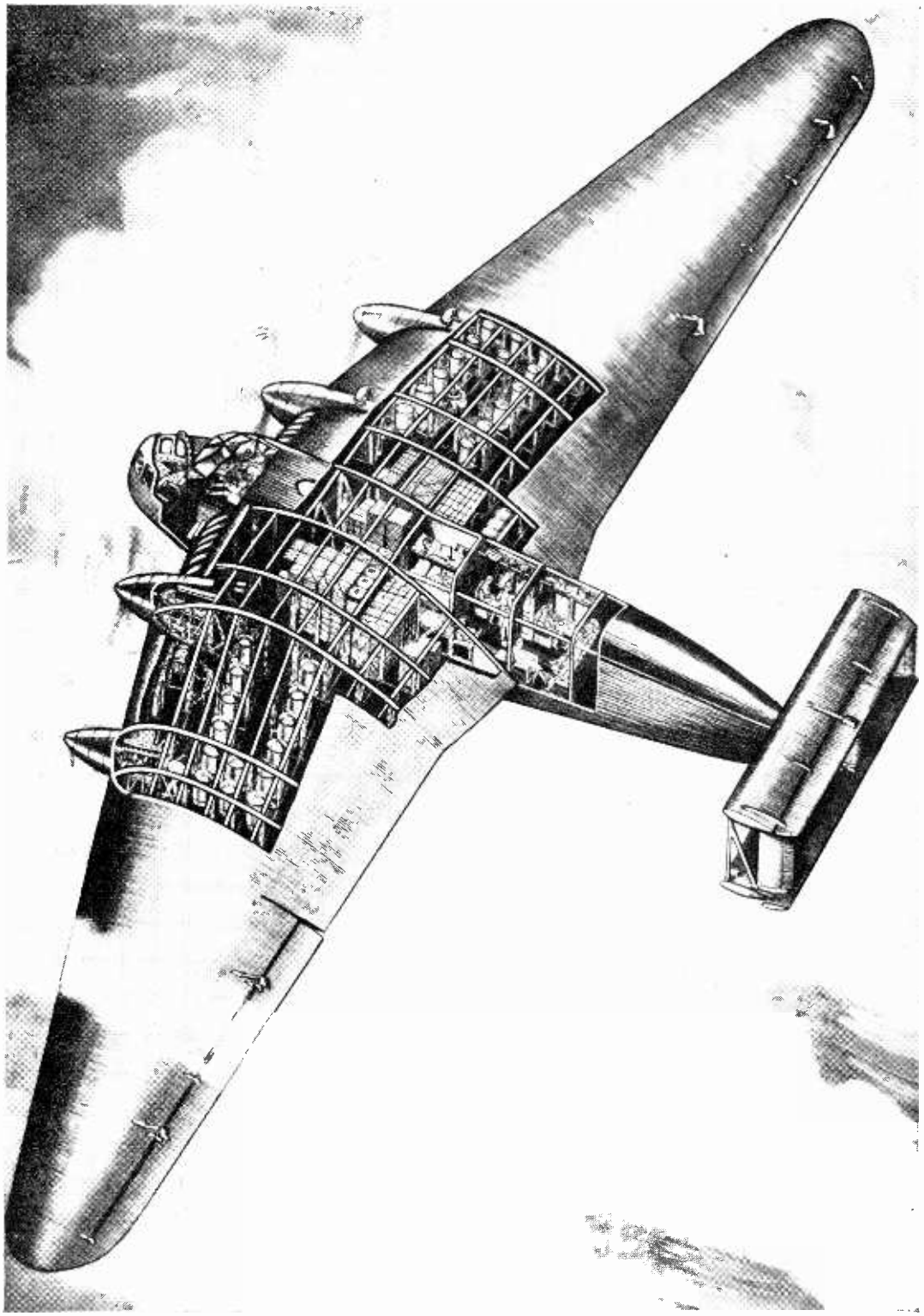
A simple and effective yet decorative metallic coating for walls, within the reach of the average home owner, is a suggestion upon which inventors can spend some thought. Methods are known today which will allow of the spraying of metal upon wood or wall surfaces. Unfortunately, they are too expensive to be popular. Strips of metal could be melted in a miniature arc furnace held in the hand and the melted metal could be sprayed on the wall. This should make a waterproof and moisture-proof coating that should never show cracks.

In the field of medicine, there would be a demand for a method of producing local or general anesthesia that is entirely safe. This should not be in the form of an inhalation or an injection. We know that electric currents of certain frequencies applied directly to a nerve will interfere with the propagation of nerve impulses, slowing the impulses down or even rendering the nerve incapable of transmitting pain. A method of properly developing these currents and applying them to the sensory nerves by means of electrodes placed on the skin, would considerably lessen the danger resulting from anesthesia.

These suggestions do not by any means cover the entire field of new inventions.—*Editor.*

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

The Flying Wing



The G-38 or D-2000 is not only the world's largest land plane but the only one which affords accommodation for its passengers in its two wings. The ship will carry in the neighborhood of 6,500 pounds and is able to fly a distance of more than 2,000 miles before refueling. For further photos, see article, "The Miracles of Aviation."

FEBRUARY, 1931
WHOLE NO. 214

Science and Invention

VOLUME XVIII
NUMBER 10

Tapping a Thirty-six Million Year Old Factory

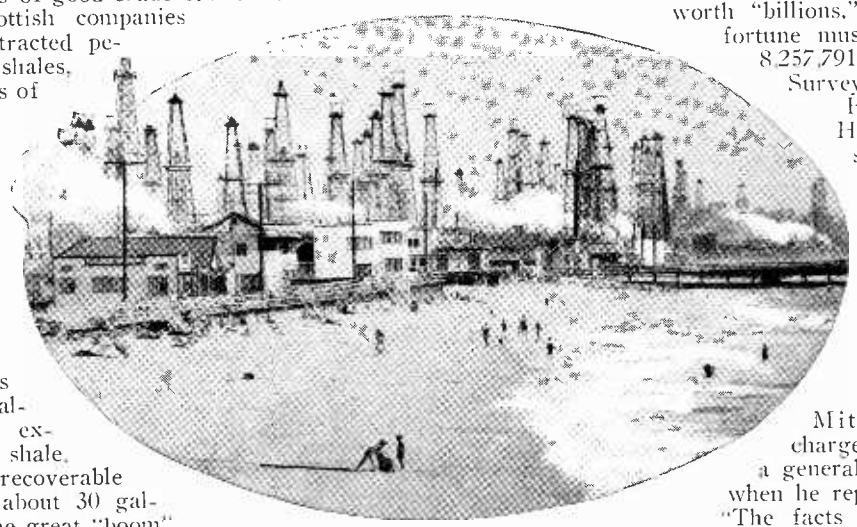
Science Has at Last Discovered the Origin of Oil, How Decayed Fish, Plants, Dinosaurs, Shellfish and Diatoms Yielded the Power That Now Drives Our Electric Plants and Motor Cars, Airplanes and Dirigibles, Heats Our Homes and Roofs Them, and Helps Us to Make Candy and Chewing Gum

By Orville H. Kneen

OUT in Colorado, Wyoming, Utah and Nevada, not to mention Indiana, Kentucky, Canada, etc., are thousands of square miles of oil shales. The tough, hard oil-soaked rock contains billions of barrels of absorbed petroleum. This oil is not buried deep in the earth, to be sought blindly with a probing drill. Whole mountains and valleys of oil shales, layer upon layer, are in plain sight!

A mining engineer estimates that these shales contain at least 100 billion barrels of good crude oil. And for eighty years Scottish companies have commercially extracted petroleum from such shales, getting about 23 gallons of oil per ton of shale.

The government owns most of our shale lands. In 1925 an oil-recovery plant was established at Rulison, Colorado. From this and another plant run by the Union Oil Company of California, it was found that 15 to 67 gallons of oil can be extracted per ton of shale. This is over 90% of recoverable oil. The average is about 30 gallons per ton. When the great "boom" was on in oil shale lands, some changed hands at $50 an acre.



With a forest of derricks sprung up as though by magic, a sand strip at Venice, has suddenly become one of Southern California's most spectacular oil fields.

Why then do we still spend half a billion dollars in drilling 20,000 new wells a year? A single well may cost $150,000—and it may prove to be dry, as are the great majority. In seventy years since Col. E. L. Drake drilled the first well for oil, at Titusville, Pennsylvania, striking it at seventy feet, over *thirteen billion dollars* has gone into finding and developing oil supplies in the United States.

But all the petroleum produced has been worth only nine billions. Thus four billion dollars have been lost in drilling dry wells, and in other ways.

A government clerk recently charged that in leasing some of its oil shale lands the government was "surrendering billions of dollars of oil lands." The total leased to date is two per cent of government holdings.

If these 175,724 acres leased privately are worth "billions," what an incalculable fortune must the government's 8,257,791 acres (Geological Survey estimate) be worth! But President Herbert Hoover, one of the most successful mining engineers of all time, points out that "these oil shale lands have little present value, and instead of being worth billions, can be bought from private owners for a few dollars per acre." Attorney General Mitchell, finding the charges baseless, expressed a general engineering judgment when he reported:

"The facts are that oil shale has no substantial present commercial value; that the cost of mining the shale and extracting the oil greatly exceeds the value of the product . . . whether it will be found advantageous to extract oil from shale after our present sources of supply are exhausted, or at any time, is purely speculative."

How did the oil get into these shales? Is there any connection between oil fields and oil shales? The story of

shales and oil pools is the whole geological story of the earth, of the beginnings of our fuel and power—of not only petroleum, but of coal as well.

Kerosene, old folks will recall, was once called "coal oil," and was made entirely by distilling coal, such as the "cannel coals" of Kentucky. Geologists have long concluded that coal and oil must have come from similar materials, as they are of organic (non-mineral) origin. Coal and oil are both hydrocarbons, composed essentially of carbon and hydrogen.

Nature deposited oil underground, geologists believe, by an odd reversal of her usual law that oil floats on water. Prof. Murray Stuart, who investigated large oil fields, has described a simple scientific experiment proving that under certain conditions oil sinks to the bottom of water!

He put 66 grammes (2.3 ounces avoirdupois) of finely-pulverized clay into a conical flask of about 500 cubic centimeters (17 fluid oz.) capacity. He added 350 cubic centimeters (12 fluid oz.) of water (which he had agitated with oil and left to stand 24 hours, to take up into solution everything possible from the oil). To the clay and water he now added 14 c.c. of crude oil (about ½ ounce), in three parts, shaking moderately for 30 seconds after each addition of oil, and allowing the mixture to settle before adding another 5 c.c., closely.

Each time, after settling, there was no oil on the surface of the water, or on the sides of the flask! After 14 c.c. had been added, some oil came to the top. In another experiment 28 grammes (1 oz. avoirdupois) of powdered clay carried down about 10 c.c. (1/3 fluid ounce) of kerosene oil. The clay and oil each occupied about 10 cubic centimeters. Thus the clay had carried down its own volume of light oil. In the experiment with crude oil, the powdered shale, when compressed and solidified, occupied about 23.5 c.c. of space, while the heavy oil carried down was 14 c.c.

Prof. Stuart found under the microscope that the oil was mechanically mixed with the sediment. "It was the small size of the shale particles," he concluded, "that made it impossible for the globules of oil to escape between them."

The clay particles, already wet, will not take up the oil. The globules cannot join together because of the fine state of division of the mud particles, until considerable oil is put in. More kerosene is carried down by an equal weight of clay because the light oil breaks up into smaller globules. The mixture of sediment and oil, being heavier than water, sinks into the muddy deposit. This becomes compressed by the weight above, the clay particles come into contact, and as all passages are closed the oil is held underneath.

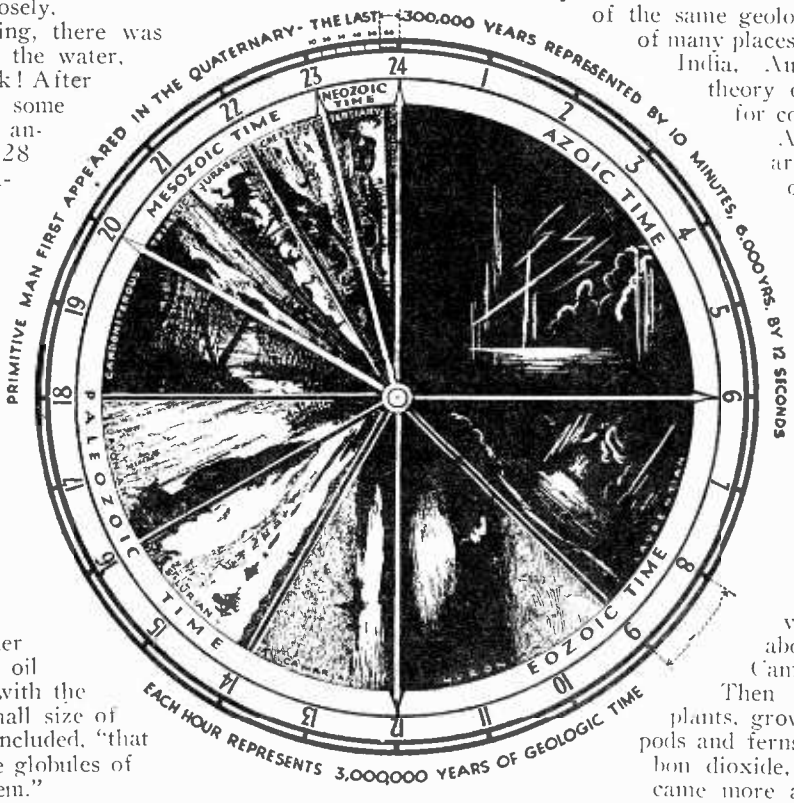
Upon this principle, a reversal of nature's universal law, depends the present theory of oil formation. "The sedimentary deposition of oil by mud in water," says Prof. Stuart, "is not a theory but is one of the laws governing the accumulation and deposition of aqueous sediments which can be demonstrated by anyone in a few minutes with the aid of a bottle, some water, a piece of clay, and some oil."

Salt water is often found in or near oil pools. The earth's surface was once largely covered by salt water. Nearly three-quarters of the earth's surface is still covered by water. Oil fields are always found near present or ancient shore lines, as in California, Texas, Oklahoma, Mexico, the Appalachian region, etc. Most oil must have been formed, or certainly was deposited, under salt water. Samples of bottom ooze from ocean deeps and bays, as around the Red Sea, the Dead Sea, the salt marshes of Sardinia, etc., reveal traces of petroleum.

Such oil was "rendered" from animal or plant remains, or both. We can distill petroleum from fish bodies, and from plants such as diatoms. But oil *pools* never reveal these animal fossils or plant remains (except "spores.") Prof. Stuart concludes that much of the original source of oil—the luxuriant plant life of the Carboniferous era and succeeding animal life—became coal instead of oil.

His ingenious explanation of oil and coal formation clears up many hitherto unanswered questions. Coal and oil fields often are close together. Coal seams often are separated by shale and sandstone seams. All the world's oil is found in these sedimentary rocks, formed by the solidification of muddy sediment under pressure.

It was once taught that coal was formed only by earth pressure and heat on the plant remains of swamps. Thus peat would be the youngest coal, hard anthracite the oldest, with millions of years between. But English lignites, only a little more carbonaceous than peat, are found embedded in Jurassic strata. This would make the lignites of the same geologic age as the true coal of many places, as in Bohemia, Hungary, India, Australia, etc. The age theory of coal does not account for coal as we find it.



Courtesy American Museum of Natural History

A graphic illustration of the age of the earth, and the various stages of development through which it has passed. The formation of oil commenced over thirty-six million years ago, and is found in rocks which date back beyond the Cambrian Period.

According to Prof. Stuart's graphic reconstruction of nearly two billion years of geologic history, the hot lurid earth cooled and forms of vegetable life began on the sea-bottom, where oxygen was almost completely absent. Later life in the water, more nearly animal in nature, ate vegetable life to obtain body material, liberating carbon dioxide and water. These organisms became free-moving, sought their food, ate each other, and developed protective shells about the beginning of the Cambrian Period.

Then sea-weeds became land plants, growing into enormous lycopods and ferns in Silurian times. Carbon dioxide, vital plant element, became more abundant. Land vegetation became luxuriant in Carboniferous and Permian times, liberating oxygen. Then came the age of animals—amphibians, reptiles, mammals and finally man. Land vegetation decreased. In enormous swamps and lagoons the remains decayed.

French scientists were the first to discover active bacteria in coal, and it is now established that such bacteria are active in carbonizing wood into coal-like forms. Able to live only in fresh water, the bacteria converted incredible quantities of débris—trees, branches, leaves, ferns, etc.—into a black mud, which settled on the lagoon bottoms. Often it was almost pure carbon.

Movements of the restless, shrinking earth started rivers to draining this mud off into estuaries and the open sea. The salt water killed the bacteria, arresting the carbonization of the mud at whatever stage it was in. Thus we have everything from lignites to bituminous and anthracite coal.

The river, flowing into the sea, dropped its heavy pebbles, gravel, etc., near the sea shore. This mass became consolidated into conglomerate. The heavier matter carried in suspension was laid into beds, often many feet thick, of sand (converted into sandstone); finer clay particles farther out, compressed into shale, and finally the black carbonized

mud. This would be lighter than sand or clay matter, and would be dropped farther out, making the coal beds after pressure had forced out the water and solidified the mud.

During the decomposition of plant life in lagoon bottoms, also of dead animals, from the largest to those of microscopic size, oil would be liberated and held in the bottom mud. The rivers would carry out the oil with the black mud and sediment. Oil being lighter than water, oily mud would be lighter and would be deposited beyond the black mud that made coal. Farthest out of all would be the lime solutions derived from calcareous shells and microscopic marine life, which finally settled and made limestone.

Thus we would find gently sloping beds, with materials in a definite order of "specific gravity," except as changes of the river's velocity, sediment, areas drained, etc., and profound earth movements would cause alternate layers of mud, sand and so on. This accounts for the strata found in coal mines and for oil-proof structure.

Volcanic action, earthquakes, increasing weight of rock, water, and other changes finally converted the mud into coal in various stages. The mussel-like fossil animals found in coal grow only in brackish water; these died in the lagoon mud and were carried to sea. The remains of fossilized plants, fern leaves, etc., growing only in fresh water, on dry land, were carried out before the bacteria could work on them. Strictly marine life dropped on the deposited mud before it was finally covered.

Vertical trunks of fossilized trees, found in coal seams, were snags which were carried out to sea and settled down on their water-logged roots, becoming fossilized by silicates in the water. They were not carbonized into coal because the bacteria were killed in salt water. Complete fossilized trees, in their original growing location, are found, but not in coal seams.

The La Brea oil tar pits in Los Angeles, Calif., which, scientists say, have been bubbling for 400 centuries. Remains of sabre tooth tigers, and imperial elephants of remote ages have been recovered from these pits.

Thus we have seams of coal of varying quality, perhaps with nothing between them. The black mud was laid down layer by layer, in various stages of decomposition. Special plant forms probably produced anthracite, found only in a few places. Bituminous coals have more carbon than lignites, and some grades approach anthracite.

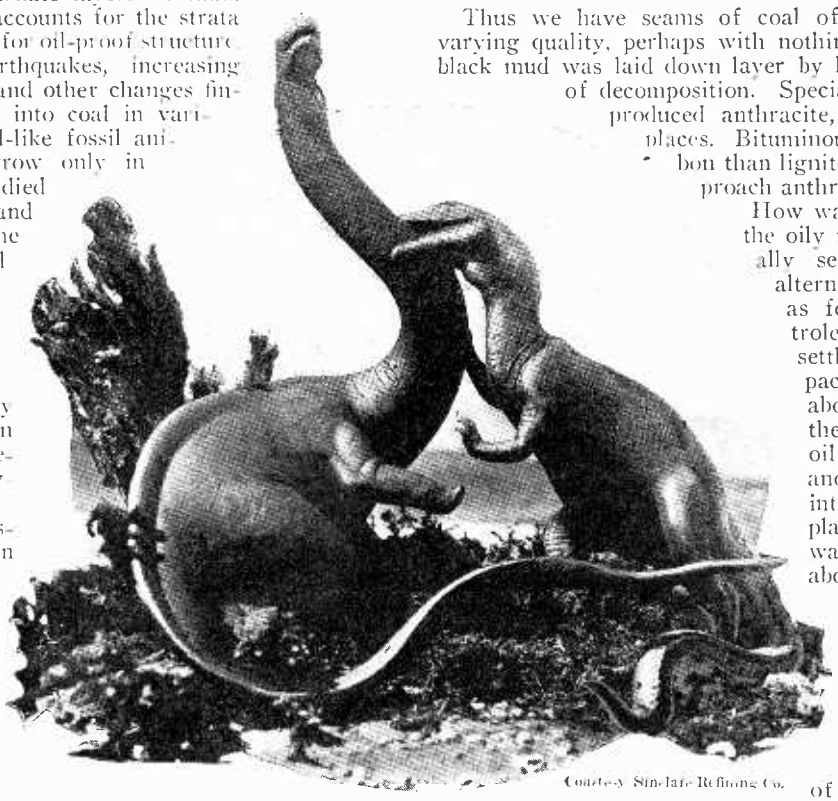
How was the oil removed from the oily mud? There were usually several layers of mud, alternating with sand or clay, as found by drillers in petroleum regions. The muds settled, became more compact, and the weight above forced water out of the lower beds first. The oil globules came together, and the oil was forced up into the sand above, replacing some or all of the water, which went on above. The oil, unable to percolate through the mud above, remained in the sand.

This occurred to some or all of the layers above. Thus there may be numerous alternating layers of oily sand and compact clay-mud. Some sea water would be preserved in pockets, and this is often found, though perhaps far removed from its original location. The clay-mud finally hardened into sandstone. Oil shale is similar hardened mud, still retaining more or less of its original oil, the pressure having been insufficient to squeeze it all out.

The oil in fields such as California's San Joaquin valley has been traced directly to huge beds of diatomaceous earth —the dried compacted remains of diatoms, calcareous shell life and other marine organisms. Diatoms, tiny free-moving plants, occur in incredible quantities in all oceans. Diatomaceous earth is often associated with oil, and much oil must have come from their putrefying bodies.

Petroleum can also be distilled from fish bodies, perhaps killed in great quantities by underwater eruptions and earth convulsions. Oil has been found in limestones of salt-water origin. Fossils of fishes, shellfish, etc., are found in all oil fields.

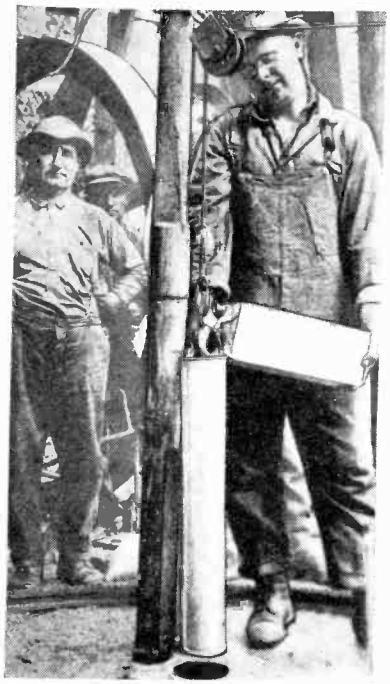
Every step in the formation of oil can be duplicated in the laboratory, without great pressures or heat, though pressure certainly played its part in separating the oil from sediment. Earth changes caused the oil to migrate, often



Courtesy Sinclair Refining Co.

A reconstruction of one of many battles which occurred millions of years ago between brontosauri, gigantic prehistoric monsters which lived in the age of dinosaurs and pterodactyls.

Half a billion years ago the seashore was populated by fifteen-foot devil-fish such as those shown below. From a painting by Charles R. Knight in the Field Museum, Chicago.



A shell being loaded with nitroglycerine preparatory to shooting a Pennsylvania oil well.

or converted whole pools into gas. This collects in the tops of domed "anticlines," usually in sandstone, where oil is often found below, and water under the oil, as illustrated. Coal, which gives off natural gas when heated, may have furnished some of the enormous quantities now being piped all over the United States.

"Wet" or casing-head gas, collected from around the casing of many oil wells, yields about 10% of our gasoline. Often such gas escapes in huge quantities, up to 100 million cubic feet per day, under pressures up to 1500 pounds per square inch.

Oil is the most sought of all minerals today, not even excepting gold. The industry maintains over 1,250,000 people, including hundreds of geologists. "Doodlebugs," divining rods and "hunches" no longer determine the drilling of wells that may go down to 8,000 feet. Geologists explore the sub-surface by small diamond drills that cut cores, which show the type and kind of rock, its "dip and strike," or angle of descent, presence of fossils, domes and anticlines, etc. Deserts are considered unfavorable for oil, as both plant and animal remains would not occur in quantity.

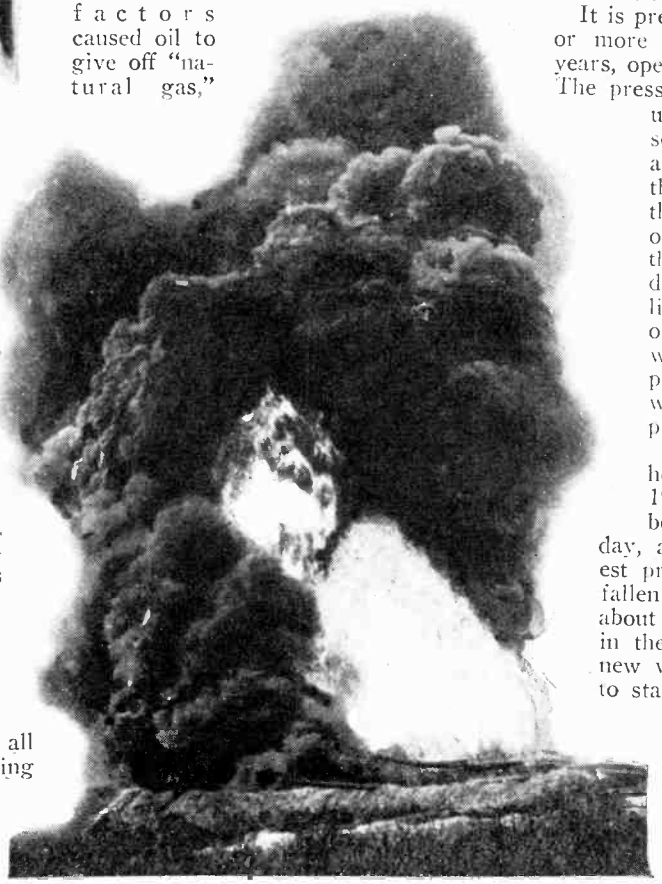
Delicate instruments are often used to determine the gravity and density of rock, its location, magnetic qualities, and so on. The seismograph, measuring the time for explosion-waves to travel certain distances, is widely used. In known fields the geologist often knows clearly what to expect. But even today every third hole is "dry." Wildcat drilling in unproved areas is hopeless unless there are geologists to study, measure, calculate and advise. A well may miss a pool by only a few feet or inches.

When a rotary drill is down a mile and a half it takes a day or more to raise the four hundred 20-foot sections of pipe "stem" and sharpen or replace the hard steel cutting bit. The holes are never exactly straight or vertical. Drillers still tell of two holes, begun 600 feet apart, that wandered down at various angles and finally, by a curious "twist of fate," ran into each other at 3,000 feet!

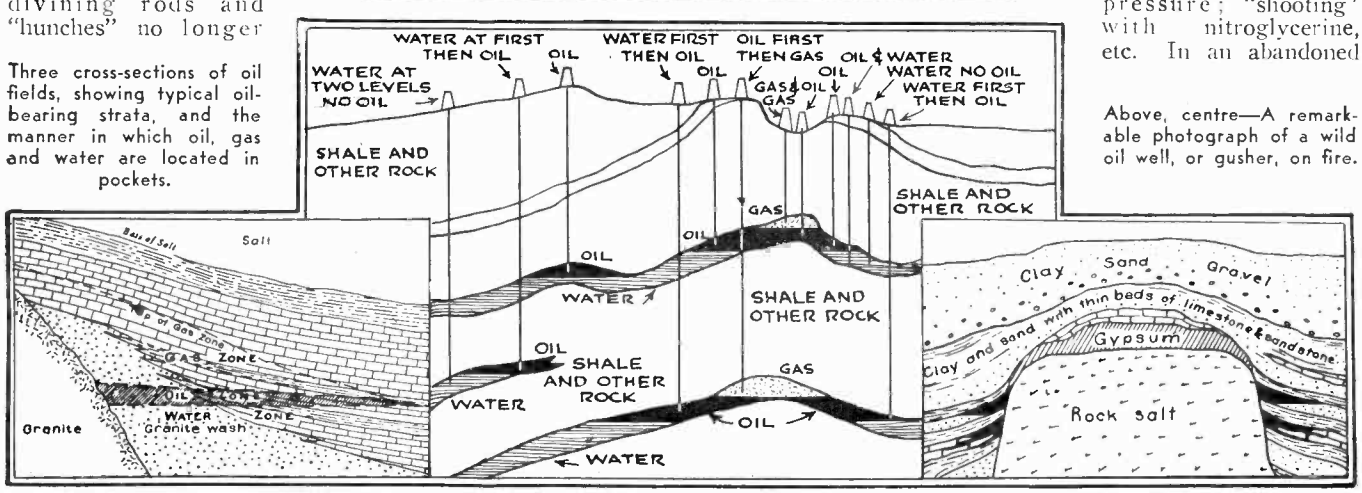
It is predicted that depths of two miles or more will be drilled within a few years, opening up new pools of finer oil. The pressure in sand 1,000 feet deep is usually about 400 pounds per square inch. So when oil sands are reached, after drilling through shale and other rock, the pressure may force up gas, oil and water. At great depths the enormous pressure may produce a "gusher," spouting millions of gallons of oil for days or weeks. The gusher often wastes fortunes in oil and gas, perhaps bankrupting the driller with damages to equipment and property.

Few gushers or wells produce heavily after the first year. In 1916 however, a Mexican well began with 200,000 barrels a day, and became the world's greatest producer. Mexican output has fallen off in recent years. So far about 735,000 wells have been drilled in the United States. Not 3% of new wells yield 1,000 barrels a day to start.

Of some 300,000 producing wells in this country, half the oil must be pumped. Many wells give less than a barrel a day. Output is being increased in some cases by using gas, water or air pressure; "shooting" with nitroglycerine, etc. In an abandoned



Above, centre—A remarkable photograph of a wild oil well, or gusher, on fire.



Three cross-sections of oil fields, showing typical oil-bearing strata, and the manner in which oil, gas and water are located in pockets.

well 75% or more of the original oil may remain for better methods of recovery.

Crude oils vary from grades that burn in lamps, to some as thick and viscous as molten tar. Differences are believed due to origin, natural processes, and age. Our 400 refineries today receive and handle a great variety of oils from our 90,000 miles of trunk and feeder pipe-lines.

Paraffin-base oils, from Pennsylvania and Wyoming especially, are best for lubricating oils. When distilled they first yield gasoline, naphtha and benzene, the most volatile. Further heating drives off kerosene, then lubricating oils, then fuel oils, and finally paraffin. "Mixed-base" oils, as from Illinois, yield both paraffin and asphalt. Asphalt-base oils, as from California and Texas, distill down to semi-solid asphalt.

This process nature has completed in Trinidad, with its Pitch Lake composed of one-third bituminous matter and two-thirds sand, clay and water. An enormous supply must lie below, as a day's excavation fills overnight, and the level has receded hardly fifteen feet in fifty years, with hundreds of thousands of tons removed for road paving.

Bermudez Lake, in Venezuela, is similar. (Great oil reserves are also found in Venezuela). The great deposit of impure asphalt near Los Angeles, of solid or semi-solid bitumen, has yielded thousands of bones of extinct animals that fell into the pit and were unable to escape.

Heavy bitumen is an intermediate product between kerogen and oil. "Gilsonite" dikes, in Utah, are nearly pure bitumen, used for varnishes, paints, etc. Bituminous earth makes excellent road material. Artificial asphalt, residue from "cracking" asphalt-base oils, is hardened by blowing oxygen through it at high temperature. The tar sands on the Athabasca River, in northern Alberta, estimated from 2,000 to 10,000 square miles in extent, are 200 feet thick—the largest bituminous deposit in the world.

Between oil and asphalt are innumerable products, from liquids to solids. They are mostly obtained by "cracking," in which crude oil is heated under pressure that breaks up large molecules and drives off the vapors. About half of all the oil today goes into gasoline, over double the former output obtained per gallon by distillation.

Thus the busy and invisible bacteria of millions of years ago converted dead plant and animal life into the power that enables us to live and travel by land, sea and air. Oil heats, lights, lubricates and drives the Machine Age. For untold centuries men have used petroleum in various forms. Asphalt served for mortar in the Tower of Babel and the walls of Babylon and Nineveh. "Sicilian" oil was burned in lamps 1,800 years ago. Bitumen aided the Egyptian in embalming.

Nehemiah men

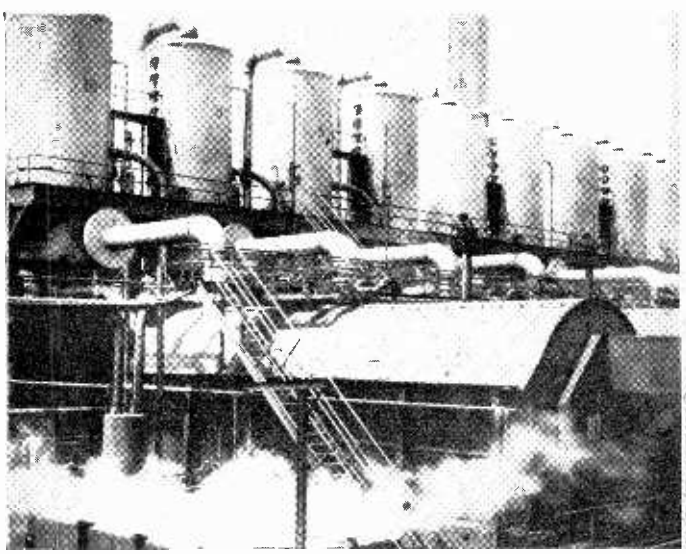
Oil well shafts on the grassy front lawns of houses in Los Angeles, Calif.

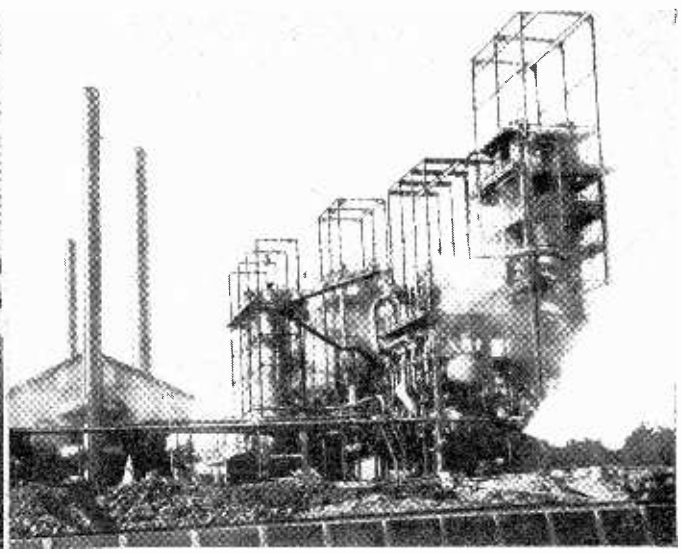
Above—This study, showing a baby imperial elephant trapped in the La Brea tar pits of Los Angeles, 400 centuries ago, and its parent trying to rescue it, was made for the Los Angeles Museum of Natural History, and is based upon bones of the elephants recovered from the pits. Below, left—A battery of crude oil stills at Cleveland, Ohio, Number One Works, where Red Crown Gasoline is made. Below, right—An oil-cracking unit at Cleveland, Ohio.

tions in the Bible the liquid that burst into flames and kindled a great fire. In Japan, China, Persia, early California, Central and South America, and our own West Virginia and Pennsylvania, men for centuries used oil for heating, lighting, medicinal and other purposes.

About half our crude oil (one billion barrels, or two-thirds the world's output), operates utility plants, ships and locomotives, about equally divided between land and marine plants. Smelting ore uses about 16%. Artificial gas and house heating take 20%, fifty million barrels go for house heating.

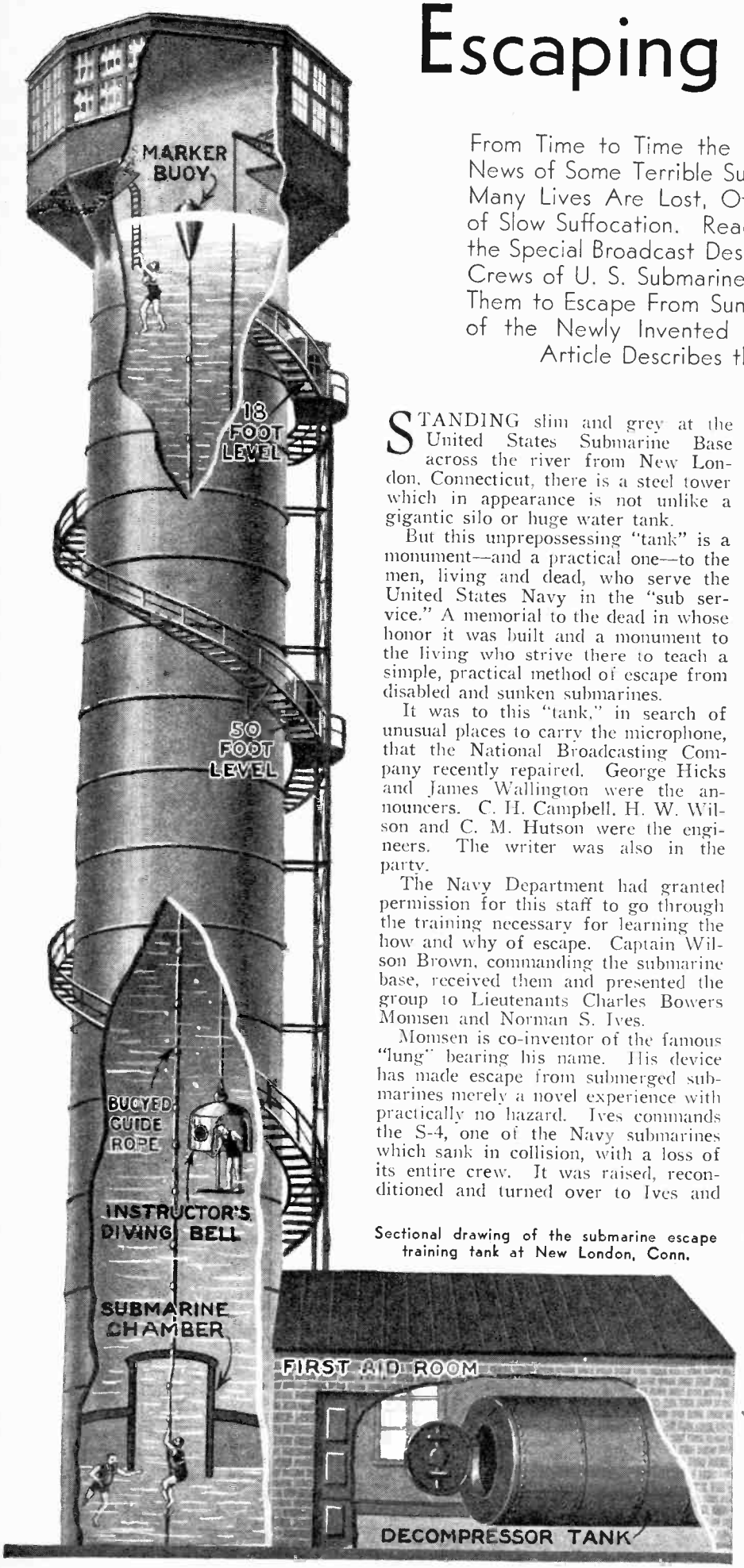
(*Continued on page* 954)





Escaping Neptune's

From Time to Time the World Is Shocked by the News of Some Terrible Submarine Disaster in Which Many Lives Are Lost, Often After Hours or Days of Slow Suffocation. Readers Will No Doubt Recall the Special Broadcast Describing the Training Which Crews of U. S. Submarines Now Undergo to Enable Them to Escape From Sunken Submarines by Means of the Newly Invented Momsen Air Lung. This Article Describes the Training Process



Sectional drawing of the submarine escape training tank at New London, Conn.

STANDING slim and grey at the United States Submarine Base across the river from New London, Connecticut, there is a steel tower which in appearance is not unlike a gigantic silo or huge water tank.

But this unprepossessing "tank" is a monument—and a practical one—to the men, living and dead, who serve the United States Navy in the "sub service." A memorial to the dead in whose honor it was built and a monument to the living who strive there to teach a simple, practical method of escape from disabled and sunken submarines.

It was to this "tank," in search of unusual places to carry the microphone, that the National Broadcasting Company recently repaired. George Hicks and James Wallington were the announcers. C. H. Campbell, H. W. Wilson and C. M. Hutson were the engineers. The writer was also in the party.

The Navy Department had granted permission for this staff to go through the training necessary for learning the how and why of escape. Captain Wilson Brown, commanding the submarine base, received them and presented the group to Lieutenants Charles Bowers Momsen and Norman S. Ives.

Momsen is co-inventor of the famous "lung" bearing his name. His device has made escape from submerged submarines merely a novel experience with practically no hazard. Ives commands the S-4, one of the Navy submarines which sank in collision, with a loss of its entire crew. It was raised, reconditioned and turned over to Ives and Momsen to use in the study and development of safety devices. Momsen is in charge of instruction at the "tank." Ives assists him.

The author, Wm. Burke Miller

At the base of the submarine escape-training tank there is a small brick house. Inside this is the technical set-up for operating the "tank." Along one side there is a small drum-like tank. Momsen led the N. B. C. group to this point upon their arrival at the Base.

The engineers, headed by Campbell, began studying the "tank" proper for setting up radio equipment. Momsen, meanwhile, invited Wallington, Hicks and myself to enter the drum.

"What's the idea?" asked Wallington.

"Must check your reaction to high pressure," Momsen replied as he slipped his sweater and shirt over his head. "Better take off your coats and vests," he added, "but take 'em in with you. Leave your fountain pens and watches outside."

"Why's that, Lieutenant?" queried Hicks, a bit anxiously.

"Pens might burst and spatter us with ink and the pressure would probably ruin your watches." Momsen said. The three embryo "lungers" exchanged glances.

The inside of the small drum is painted white. A smooth, hardwood floor covers the bottom. There are no seats. A few handles and gauges are on the wall.

Momsen followed the trio in and slammed shut a round door which somewhat resembles that of a bank vault.

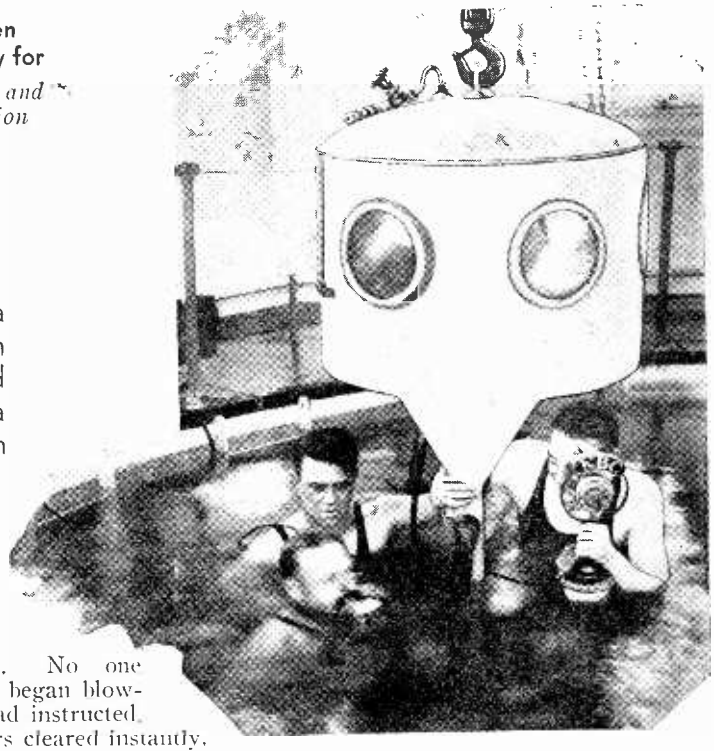
"Our personnel now is required to take pressure only up to fifty pounds per square inch. After that it's optional." Momsen explained. "None of the men has to take the training beyond that and at present do not have to accept instruction at a depth greater than eighteen feet. But none

Clutches

Written Specially for *Science and Invention*

By Wm. Burke Miller
Director of Special Broadcast Events, National Broadcasting Company

In the Following Article, Mr. Miller Gives a Thrilling Account of the Experiences Which He and His Fellow Announcers Encountered While Undergoing Training Prior to Giving a Broadcast from the U. S. Navy Training Station at New London, Conn.



Lt. Charles B. Momsen and James Wallington receiving Edward Kalinoski (Chief Torpedoman on the ill-fated S-4) as he broke surface with the Momsen "lung." Wallington is giving the unseen audience details of the feat.

of them is content with that, and after one experience they ask for the entire course.

"To escape from a hundred-foot depth we must undergo a pressure of nearly fifty pounds. That's what I've got to test you for now. Here goes."

A hissing sound crashed through the boiler. No one could say a word. The boys sat on the floor and grinned a bit foolishly at one another. There was no sensation. The hiss ceased as quickly as it had begun.

"It's up to five pounds now," Momsen said. "I'll take it slow at first. You may experience a little difficulty with your ears," he added. "If so, hold your nose, close your mouth and blow. The ears should pop open. If they don't, hold up your hand and I'll cut the pressure."

George Hicks, N. B. C. Announcer.

Before anyone could ask a question, the air hiss began again, and seemingly at a faster pace. The air became a trifle warm. Perhaps a minute passed—it seemed longer. Again the hissing stopped as abruptly as it began.

"All right?" Momsen queried casually, though studying each man closely. His voice sounded high and queer. Wallington started to speak. His voice was high-pitched, too. Hicks and I laughed. Then all began howling. All voices seemed affected and it started all to laugning upon the discovery.

Momsen smiled. "Air pressure seems to affect the larynx," he explained. "Try to whistle."

It was hopeless.

"Why is that, Lieutenant?" Hicks asked, and his usually deep, resonant voice was like a small boy's. The laughing fit began all 'round again.

"This is serious, Lieutenant," someone said. "These boys will not be understood over the air. No one will be able to understand a word they say."

Momsen's reply was a hiss of air that continued for seemingly a long time. It grew warmer and perspiration popped out on all. Ears began to ache slightly. No one raised a hand but began blowing as Momsen had instructed. Sometimes the ears cleared instantly, once or twice it took longer. The air now was hot.

The air hiss ceased.

"Hurt much?" asked Momsen, but no one would have recognized his voice. "Probably did between fifteen and twenty pounds," he said, answering his own question. "It's around thirty-eight pounds now. You should have no more clogging of the ears."

Wallington was massaging his left ear vigorously. It had not entirely cleared. Hicks seemed unaffected. He explained he had only one ear drum, the other having been operated on. Momsen nodded and turned on the air again. A few seconds and the needle on a gauge pointed just slightly over the fifty-pound mark.

A few minutes' experimenting with their voices, and then Momsen began to decompress the tank. The air grew chilly and a white vapor enveloped all. This process was continued and the coats and vests were hurriedly put on and were most welcome. Soon a pounding was heard outside. Momsen responded from within, a short delay and the door was open.

James Wallington, N. B. C. Announcer.

"All O. K.," said Momsen to a petty officer who asked each man's name and wrote it into a ledger.

"But what has this to do with escaping from a submarine?" Wallington began.

"You'll understand once we go through the training tank," Momsen replied.

A tour of the training tank followed. At the bottom, within the "tank" proper, there is an exact replica of a submarine compartment. It is built to specification and everything resembles one section of a submarine. In the center there is a hatch and below it, extending down into the compartment some five or six feet, there is a skirt-like bell.

"Above you now," said Momsen, after the group had entered, "there are a quarter million gallons of warm salt water. That's the only thing here not according to Hoyle," he smiled. "We plan to use this tank all winter and in training men it would not be fair to send them through cold water time and again."

(*Continued on page* 952)

Photograph of the New London training tank, which is 130 feet high, including the observation gallery at the top.

The Everlasting

Himself, His Tools, His Craft—Craftsman of India, Who Is World Pursue Its Course of Leave Him to Work on World Lose if Dominion Status Production Methods Supplant

By Count A. N.

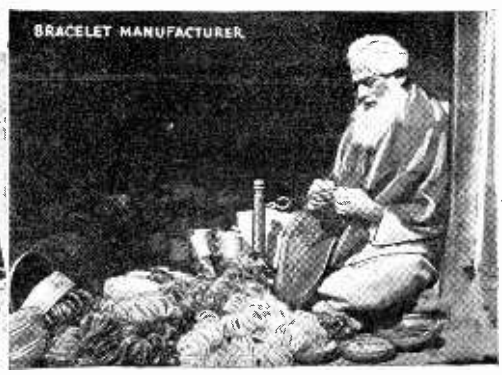
IN the industrial and commercial centers of British India one meets the same bewildering, planless mess of factory production and impersonal distribution which characterizes Birmingham or any other city of the Western World. Withdraw from these centers and make your way into the native provinces, and you find yourself in the center of a still flourishing village economy, where the relations between economic functions are simple, direct, and observable in clear relief.

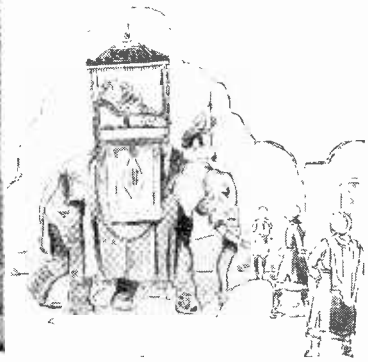
Here the town reveals itself as a convenient concentration of the crafts, serving the agricultural population whose land surrounds it. The potter, the blacksmith, the weaver, the tailor, the apothecary, the joiner—representatives of all the needed trades—here supply their product on demand to those otherwise occupied, and in return receive agricultural produce, the right to cultivate and harvest a certain portion of the village lands, and in some cases a money payment. The most necessary craftsmen receive a regular salary—a certain number of bundles of grain from every peasant served.

Of all the craft products, the most in demand are those of the potter. His industry occupies a spot where considerable open space is available for storing his products in volume. In the midst of piles of pots and earthenware vessels he squats at his wheel, a horizontal wooden disc two or three feet in diameter, heavily loaded with clay at the rim, to aid in maintaining its momentum. The clay for the vessel is heaped at the center, and the wheel is spun. Despite its primitive form, the wheel will continue to turn for from five to seven minutes at a fairly constant rate. As it whirls, the potter by his craft raises from the heap of earth a jar or pot symmetrical in form and adapted to a particular purpose.

The demand for earthenware is vastly increased by the Hindu scruples against using an earthen vessel for more than a day. The same is true of clay idols. After being worshiped for a day they are broken, and new ones are obtained from the village potter. Among the products of this artisan are pitchers, cooking pans, and jars for storing grain, spices, and salt. When grain begins to sprout in the fields, the potter must make a water jar for each worker, so that the crop tenders may secure water without leaving their work. Often for bricks and tiles the potter receives extra payment. He receives also a bonus in the form of extraordinary honors—he is privileged to beat the village drum on ceremonial occasions, to chant hymns at marriages, and at harvest festivals to prepare the mutton stew.

The woodworker in provincial India universally employs a lathe consisting of two fixed points, between which the work is held and spun by means of a bowstring. There are no fixtures for cutting-tools; these are held against the work with the hands and feet. With such simple machinery, the Hindu wood-turner manages to produce remarkably accurate work. The carvings for which India is famed





Riddle of India

These Are Enough for the Native Content to Let the Western Power Production, if It Will Undisturbed. What Will the Is Granted to India and Modern Her Traditional Craftsman?

Mirzaoff

are produced, of course, with even less elaborate mechanical aid. The bowstring lathe of the woodworker finds application also in other industries, among them the manufacture of bangles from cocoanut shells.

Caste and occupation have tended to go hand in hand in India, and woodworkers have traditionally held a low social rank, not because of their calling but because of their accidental position in society at a time when conquest was following upon conquest. Established in their trade at a comparatively early date, their connection with it was made hereditary and exclusive through the familiar workings of the psychology of conquest, and the trades pursued by the craftsmen of the successive conquering tribes were ranked above theirs. Undoubtedly it is the succession of conquests which has given India her remarkable system of craft layers and the caste system which has fixed them permanently, except in the large commercial centers.

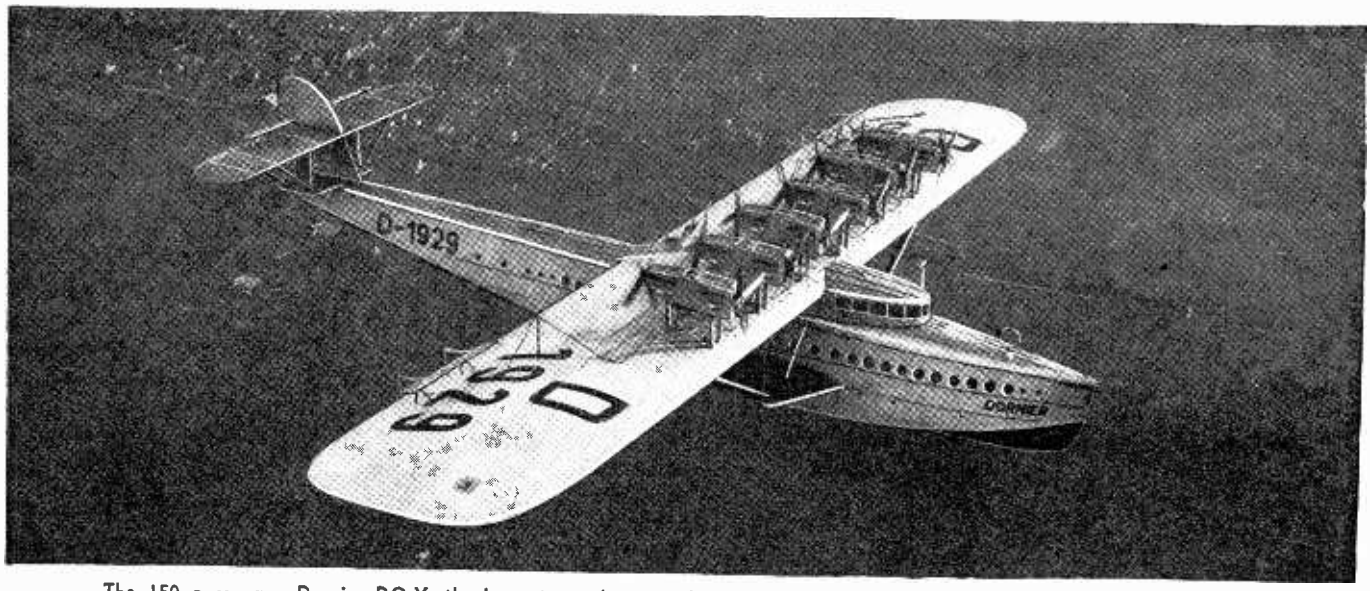
Throughout the native industrial economy, one finds the same dependence on the man, the same minimum of machinery, that has been indicated in connection with the potter's and woodworker's trades. Workers in the non-ferrous metals blow up their fires by lung-power, and shape their product with the simplest of manual tools. Thread is spun with the most primitive of hand-turned wheels; cloth is woven on a rudimentary loom; and textiles are decorated with patterns carved on wood, dipped in dye, and impressed by hand. Rods of the softer metals are pulled into wire without the use of a single gear or even wheel. There is only a fixed die containing holes of successively smaller dimensions, through which the material is drawn by means of a lever carrying a pincer-like attachment by which the rod is gripped.

Everything is obvious and elemental, yet the economy is complete. The apothecary selects the components of a prescription from vessels lying open to the view of the passerby, and compounds it before the customer. The scribe sits copying a manuscript at the edge of the street. The money changer squats behind piles of coin and casts his accounts while the world looks on. There is no mystery, no expensive effort to impress, no indication that some fundamental lack of utility must be compensated by dignity or by theatrical scenery or tricks. There is not even furniture; everyone, as though his function were too important and absorbing to be hampered by any but the absolutely necessary equipment, confines his apparatus to the tools of his craft, and sits on the ground. All the machinery—the lathe, the wheel, the forge, the vise—is built close to the ground, for use on the ground, as if the craftsman were jealous of everything which might distract attention from the supreme importance of his work. Himself, his tools, his craft—these are enough. And it seems not impossible that to supersede his view with that of the West, with its emphasis on power, speed and efficiency of (*Continued on page* 938)

The Miracles of Aviation

Twenty Years May Mean Very Little in the Usual Fields of Industry . . . But What a Contrast Between Aviation in 1910 and Aviation in 1930. These Newspaper Clippings Bring Prophecy and Reality, Side by Side

By Beryl Dill



The 150 passenger Dornier DO-X, the largest seaplane in the world, soaring over the Rhine on beginning its planned 15½-hour flight from Harbor Grace to New York.

New York Herald, October 2, 1910

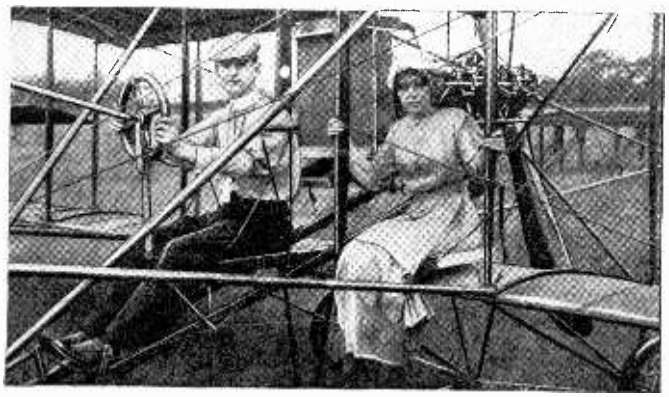
9,121 FEET IS NOW ALTITUDE RECORD

Mons. Henri Wynmalen Forced to Stop at That Height by Motor's Failure.

Mourmelon, France, Saturday.

Mons. Henri Wynmalen, the aviator, established a new world's record for altitude to-day, rising to 9,121 feet.

Mons. Wynmalen rose till his motor failed him and then made a perilous descent. He suffered intensely, and his exciting experience was similar to that of Mons. Leon Morane, who on September 3 ascended 8,472 feet, establishing a record that stood until eclipsed by Senor Chavez.



Bud Mars and Mrs. Mars in their Curtiss plane.

New York Herald, October 2, 1910

MR. J. C. MARS LOST IN FLIGHT OVER ROCKIES

(Special Despatch to The Herald)

Helena, Mont., Saturday.—Mr. J. C. Mars, the well known aviator, underwent one of the most remarkable experiences of his career, to-day, when he essayed to make a flight across the Rocky Mountains. The effort resulted in disaster, but Mr. Mars succeeded in establishing an American altitude record, his aneroid indicating a height of 7,000 feet.

Messrs. John Ringling of Chicago, and Lewis Penwell, of Helena, offered Mr. Mars a purse of $1,000 if he succeeded in crossing the main range of the Rockies.

New York Times, June 9, 1930

LIEUT. SOUCEK ROSE 8 MILES FOR RECORD

Calibration of Barographs Discloses World Altitude Mark of 43,166 Feet

Flier Out to Better It

Maker of Highest Ascent in Any Craft Will Devote This Week to Further Efforts

Praised by Naval Chiefs

Instruments Show He Reached a Region with Air Pressure Lowest Ever Experienced

New York Times, July 12, 1930

Girl Flier Rises 26,600 Feet; Unconscious as Plane Dropped

San Diego, Cal., July 11. (AP)—Ruth Alexander piloted her airplane today to an indicated barograph altitude of 26,600 feet, exceeding her previous mark by 6,000 feet.

PLANE FLIES OVER ANDES

Southern Star Is First Craft to Carry Passengers Over Range

The Sikorsky biplane Southern Star, formerly the Ville de Paris, constructed for Captain Rene Fonck for his projected transatlantic flight, has just completed the first commercial transport airplane crossing of the Andes, according to a cablegram received yesterday in the offices of the New York, Rio and Buenos Aires Line, Inc., with whom the American International Airways, the present owner of the plane, is affiliated.

The cablegram was sent by Captain John K. Montgomery, president of the American International and co-pilot of the plane. He said that the plane carried eight passengers on the trip and was forced to fly as high as 19,000 feet in making the trip from Santiago, Chile, to Mendoza, Argentina, 120 miles over the highest part of the range. The plane was piloted by Harold E. McMahon, formerly of the Curtiss Company in Garden City.

The New York Times, January 17, 1930

FOUR ARMY PLANES ARRIVE AT SPOKANE

Thirteen in 'Arctic Patrol' From Selfridge Field Are Held at Great Falls, Montana

End of Storm Awaited

First Group Cleared Continental Divide Before Fifty-Five-Mile Wind Sprang Up

New York Herald, October 4, 1910

SAYS AEROPLANES WILL STOP FLEETS

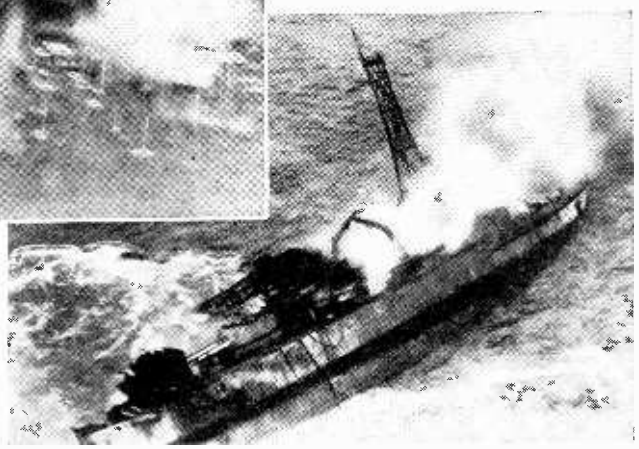
Denver, Colo., Monday.—The aeroplane, instead of being an adjunct to the navy, is likely to replace it so far as coast defense is concerned, is the opinion of Lieutenant General Nelson A. Miles, U. S. A., retired, who arrived here yesterday.

"The aeroplane eventually will be a means of coast defense," said the General, discussing aerial navigation. "Aeroplanes can be built by the score for what one battleship costs. Their use would curtail greatly the expense of building coast defense vessels. When aeroplanes can fly a hundred miles out to sea and drop explosives over hostile fleets these fleets will be cautious about attacking a coast. And this condition will come.

"All nations which go to war must reckon with the aeroplane. They would be extremely advantageous in reconnoitring, and when up several thousand feet would be practically immune from injury by rifle shots."

In the next war, airplanes will be one of the chief weapons of offense. Boats will be sunk by bombing from great altitudes.

A direct hit. The 2,000 pound bomb which sank the old U.S.S. Alabama, as it landed.



The boat as it sank. The bomb, thrown from an Army Air Service plane, struck the base of the mainmast.

New York Herald, Sunday, October 2, 1910

"Aerial navigation, with its tremendous possibilities, is going to furnish a field for the adventurous spirits such as has never been opened to them before. While many of the features of war have radically changed the opportunities for adventure are as great as ever." (Gen. Wood.)

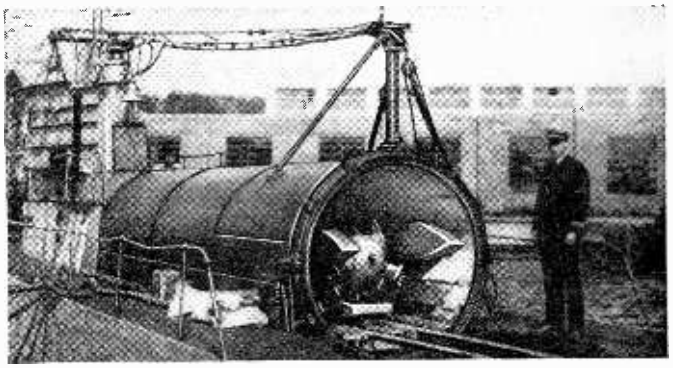
New York Herald, October 1, 1910

"Aviation Novel"

To say that "Danbury Rodd, Aviator" (Scribner's), is up to date, is to speak feebly. Mr. Frederick Pulman has projected himself into that future—perhaps not so very remote—when the laws governing aviation shall be understood and the airship recognized as a more or less certain means of locomotion. With space thus annihilated, it is easy to write stories of adventure, but it is harder to give them the air of versimilitude which distinguishes the doings of Mr. Danbury Rodd.

As we read them we find ourselves believing in the possibility of going 200 miles an hour and covering the distance between New York and Seattle in two days. . . .

The book is pleasingly written and is probably the forerunner of a big line of others upon the same topic.



The first submarine airplane, the S-1, and her pilot, Adolph C. Allen. After the submarine comes to the surface its tube opens to permit the launching of its three-cylindered peanut plane. The plane is assembled and launched in nine minutes. It weighs 1000 pounds.

The New York Times, August 6, 1930

TO TEST SUBMARINES AS AIRPLANE CARRIERS

Navy Will Also Experiment on Use of Aircraft with Destroyers

The New York Times, April 12, 1930

19 U. S. ARMY PLANES ASCEND SIX MILES IN GROUP FORMATION

Fliers Brave a Temperature of 40 Below in Making World Record in Combat Test

Air Corps Officers Declare Altitude Puts Planes Out of Range of Anti-Aircraft Guns

The New York Times, February 9, 1930

156 PLANES WILL ACCOMPANY FLEET

Fighters, Bombers and Observation Types Will Have Test in Tactical Manoeuvres Which Start This Week—New Amphibians

The New York Times, March 3, 1930

TO TRY AIR DEFENSE OF SAN FRANCISCO

Army Fliers Will Seek to Stop "Naval Attack" There in April Manoeuvres

March 30, 1930.

150 BATTLE PLANES WILL TAKE AIR TOMORROW TO ATTACK "RED" ARMY INVADING CALIFORNIA

April 2, 1930.

ARMY PLANES OPEN "WAR" ON RAILWAYS

April 7, 1930.

ARMY PLANES OPEN "WAR" ON CISCO PORT

100 Air Corps Machines Rout Defense and "Reach All Objectives," Communique Says

90 ARMY AIRPLANES "WRECK" ENEMY BASE

(SAYS AEROPLANES WILL STOP FLEETS)

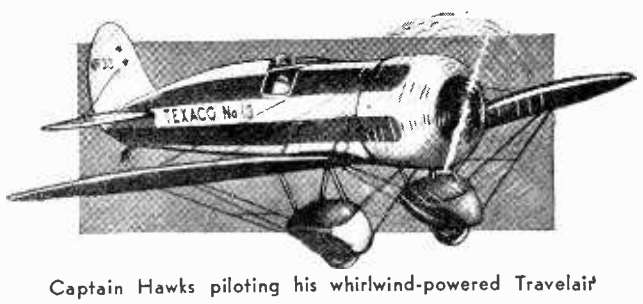
The New York Times, March 26, 1930

BURNEY SEES SIX FLYING BOATS WORTH BATTLESHIP IN NEXT WAR

New York Times, August 14, 1930

HAWKS FLIES FROM COAST IN 12½ HOURS, EXCEEDS 200-MILE SPEED ALL THE WAY

Speed Is Greatest Ever Attained by Man for Like Distance Starting by Moonlight, Flier Roars Across the Country to Land Before Sun Sets



Captain Hawks piloting his whirlwind-powered Travelair

New York Herald, October 3, 1910

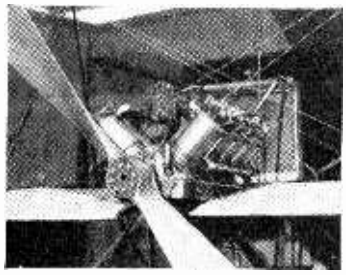
MR. SCHWAB URGES NEW AIR ENGINE

Offers to Back Aviators in Developing One of 200 Horsepower

Mr. Charles M. Schwab, who was at the Garden City Aviation Grounds Saturday with Prince Suun, of China, was again a visitor there yesterday.

He came down this time to make a proposal to the aviators, whom he met yesterday. It was in effect his willingness to back financially the development of a powerful engine for air work.

He suggested a horse power of 200 and thought the machine could be built light enough to permit its use in an aeroplane.

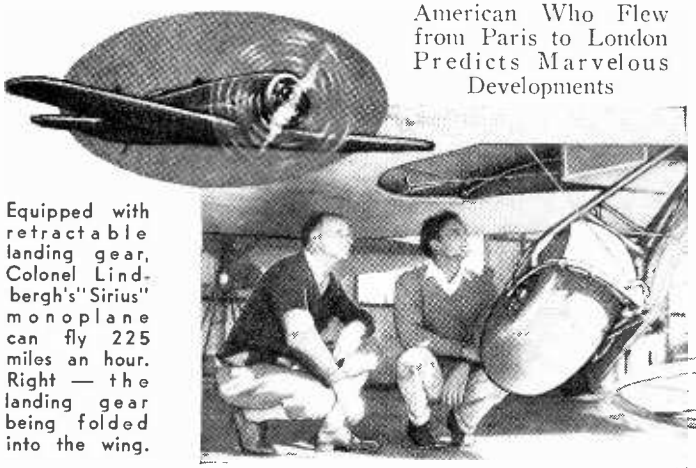


Motor of a Curtiss racer, 1910 model.

The New York Times, September 9, 1910

ATLANTIC FLIGHT COMING—MOISSANT

American Who Flew from Paris to London Predicts Marvelous Developments



Equipped with retractable landing gear, Colonel Lindbergh's "Sirius" monoplane can fly 225 miles an hour. Right — the landing gear being folded into the wing.

With the Proper Motor the Airmen Will Laugh at the Wind—The Goal Already in Sight

"Within five years from to-day," he said, "the Atlantic will have been crossed by aeroplane. All that is really necessary is to have a motor developing 200 or 300 horse power. Two men will be able to relieve one another in the task of handling the machine. Already a 100 horsepower motor, which is suited to aviation, is being built, and I repeat that within five years from now we shall have flown across the Atlantic.

". . . In less than two years' time we shall produce a monoplane with a 200 horsepower engine which will thrust that machine through the air at 100 miles an hour. . . . Passing so swiftly through the atmosphere, the craft will be altogether unaffected by even the highest winds.

"But in a couple of years' time you must understand, the construction of aeroplanes will be altered entirely. They will not any longer be flimsy structures of wood and canvas and wire. No sir, we shall have come to the era of the metal aeroplane.

". . . by the time we are flying at such a pace there will be great air stations dotted about all over the country. The Dreadnought of the sea is to have a special harbor to come into, and so will the Dreadnoughts of the air. These air stations will be great, flat spaces. They will be surrounded by sheds and repair depots.

"Aircraft will be continually rising from them and arriving at them after long aerial journeys.

"'Give us more engine power,' say the airmen, 'and we will fly faster than anything that moves on land, and ignore all the wind gusts that now chain us to earth.

The New York Times, June 24, 1930

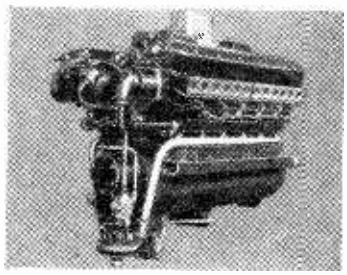
ORDERS 876 PLANE ENGINES

Army Air Corps Lets Contracts for Engines for $5,336,556

The New York Times, December 26, 1929

20 PLANES TO FLY IN HARD ARMY TEST

6,000-Mile Flight from Michigan to Seattle Over Snowy Northwest Will Start January 5



A Curtiss motor, 1930 model

The New York Times, January 12, 1930

AIR NAVIES, THE GREAT MENACE

Far More Mobile Than Ships and Armies, the Flying Fleets Have the Power to Spread Terror and Destruction Over a Wide Area and Perhaps to Render Impotent All Other Armaments

KINGSFORD-SMITH NEARLY ACROSS THE ATLANTIC; 160 MILES FROM CAPE RACE AS THE DAWN BREAKS; MESSAGES DIRECT TO THE TIMES TELL OF FLIGHT

Flying High Above Fog

Four in Southern Cross Dine Happily in Cabin

The New York Times, February 13, 1930

WOULD FLY ATLANTIC AGAIN

Crew of Yellow Bird Plans Trip from Seville to New York

ditto May 14, 1930.

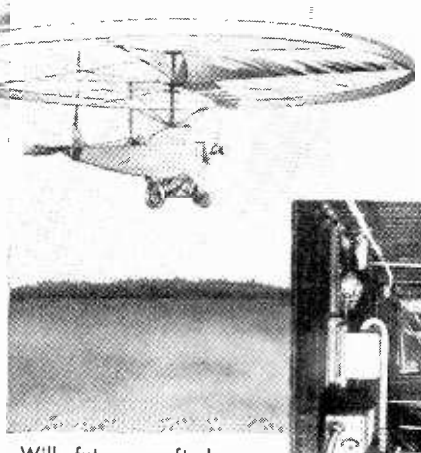
FRENCH FLIERS SPAN ATLANTIC WITH MAIL

Mermoz and Companions Land in Brazil

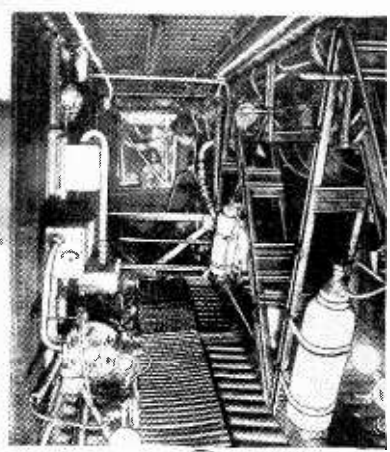
The New York Times, April 11, 1930

SCHILDHAUER TO FLY DO-X TO NEW YORK

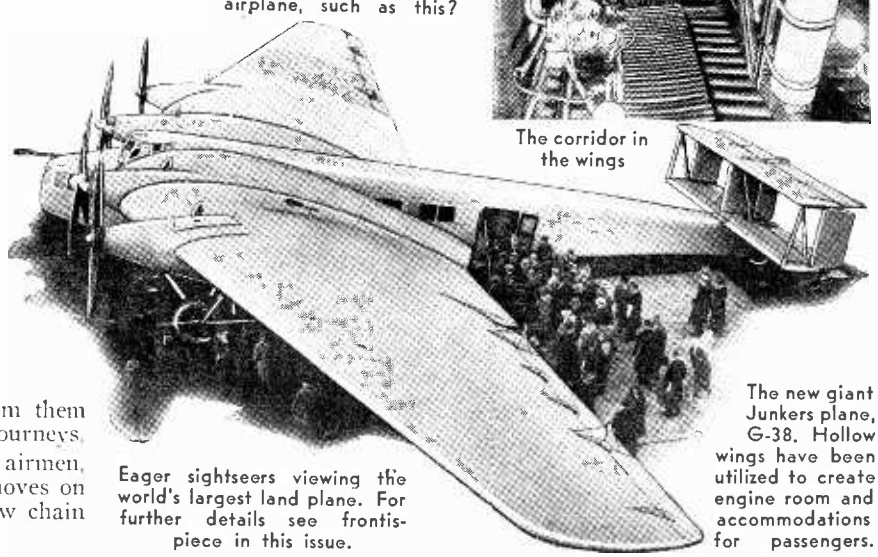
Huge Craft to Make Several Stops on Trip



Will future craft be a combination of gyroscope, helicopter and airplane, such as this?

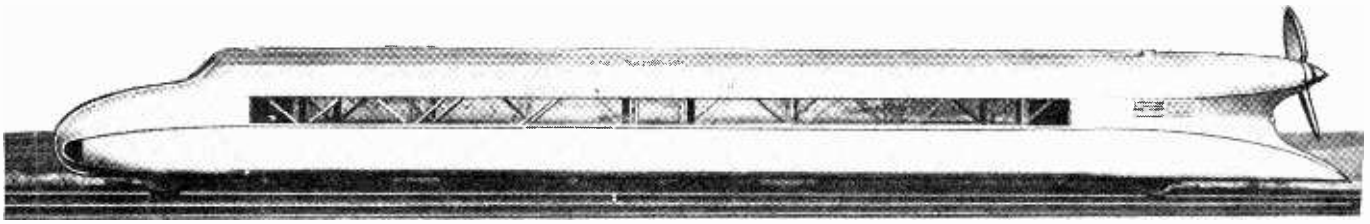


The corridor in the wings



Eager sightseers viewing the world's largest land plane. For further details see frontispiece in this issue.

The new giant Junkers plane, G-38. Hollow wings have been utilized to create engine room and accommodations for passengers.



New Zeppelin Rail Car Tested in Germany

RAILROADS have long been the target of mud-slingers, particularly government-owned railroads. Because railroads represent such an enormous capital investment, a very considerable delay must inevitably occur before they can adopt new innovations. When faced with proposed changes a railroad must (or should) first of all consider the effect of such changes upon the safety of the lives of passengers. One of the next most important considerations is speed. Finally, after a new device has passed all its tests, comes the long delay while the necessary financial arrangements are being made to replace obsolete equipment with the new device, or devices. These factors, combined, tend to make the policy of a railroad appear ultra-conservative and sluggish.

It comes as somewhat of a shock, therefore, to learn that the Reichsbahn (the German State Railway) has itself produced and is experimenting with a new type of railroad car which bids fair to completely revolutionize the entire structure of railroad travel as we have known it up to the present.

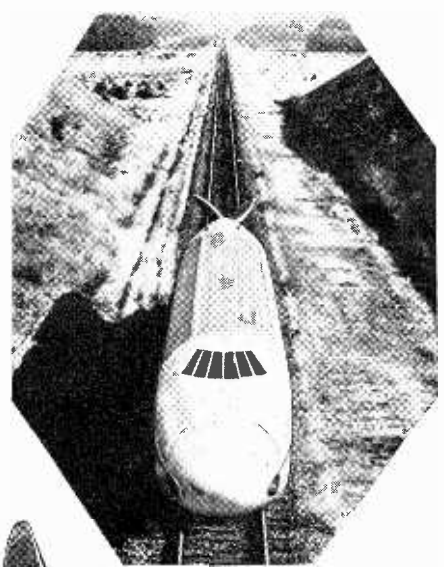
The new car, which is the product of Dr. Franz Kruckenberg and his associates in the Hanover Traffic Experimental Laboratory, is a long, silver-gray, cigar-shaped coach, closely resembling a Zeppelin airship. It measures 85 feet in length overall, and is powered by a 400 H.P. airplane motor which drives a four-bladed airplane propeller. During recent public tests the vehicle attained a speed of 60 M.P.H. within sixty seconds of a standing start, and 100 M.P.H. a few seconds later. In earlier secret trials the car is said to have reached a maximum speed of 114 M.P.H.

Two types of brakes are fitted, railway and automobile, and these brought the car to a smooth stop at the end of the test, which was run over a section of line nine miles long between Celle and Hanover which is completely straight throughout its length and used only for experimental purposes. It was over this stretch of track that the Opel rocket rail car was tested.

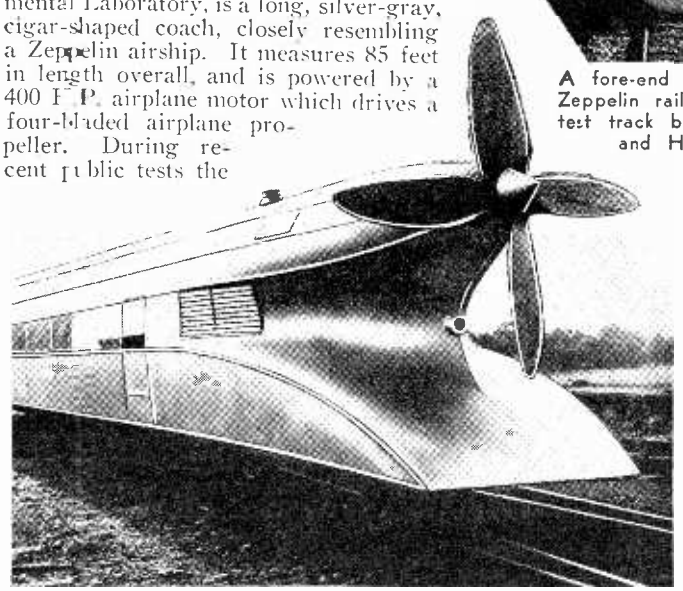
The car weighs 20 tons only, and has room for forty passengers in comfortable parlor car chairs. A single pair of wheels fore and aft supports the body on axles placed sixty-five feet apart. The springing of the car is said to be so smooth that absolutely no vibration or "train feeling" can be observed; the car flashes along as if it were an aerial and not an earthbound vehicle. The rigorous application of the modern principles of streamlining has contributed very largely to the great speed of the car, in addition to the light construction which has been followed throughout.

The shaping of the fore and aft ends of the car tends, at speed, to press the car down on to the rails, as also does the propellor, the shaft of which is mounted with a slight upward tilt. But for this downward pressure, there would be a tendency for the car to leave the rails. Just how the new Zeppelin rail car will behave on curves is yet to be determined, but according to theoretical calculations, it should be able to negotiate all ordinary railroad curves in perfect safety.

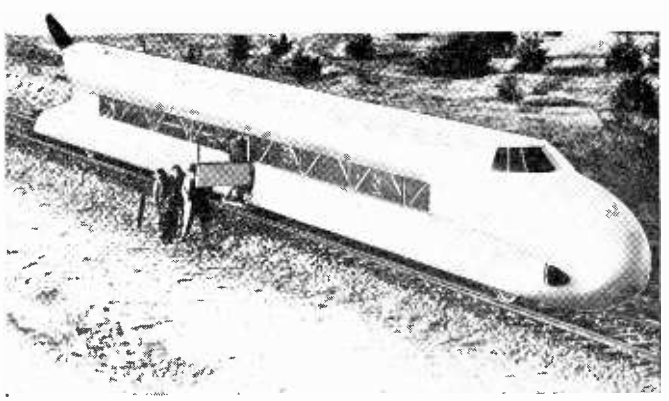
If the new cars are finally introduced into service, they will have to be run singly, at frequent intervals like trolley cars, and not in trains as is done with present railroad cars.



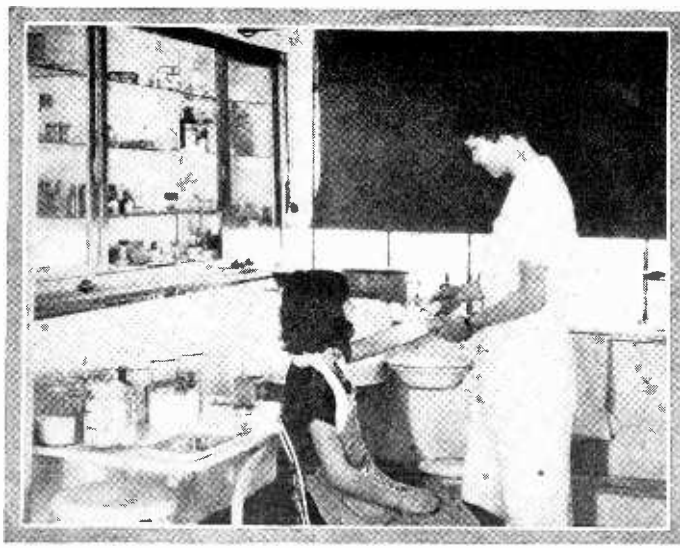
A fore-end view of the Zeppelin rail car on the test track between Celle and Hanover.



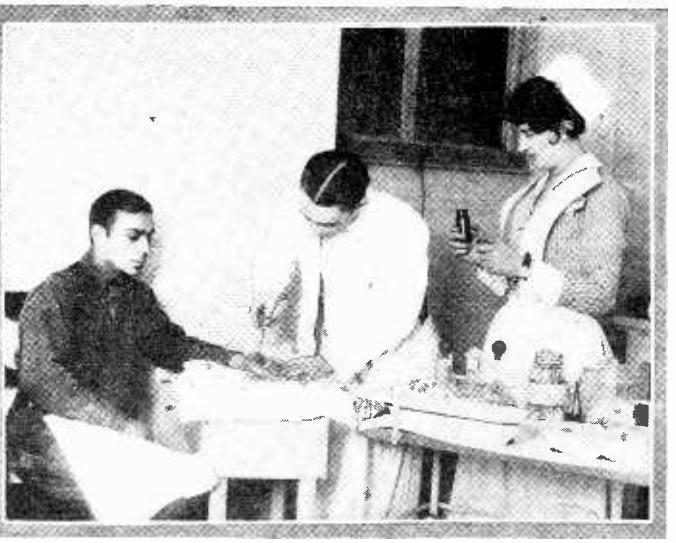
Stern view of the car, showing propeller and streamline shape which tends to press the car down on to the rails when travelling at high speed.



Showing entrance door. The streamline shape of the nose and the tail tends to press the car down. At top of page is a broadside view of the car.



A trained nurse treating the slightly bruised arm of an operative in the model medical room of the Kahn & Feldman silk mill in Brooklyn, N. Y.



Photos, Ewing Galloway, N. Y.

An emergency patient in St. Mary's Hospital, Brooklyn, N. Y., having a splinter removed from his hand. The surgeon first paints round the wound with iodine.

That Cut May Cost Your Life

By Frederic Damrau, M.D.

"IT'S only a scratch!" you may say. But watch out—it may cost your life. The majority of serious cases of blood poisoning result from very small cuts or scratches. When the hand or foot has swollen to twice its normal size, when throbbing pain is almost unbearable, then the patient comes to the doctor for help.

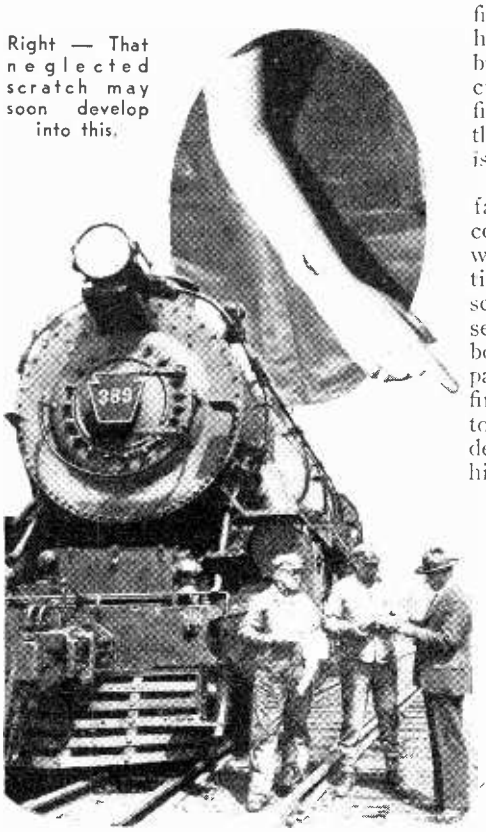
How does a little scratch get that way? Generally through neglect, through wrong treatment, or through use of inferior antiseptics. In fact, the minor scratch, cut or tear may lead to extreme suffering, hospital and operative expense, to loss of earning power and even to death. This may sound over-serious, but each one of us can think of some friend, acquaintance or member of the family who has had a great deal of trouble from a local infection.

Cuts and scratches are rarely clean in the surgical sense. Microbes always present on the surface of the skin are sure to be carried into the wound. True, the majority of them are likely to be harmless; but, if any should happen to be pus producers, there is grave danger unless effective precautionary measures are taken.

Not long ago a friend of mine was driving out in the country when one of his rear tires became punctured. In prying off the tire, he scratched his hand. Hastily he wiped the blood away on a piece of cheese cloth in his tool kit and finished changing the tire. Three days later, when I saw him, his hand was in such condition that it had to be lanced to let the pus drain out. It was some time before he could drive his car again.

Every motorist should carry a simple first aid kit. Not only will it come in handy for scratches like my friend's, but may help save a life in case of accidents. It would be a good idea if all filling stations were equipped to give this type of first aid service to motorists.

Right — That neglected scratch may soon develop into this.



Pennsylvania Railroad Safety Agent W. V. Miller (right) instructing Engineer E. L. Cotter (left) and Fireman M. B. Tarbert (centre) of the Liberty Limited, in the use of the iodine swab in promptly caring for the little cuts and scratches which, when neglected, very often develop into serious infections. Iodine is included in the first aid box carried on all P. R. R. trains.

A neglected cut sometimes results fatally. A few years ago one of my colleagues was operating on a patient with appendicitis. During the operation he nicked his finger with the scalpel. He realized the danger to himself, because the diseased appendix harbored deadly microbes; but, as his patient was in a critical condition, he finished the operation before attending to his own finger. Meanwhile the deadly microbes were traveling toward his blood stream. Blood poisoning set in and a few days later the surgeon died. The patient, thanks to this noble sacrifice, made a complete recovery.

There is also danger from infection of cuts and scratches that are treated improperly, or with inferior antiseptics. Pus germs lurk on the clothing, on the skin, on any piece of unsterilized cloth used to bind a minor wound. For this reason a wound which bleeds freely lessens danger by carrying out any foreign germs.

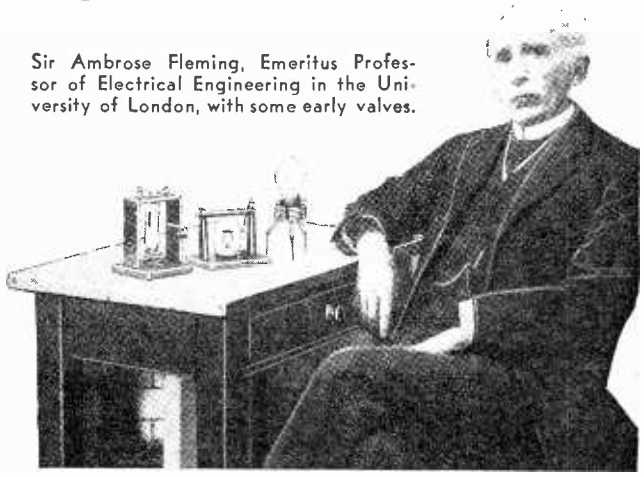
One of the most dangerous kinds of minor injuries is the *puncture,* made by a rusty nail or sharp stone, by stabbing, or by blank cartridge waddings. The danger of tetanus (lock-jaw) may be added to that of pus formation.

The sturdy young son of a friend of mine had a serious time last summer after he stepped on a rusty nail while climbing a (*Continued on page* 939)

Side-Bands and the Stenode

By Sir Ambrose Fleming, F.R.S.

The Author of This Very Clearly Expressed Article Is Known Throughout the World as the Inventor of the Fleming Valve, the Prototype of the Present-Day Thermionic-Tubes Which Are Used in All Radio Receivers. He Has Received Many of the Highest Distinctions for His Scientific Work, Such as the Gold Albert Medal of the Royal Society of Arts, the Faraday Medal of the Institution of Electrical Engineers, and the Hughes Medal of the Royal Society of London. He Is Technical Consultant to the British Marconi Company



Sir Ambrose Fleming, Emeritus Professor of Electrical Engineering in the University of London, with some early valves.

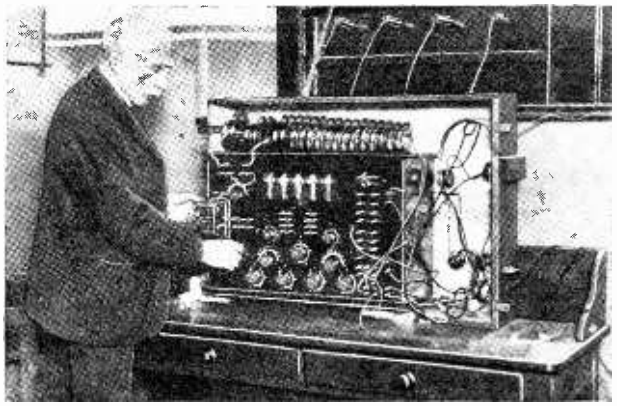
THE question of the permissible or necessary wave-band width in connection with satisfactory television transmission and also with good selective wireless broadcasting of music or speech has been much discussed. Controversy has raged around the question whether the so-called side-bands involved in the reception of modulated carrier waves have a real existence or are only mathematical abstractions. In the discussion of this point we are brought perilously near to a metaphysical dispute as to the true criteria of reality.

We know, for instance, that a force can be resolved into two or more components along different axial directions, and we might enter into a profitless discussion as to whether these components were real or not.

A ball placed on an inclined plane is acted upon by a single vertical force due to gravitation. But in discussing the problem of its motion we can consider this force to be resolved into two components, one along the inclined plane, and one vertical to the earth's surface.

Everything takes place as if these two components were actual impressed forces and the single vertical force were non-existent.

In the same way we can resolve a simple harmonic vibration having a simple harmonic modulation of its amplitude into the sum of two separate simple harmonic vibrations of constant amplitude but different frequency. How far these components can be called *real* is a matter of opinion.



Sir Ambrose photographed in his radio laboratory at University College, London. Not only was the Thermionic valve, or vacuum tube, invented in this laboratory, but also one of the first appliances for measuring wireless wavelengths, known as the Fleming Cymometer (wavemeter). University College was one of the first colleges to establish a special laboratory for wireless research.

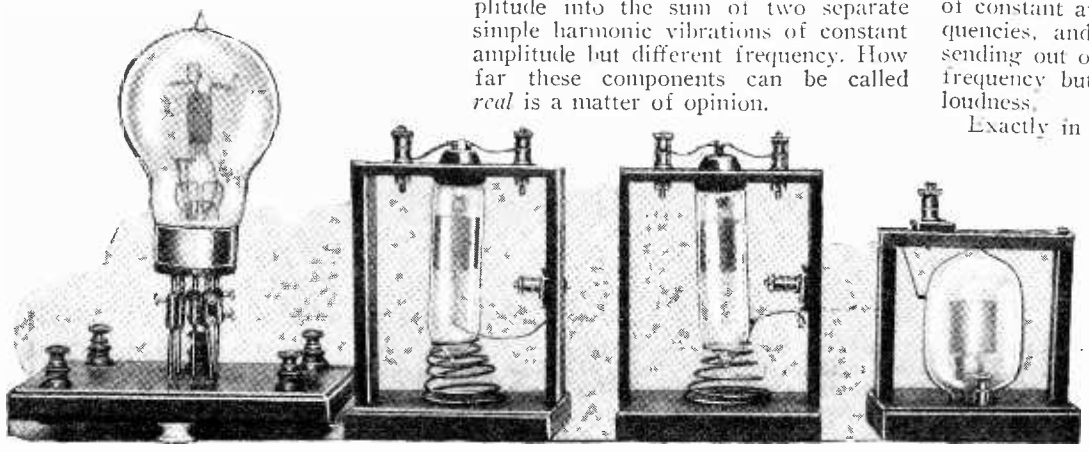
The point to notice is that the receiving device cannot distinguish between the single-frequency but modulated oscillation, and the two equivalent component vibrations of slightly different frequency but constant amplitudes.

Thus, for instance, if we were to sound simultaneously two open organ pipes tuned to slightly different frequencies a listener would hear a sound which fluctuated in loudness or had "beats" in it, and the frequency of the beats would be equal to the difference of the frequencies of the notes given by the two pipes.

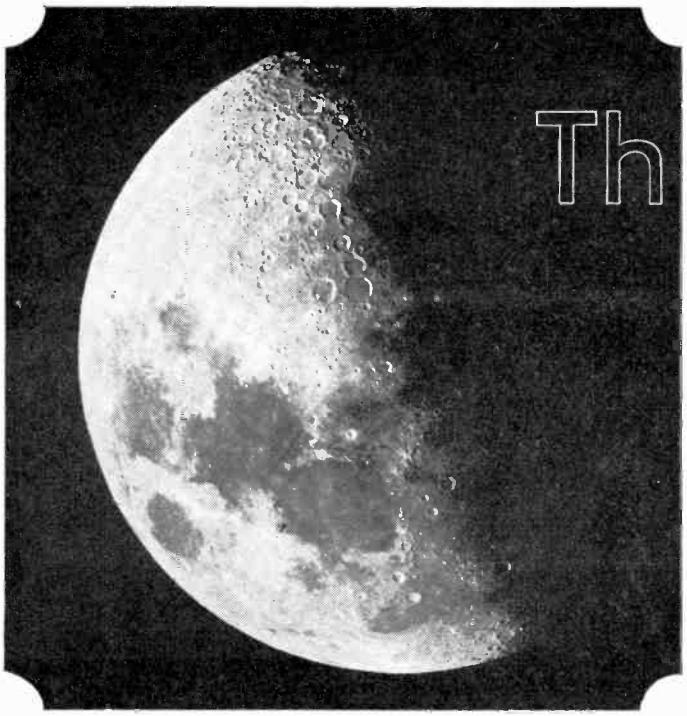
But if we had a single pipe with frequency equal to the mean of those of the two other pipes, and if by some valve in the air supply we were to make variations of air pressure and therefore variations of loudness of the sound, it would be possible to adjust matters so that the "beats" in the two cases had the same frequency and loudness.

A listener at a distance could not then distinguish by ear between the two cases: (1) of two pipes sending out two wave trains of constant amplitude but different frequencies, and (2) of the single pipe sending out one wave train of constant frequency but fluctuating amplitude or loudness.

Exactly in (*Continued on page* 931)



Photograph shows some of the original Fleming Valves, used as detectors in wireless telegraphy, patented in Great Britain in November, 1904. The originals are now preserved in the National Science Museum, South Kensington, London, and duplicate copies have been made for other museums.



The Wonders

From Time to Time We Have All of Us Looked at the Moon and Wondered What it Is All About. What Are the Markings on Its Face? Why Does It Shine So Brightly? Why Don't We Ever See the Other Side?

By Dr. Donald

Lick Observatory,

Fig. 4 — The moon near first quarter, as seen through a small telescope. Note the dark smooth areas, called Maria.

TO the average person few phenomena are more mysterious than the ever-changing shape of the moon—from crescent to full and then back to crescent again. Yet nothing could be simpler! Like the earth, the moon is a great sphere and the sun, shining upon it, makes one side appear bright while the other remains in shade and, therefore, usually invisible. Thus, when the illuminated half of the moon is turned toward us, we see it as a bright circle—the full moon. When it is viewed at a slight angle it appears gibbous, somewhat "flattened" on one edge. If the moon is so placed that we see half of the dark and half of the bright side, it is said to be at first (or last) quarter. When more than half of the dark side is presented to us, we have a crescent moon and, finally, if the dark side were to completely face us, the moon would be of course, invisible. This last phase corresponds closely to so-called new moon.

The full significance of the above explanation is best realized through a simple experiment. Place some source of light, a candle or a lamp with a short base, in the center of a large table. The room should otherwise be darkened. Arrange five or six tennis balls in various positions about the light and then stand at some distance to view the resultant effect. (Fig. 1) Clearly, a ball on the far side of the light is shaped like the full moon, one to the right or left like the moon at first quarter, while one partially between you and the light looks like a crescent moon, etc.

The moon revolves around the earth once every twenty-seven and one-third days, *i.e.*, about one a month.* During this period it goes through a complete cycle of changes. The relation of the moon's orbit to the earth and a terrestrial observer is shown in Fig. 2.

*The word *month* is actually derived from the word *moon*.—Ed.

Fig. 3 — Photograph of the crater Copernicus and surroundings, taken with the Mount Wilson 100-inch reflecting telescope. Note the streaks radiating from the crater.

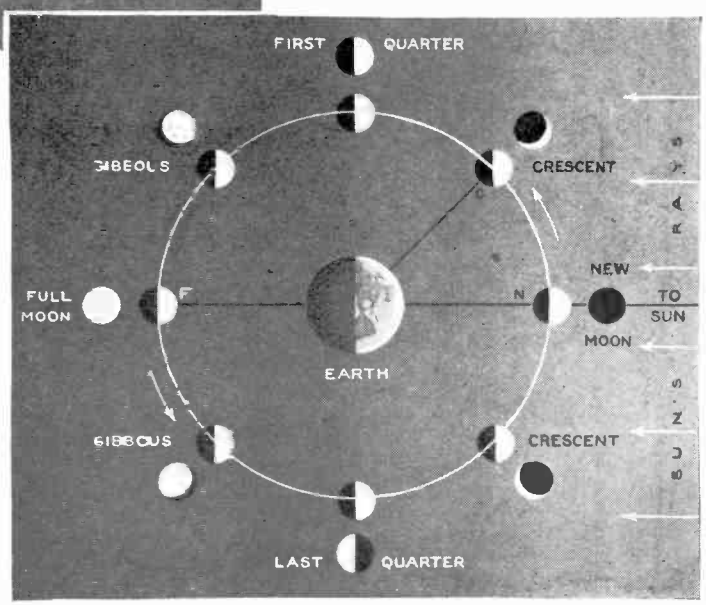


Fig. 2—The relation of the moon's orbit to the earth and a terrestrial observer. The appearance of the moon during the different stages of its travel round its orbit is shown in the outer set of figures.

The sun is supposed to be far to the right, hence the right-hand portion of each globe is illuminated. The actual appearance of the moon as seen from the earth is indicated by the outer set of figures, which accompanies the inner set depicting the orbital relations.

In addition to rotating around the earth once every twenty-seven and one-third days, the moon also rotates around its own axis, but it takes exactly the same average length of time to make one revolution around its own axis as it does to make one revolution round the earth. It is for this reason that we always see the same side of the moon, and never the other side. If we were not stationed on the earth, we would see successively all sides of the moon.

The fact that the two periods of rotation are now coincident is to be attributed to the action of terrestrial gravity—a sort of tidal action upon the Moon's interior—which acted as a brake upon the lunar rotation, once more rapid than at present—but this

of the Moon

A picture of a model, built by Scriven Bolton, of the polar regions of the moon. On the moon, stars are visible even in daylight.

These and a Number of Other Interesting Questions Are Answered in the Following Article by Our Popular Astro-Physics Editor, Who Writes in His Usual Free-Running, Fascinating and Clearly Expressive Style

H. Menzel

Mount Hamilton, California.

last point will be discussed more fully in a subsequent article dealing with the birth and evolution of the planetary system.

As another result of this coincidence, sunrise to sunset, a day on the moon, is a slow process, occupying practically fourteen of our days of twenty-four hours each.

Notice that the angle between the sun and the crescent moon is never large (the angle NEC in the diagram), while the angle between the sun and the full moon (NEF) is 180°. In other words, the sun and the crescent moon necessarily are to be seen in the same general region of the sky, *i.e.*, the crescent moon sets shortly after (or rises shortly before) the sun. The full moon, on the other hand, being directly opposite the sun, rises just at sunset and thus is visible all night long. That these simple facts are not known to or realized by everyone is shown in the frequent errors made by illustrious writers of popular fiction, who may tell of the crescent moon's rising at midnight. Even artists, who are supposed to be particularly observing, in drawing an evening scene, often make the "horns" of the crescent point toward the horizon. This can never happen. Reference to Figure 1 will show that the "horns" must always point away from the source of light and, since the sun is below the horizon, the "horns" must point upward.

Fig. 5—The south polar regions of the moon. Note the profusion of craters, both large and small.

What caused these craters? Are they the results of past volcanic eruptions, or of the collisions of meteors? These questions are dealt with in this article.

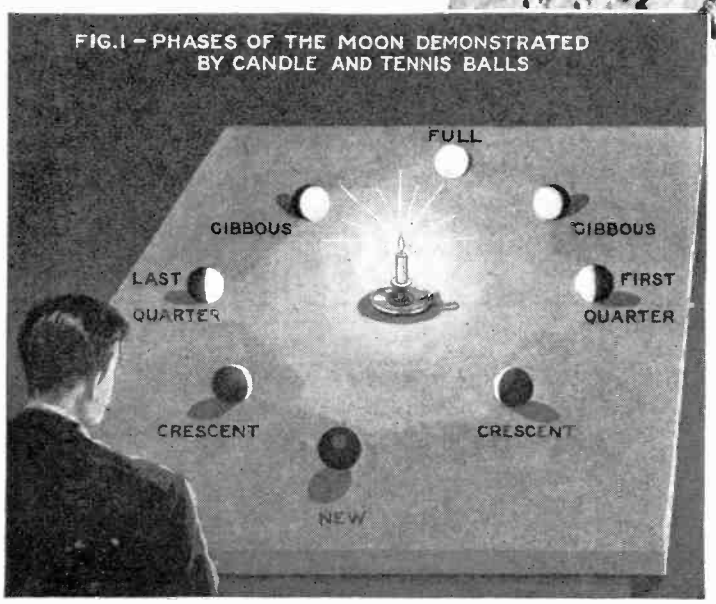
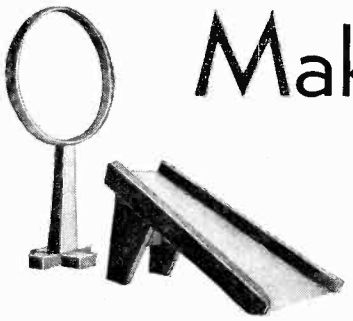


Fig. 1—Phases of the moon can be simply demonstrated by means of a candle and a few tennis balls arranged on a table.

How large does the full moon look to you? As big as a dollar? A saucer? A dinner plate? A wash tub? Whatever guess you may make, the chances are a thousand to one that you will be wrong and at least ten to one that you will not believe me when I say that a pea, held out at arm's length, will just hide the moon from view. It seems incredible that a sphere over 2000 miles in diameter, a little more than one-fourth the diameter of our earth, would appear as small as a pea, but remember that the moon is nearly a quarter of a million miles, or about 120 times its diameter away. The same ratio of numbers is exhibited by a pea one-fourth of an inch in diameter and thirty inches distant from the eye. Try this experiment for yourself.

The man in the moon, the Madonna, the crab, Jack and Jill, the rabbit, and the host of other objects that the imaginative see in the hazy markings visible to the naked eye upon the lunar surface all vanish in a telescope. We see, instead, vast rolling plains, thought by the early observers to be oceans and therefore individually christened *"mare,"* after the Latin word for *sea*, a name that has persisted in spite of the fact that they are certainly waterless. There are huge mountain ranges and thousands of craters, from about 100 miles in diameter, plainly discernible with good field glasses, (*Continued on page* 936)



The "Hoop."

Make Your Own Miniature Golf Course

The "Trough."

For Indoor Use During the Winter Months, and for Outdoor Play When Warm Weather Arrives

By H. L. Weatherby

Director of Manual Training, Montgomery County Schools, Montgomery, Alabama.

"PAR on this hole is three." That statement in golf parlance means that you can take three strokes at the ball to drive it into the hole at the other end of a hazard, an obstacle that has purposely been interjected in the path of the player.

If you have never played golf before, you are instructed to grasp the club firmly with any one of the numerous approved grips, and with your arms stiff but with your wrists rather free you swing the club so as to properly strike the ball and drive it straight forward, or around through the obstacles, and try to make a hole in one. The object of the game is to go around the course in the least number of strokes.

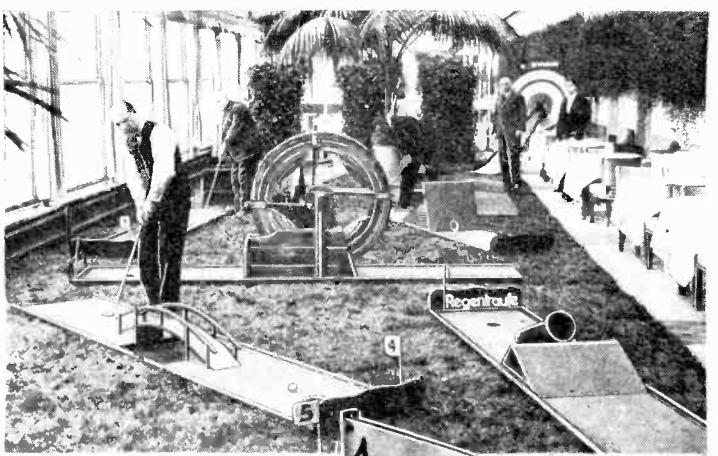
"Simple child's play," is your exclamation. You set yourself properly to one side of the ball, practice the swinging motion with your club, and drive the small sphere forward. It strikes the obstacle. Stroke one. It now requires another stroke to get you in proper position for your next punt. That is stroke two. If you are lucky, stroke three may get the ball into the hole. The odds are greatly against you, and so you have failed to come up to par on this hole. The same story is true of the entire field of miniature golf. It is for this reason that the game is fascinating. You need a steady hand, a keen sense of judgment, proper muscular control, and steady nerves to play it well.

As an indication of the manner in which miniature golf has swept the country, and the popularity of the game, there was published last summer a statement to the effect that there were at that time more than 1200 public miniature courses in New York City alone. The village or hamlet is small indeed that does not boast of one or more courses, the private indoor course is not at all unusual, and we suspect that Santa Claus left many an indoor golf set on his rounds this Christmas, so there will probably be more than ever by the time this gets into print. Even Europe has caught the craze.

The "Come-Back." If you are lucky, the ball will go on through on the right side and towards the hole; otherwise it will roll back down the incline.

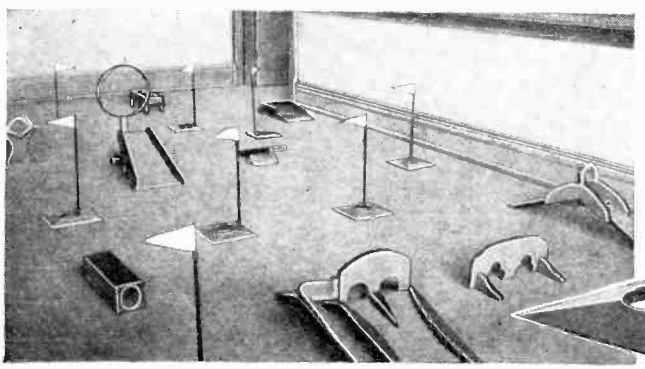
The hazards and holes making up this six or nine hole course can be built from scraps found around the home, or boxes from the nearest grocery store. High-grade lumber is not necessary and much mechanical skill would only be wasted. The average man or boy with a hammer, hand-saw and compass-saw can build the course in a few evenings of work, and then the fun begins. The boy who is enterprising can at little expense build and set up the hazards in a convenient back yard, construct his greens from sawdust soaked in old motor oil and packed, or from roll roofing; and then by the purchase of a few sticks and balls can make for himself a neat little sum during the vacation months by charging a small fee for playing. Vacation time, though, is some months away and we suggest building the course simply for the skill that may be developed and pleasure to be had from it between now and warm weather.

In order to better designate the different hazards we have given them names. The construction of most of them is very simple, but (*Continued on page* 934)



Below—The complete links can be set up in basement or spare room, or by eliminating three holes can easily be used in the living room without removal of furniture.

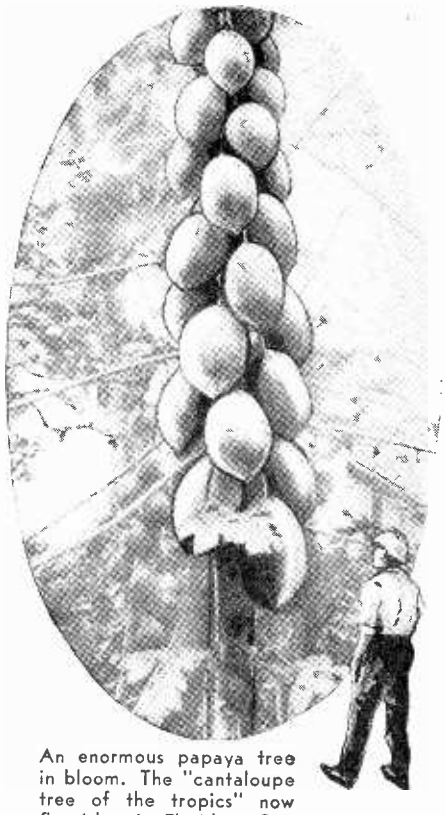
Above—Berlin's first miniature golf links, on the roof garden of the Eden Hotel. Below—The pieces described here make an ideal golf course.



Introducing the Papaya, Loquat, and Tangelo

These, and a Multitude of Other Strange Fruits, Have Been Brought Into the United States from the Farthest Corners of the Earth to Tempt Our Tired Palates. They Are Rapidly Becoming Popular

By S. H. McLean



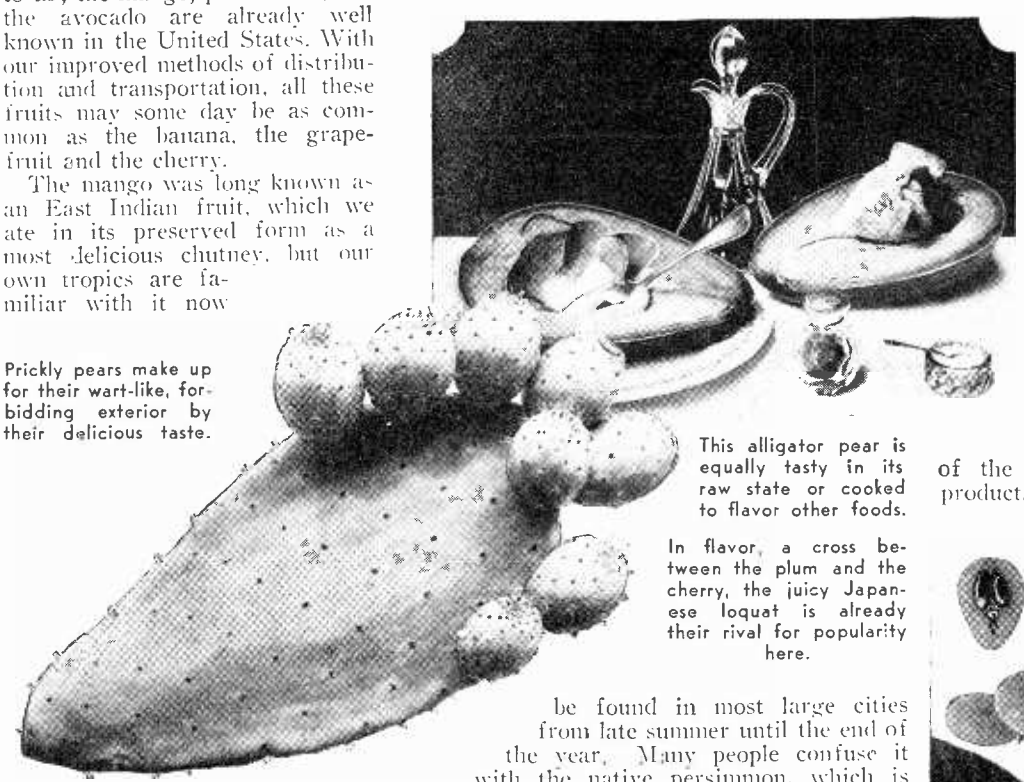
An enormous papaya tree in bloom. The "cantaloupe tree of the tropics" now flourishes in Florida. One cantaloupe weighs 30 pounds

UNCLE SAM'S agricultural explorers have been seeking for years in the farthermost corners of the earth for novel and dainty foods. They have brought to light a multitude of fruits with which to tempt the palates of those of us who are tired of eating apples and peaches and plums and oranges, just as our parents did. Some of the new fruits they have discovered, as the papaya, the loquat, the tangelo and the green-skinned orange, while eaten daily by people in other parts of the world, are comparatively unknown to us; the mango, persimmon, and the avocado are already well known in the United States. With our improved methods of distribution and transportation, all these fruits may some day be as common as the banana, the grapefruit and the cherry.

The mango was long known as an East Indian fruit, which we ate in its preserved form as a most delicious chutney, but our own tropics are familiar with it now and it is rapidly making a reputation in the North. Well it may, for the average consumer will have little trouble in eating and liking it. There are many varieties of this "apple of the tropics" of different size, shape and color, ranging from green to golden yellow with a flavor resembling both a peach, apricot, and pineapple. The mango may be used in any manner in which the apple or peach is used. A friend from Florida says: "They are eaten in such prodigious quantities by children and grown-ups alike that no claim for them seems to sound over-enthusiastic. Like the apple of the North, these never were educated; they started to school, but didn't get there. They were too good to save till school was reached. Here one sees many children eating them on the way to school." Improved varieties are being shipped in increasing quantities to markets which eagerly await them. Their season is from June to September.

Another fruit of growing popularity is the Japanese persimmon, which may be found in most large cities from late summer until the end of the year. Many people confuse it with the native persimmon, which is much smaller and less attractive. The ripe Japanese persimmon is sweet, mild, and delicious in flavor and a beautiful yellow orange or red orange in color. The softer varieties are eaten with cream and sugar.

The avocado, or alligator pear, is a fresh fruit rapidly gaining favor in northern and eastern markets. There are many hundreds of acres of it in full bearing in Florida and California and it ships well. It ranges in size from a hen's egg to a grapefruit, and as there are so many varieties which come into bloom at different seasons, it is now available practically the year round in large markets. Its flesh is about the consistency of a dead ripe banana and very smooth, melting and custardy with a nut-like flavor. It is eaten not only raw served as one does cantaloupes, but in endless salad combinations, sandwich fillings and desserts, and recently it has been found that it adds a delicious flavor to some cooked dishes. It is rich in vitamins and is one of the most nourishing of any tree product. (*Continued on page* 945)



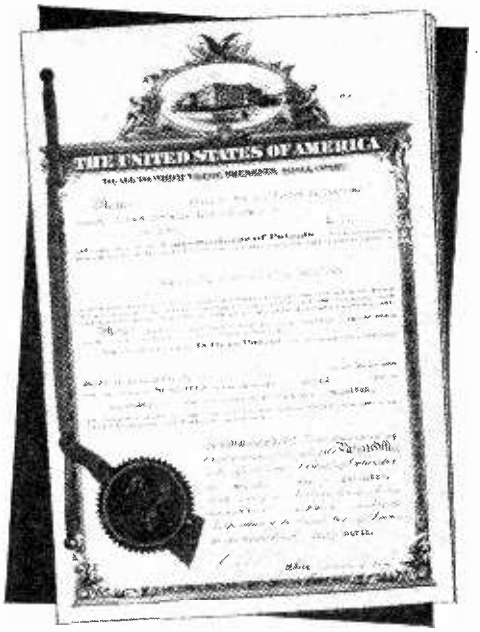
Prickly pears make up for their wart-like, forbidding exterior by their delicious taste.

This alligator pear is equally tasty in its raw state or cooked to flavor other foods.

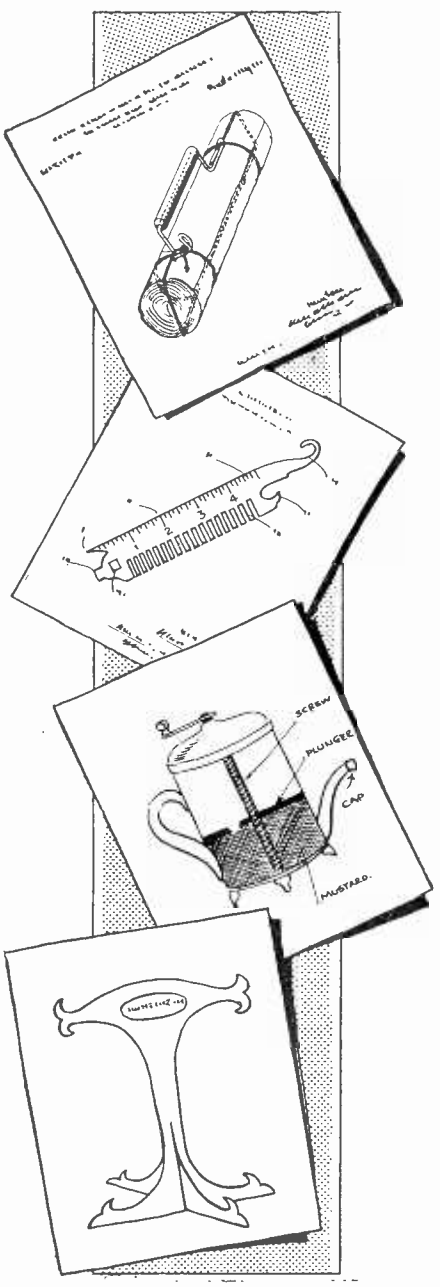
In flavor, a cross between the plum and the cherry, the juicy Japanese loquat is already their rival for popularity here.

Tribulations of

By Marcelle



What a patent looks like.



MILLIONS from inventions? How often have I heard that phrase used? How frequently have I visited stores and wondered how in the world inventors could have patented ideas and expected to sell their products to the public when they appear to reek with impracticability? I, too, became an inventor, and while I could easily see the shortcomings of some devices on the market, it was not until sad experience had taught me to realize that perhaps my own ideas, my own suggestions, and my own patents were likewise at fault.

I cannot say that I have been an inventor all my life. My first venture into the field was back in 1913. At that time I was at work digging a ditch for a railroad near Tacoma, Washington. A short distance away there was a rather large shack running along the water front which served as a bunkhouse. After my first day at hard work I was shown to my bunk, and during the usual lull after supper and before the time to retire, I engaged in conversation with a man who we will know as "Mike." As is usually the case, these shacks are provided with bits of literature. One that appealed to me was a copy of a popular magazine devoted to the subject of inventions, and I remarked upon the ridiculous simplicity and worthlessness of some of them. Mike was not in accord with my viewpoint, and I promptly boasted in the course of the argument that within five minutes I could design a better invention than any listed in the publication. He immediately took up my challenge, daring me to do so. I had to look around for an avenue for escape and I finally found one in the form of a mustard pot.

"You see that pot, Mike. The mustard is all dried up, caked on the sides, blackish in color and presents a decidedly unappetizing appearance. Supposing I were to design a mustard pot that would remain airtight and clean, that would be better than this one."

"Great, let's see you do it."

After a few moments' thought, plus a pencil and a piece of paper, a new style mustard pot was ready for careful scrutiny. This was in the form of a tea pot which was fitted with a handle like the old-fashioned coffee grinder. The principle of the device was to provide a suitable plunger which would fit the sides of the vessel tightly and which could be forced down upon the mustard by means of a threaded screw. The mustard could then ooze out of the spout.

Now that I had the idea, what was I going to do with it? I was broke, and

A new game, one of the present attempts.

an Inventor

J. Harding

Marcelle J. Harding, inventor and author of this article.

so was Mike. I tried to raise the money by giving a half interest to someone at the camp, but nothing doing. They all had as little cash as I did. At that time I was informed that a patent would cost me about $100.00. If I had $99.99 more than I possessed, I would have a hundred dollars. Nevertheless, I did not sleep on the idea. I submitted the plan to manufacturers in 48 states, but I was not able to find one who could manufacture this item at a reasonable price on account of the difficulties of (1) maintaining a tight fit between the plunger and the inside of the container and (2) of securing a suitable screw that would not be affected by the acids in the vinegar. Perhaps the suggestion could have been redesigned so as to make it more practical. I now see mustard dispensers on the American market. At that time I ascribed the failure of this idea to manufacturing difficulties.

This is an important lesson. When you have an idea, be sure that it can be turned out at a reasonable cost before spending money on patents. Perhaps it will have to be redesigned. Perhaps it cannot be made at all.

A couple of years later, the inventive bug got me again. I was listening in on the conversation of some friends, eavesdropping as it were, on a discourse on perpetual motion. I butted in, and in a short time I learned about perpetual motion. At least I thought so. In a few words I was told that all I had to do was to design a wheel that would be heavier on one side than on the other, so that it continuously overbalanced itself and remained in motion. Simple, thought I. All I had to do was to take a bicycle wheel, mount a rim inside, and then mount a ball within the rim. Accordingly I sketched up my idea and went with the following story to one of the bicycle repair shops which were so prevalent in those days.

"I would like to see the proprietor, please."

"Over here, son. What can I do for you."

"I have an idea that I have sketched up. If it runs I will pay you $20.00, if it does not I pay you nothing. O. K.?"

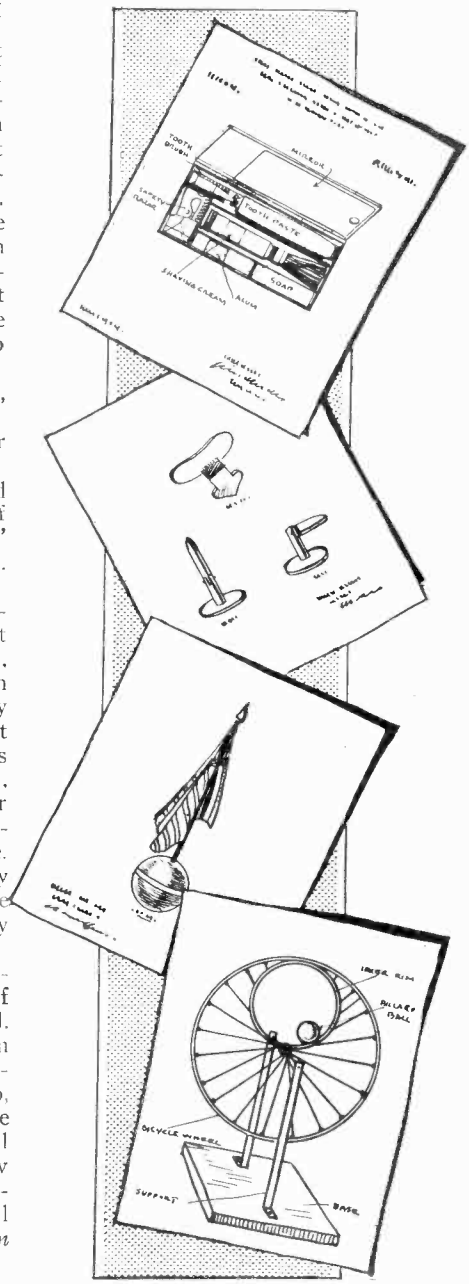
"O. K. with me," said the proprietor. "What do you want me to do now?"

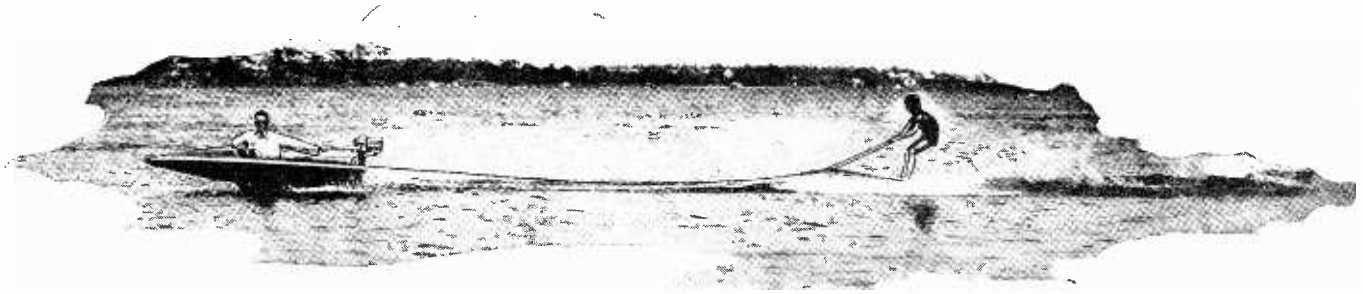
I explained to him the idea and during my discourse his face, at first serious, gradually changed. He smiled, then laughed, then called the gang in the back of the shop, who promptly gave me a glorious razzberry. I got out of that shop as quickly as I could, and I have never thought of perpetual motion since. I can see today why my scheme cannot possibly operate.

In 1916 I conceived the idea of a combination tool. This was "Jim Dandy." It consisted of a comb, bottle opener, shoe hook, a rule, nail cleaner, screw driver and Prest-o-lite tank key, all

(*Continued on page* 944)

A daisy candy box. The spinner points to the various petals.





The Speedy "Pumpkin Seed" Outboard Motor Boat

By J. Phillips Dykes

Rear Commodore and Secretary American Outboard Association

A Winning Lightweight Boat with Lightweight Engine. It Has Speed, Maneuverability, Pulling Power, and the Ability to Stay Right Side Up While Rounding the Buoys

IN the general wave of enthusiasm that has swept over the country, wherever outboard racing has been introduced, several of the most important features calculated to keep the sport in favor and to increase its popularity have been grossly overlooked, both by the industry and the drivers themselves.

The constant cry has been "Larger Motors — Larger Boats and MORE SPEED!" The result has been a veritable deluge of boat and motor designs, of rules, regulations, classes and divisions of classes, that have so complicated the handling of regattas, the keeping of records and the competition in general, that at many of the country's leading race meets during the past summer, entries were few and far between.

To attempt to classify personnel in racing which depends upon mechanical propulsion is the sheerest folly. Who is there who can honestly draw the line between an amateur and professional boat driver? To be successful outboard racing must be divided into not more than three classes, "A", "B" and "C"—or perhaps four. Eventually there will be but one division. In fact the American Outboard Association has decided to abolish divisions and to group drivers together in all regattas and return to the only way of making this kind of sport really competitive. In short the AOA intends to start all boats from scratch, the first man across the line wins.

In connection with the racing game, the youngsters have never been given a serious thought, regardless of the fact that there are thousands of healthy red-blooded lads of from eleven to seventeen years, all over the country, who would furnish the most exciting sort of competition were they equipped with a boat and motor that was inexpensive, yet fast, and really portable so that the youngsters could handle the entire outfit themselves!

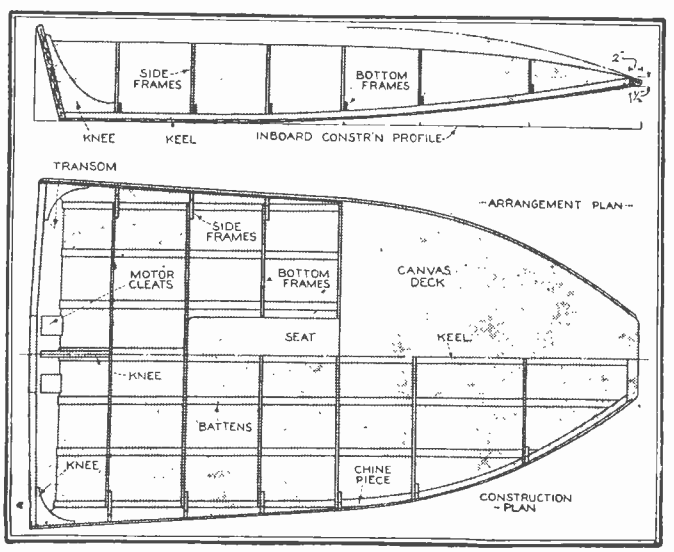
Outboard motors at present, except for the A and B classes, have become so heavy and difficult to handle, that while they can be technically called "Outboard," they are no longer portable. It is to be regretted that the engine builders have been so short-sighted as to lose sight of the fact that the portability of their product has been the vital factor in its popularity.

The Association has decided to form a Junior A Class for boys of 17 and under (of course these little boats can be used in regular A and B class competition). With this in mind, we are presenting a fast, safe and really portable racer for the youngsters to get busy on.

Twist and turn it as you will — this boat will not tip.

Half Breadths		
Sta.	Deck	Chine
0	6"	6"
1	1' 5⅛"	1' 5⅛"
2	1' 10⅞"	1' 10⅞"
3	2' 0⅜"	2' 0"
4	2' 1"	2' 0"
5	2' 1⅝"	2' 0"
6	2' 2⅜"	2' 0"
7	2' 3"	2' 0"

Planking may be cedar, cypress or mahogany. Keel may be spruce or pine.
Length overall—8' 0"
Maximum beam at chine—4'0."



This little speedster will weigh about 70 pounds when completed. The cost will be less than $35.00 to the home builder. Through special arrangements with the Pen-Yan Boat Company, the Association has been able to start the class off with a number of readymade hulls at a cost of considerably less than $100.00, a racing outfit that almost any Dad can and will afford for his "Buddy," and a little boat that will give many a thrill to the grown ups, when they hang a "B' class motor over the stern.

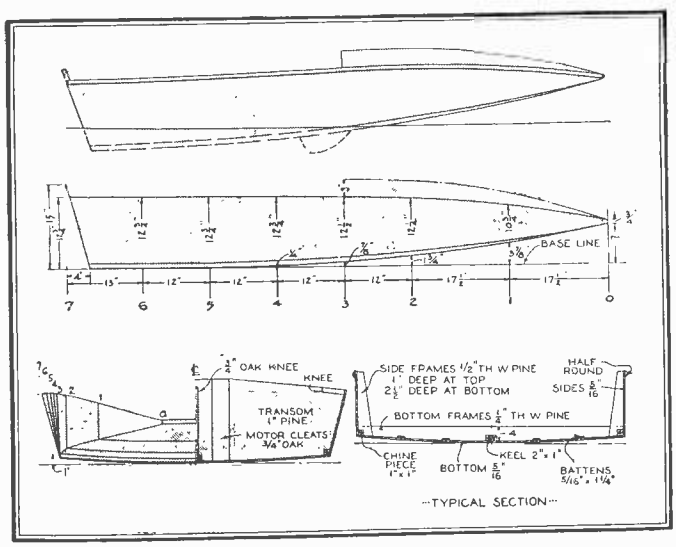
Last year, noted drivers such as Malcolm Pope and Jack Kerr, entered a pair of experimental hulls of this design in several races in the south and came through with a win in every instance. They and many other well-known drivers are enthusiastic over these little racers and during the coming season in Florida, they will be seen at twenty or more regattas

Full speed along the edge of a pool. How's that for maneuverability? Left—Baby Deauville just getting up on the step.

An ideal motor for the Junior A Class boats, is the "Fold Light," a real little motor, built by Outboard Motors Corporation of Milwaukee, a twin cylinder job weighing but 26 pounds and turning up to 4,000 R.P.M.s when equipped with a racing wheel. These small engines will drive our new boat at better than a 20-mile gait and as it is practically impossible to upset the little boat when not over-powered, this class will be mighty popular by spring and will be a regular feature at all regattas.

To get down to brass tacks, brass screws and cedar planking, here is the quick and easy dope on how this boat can be built. The building of it is just as simple as the driving. You will note when you read the plans, that the design of the round bottom and flaring sides practically eliminates all chance of tipping or upsetting. We are going to start building the boat bottom side up, because later it will be very easy to plank it in that position. First a preliminary base should be prepared consisting of two 2 by 6 inch planks, about eight feet long, which should be level on the top surface, and then set up three feet apart and three feet off the floor. Care should be taken to see that they run absolutely parallel. Then mark off each of the frame stations on each of these planks and secure a couple of cleats to the end of the planks so that you can locate the transom at the proper angle, a factor affecting the motor

The motor — so light that you can hold it comfortably.



All dimensions are to outside of planking. Half breadths are given at chine and deck. Heights for deck at side and for keel at center line are given above base line. Bottom frames are straight on top, 4" deep at center. Bottom edges all have same curvature which is 1" on each side at chine for a breadth of 4 feet. Make up all seams and joints with marine glue.

All bottom frames carry a one-inch curvature for a breadth of four inches which simplifies matters exceedingly. You can bolt the side frames together or use screws and marine glue. Notch out for the keel, chine and clamp. The seam battens can be notched into the frames after the boat is set up and ready for planking. An inside gunwale can be put in of ½ by 1½ inch spruce and later the half round strip can be added on the outside. When the frames, transom and keel are all in place and clamped with some oak pieces so that the frame is secured tightly together, the chines can be fitted and should be exactly flush with the outside of the frames. The seam battens can then be fitted into place for the batten planking and are placed parallel to the keel and eight inches from center to center. The four center bottom planks can be put in first, then the two side planks, finally the outside bottom planks. Don't forget that the seam battens, inside keel and chines should all be given a coating of Jeffery's Marine Glue—plenty of it, before the planking is fastened into place, to make a water-tight joint. It would be well to put a strand of cotton string well doused with marine glue between each joint for an added preventative against leaking. Then the boat is turned over, the deck frames put in with the right curvature, the deck battens are set in and the canvas stretched in two triangular strips over the deck and tacked to the outside of the top side planking. The half-round strip is then fastened over this and around the entire gunwale. One of the main features that gives this little craft strength is the foot-long bow piece 1½ by 2 inches, which is rabbeted out so that the keel, chines and planking and deck battens all fit in flush and solidly.

Light planking can then be put in the bottom of the boat and it is ready for painting. This final operation should include proper sandpapering and two coats of varnish or paint inside and at least that many on the outside. If you have used mahogany a varnish job will look best, but other woods require painting and a real choice color scheme can be worked out to suit the individual fancy. The (*Continued on page* 935)

Serve Your Fruit In Model Ox Cart

Models Are Usually a Bugaboo to the Neat Housewife. But When the Man of the House Makes a Model That Is of Historical Interest, Is Ornamental, and Serves as a Fruit Bowl, It Will Be Appreciated

By Charles Herbert Alder

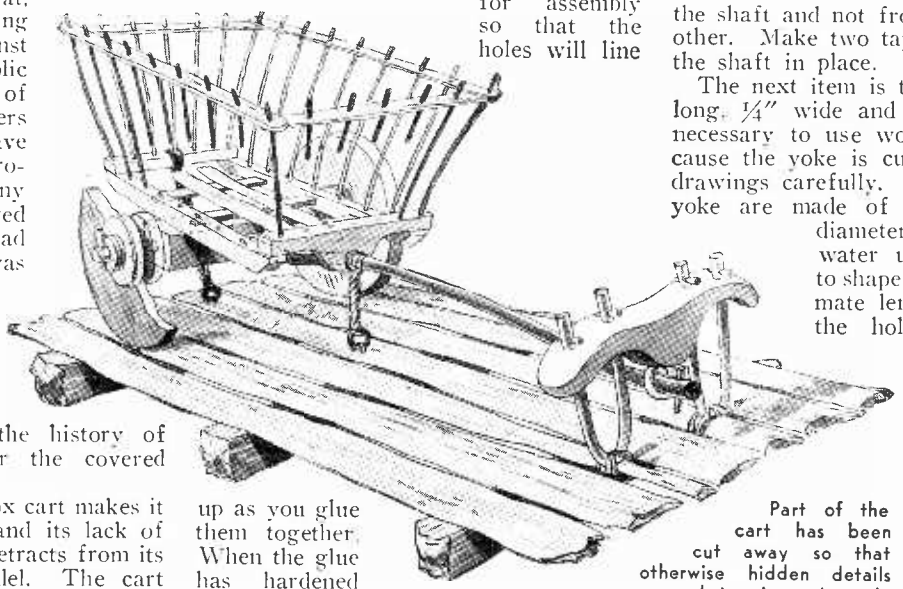
Who could refuse fruit served by such a charming miss in such a novel bowl.

LONG before stage coaches became famous — even before covered wagons came into use, the crude, clumsily built but sturdy ox cart reigned supreme. It lumbered along, its wheels wobbling and creaking, with the plodding oxen, wet with sweat, straining and shoving their shoulders against the yokes—truly symbolic of the great qualities of character that the pioneers of this country must have possessed to have progressed despite the many obstacles they encountered and the hardships they had to bear. The ox cart was as truly a forward step in the progress of transportation as the covered wagon or the stage coach. And it played as vital and as interesting a part in the history of transportation as either the covered wagon or the coach.

The simplicity of the ox cart makes it very easy to construct and its lack of detail adds rather than detracts from its attractiveness as a model. The cart could also be used to decorate your piano or table. All the parts for the model except three wire rings can be made with one tool—a knife. There should not be any equipment problem connected with this work. As for material, that can be obtained from your grocer—just ask him for a box.

As a number of views of the ox cart and a working drawing containing all the necessary dimensions are included in the article, you will not find many measurements in the text. You need not follow my plans exactly, but I think you will find it easiest if you build your model as I did.

Start your ox cart by making the large wheels. They are 5¾″ in diameter × ½″ thick. The reinforcing wheels are 1¾″ in diameter × ¼″ thick. In these wheels about ¼″ from the edge and on one side only, bore four holes and drive small wooden pegs into them. The pegs need not go all the way through the wheels as they are for appearance's sake only. Two more wheels 7/8″ wide × ⅛″ thick and two wooden washers, also of the same width but only 1/16″ thick must be made. Each wheel has a ¼″ hole through its center. Make two round wooden pegs on which the wheels can be mounted for assembly so that the holes will line up as you glue them together. When the glue has hardened you can take them off the pegs. The wooden washers are not glued to the wheels as the peg through the axle holds them in place.



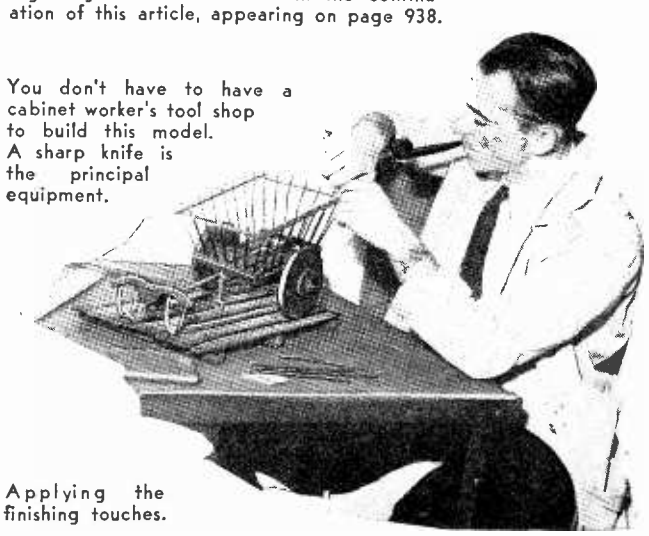
Part of the cart has been cut away so that otherwise hidden details are exposed to view. A working diagram will be found in the continuation of this article, appearing on page 938.

Now cut out the axle. When this has been done the framework can be made. This part of the job is so simple that you can get all the necessary information from the illustrations.

The shaft should not cause you much trouble. It is 13″ long and ⅜″ in diameter. Steam and curve to shape. To do this easily, make a form by driving nails into a board around a pattern marked to the desired curve. At the front end of the shaft ½″ from the end, bore a 5/64″ hole. Taper the other end of the shaft, starting 1″ from the end. About ¼″ from the same end, bore another 5/64″ hole. Refer to the illustrations and be sure that you make the holes from the top to the bottom of the shaft and not from one side to the other. Make two tapered pegs to hold the shaft in place.

The next item is the yoke. It is 6″ long, ¼″ wide and 1⅛″ deep. It is necessary to use wood 1¼″ deep because the yoke is curved. Follow the drawings carefully. The bows for the yoke are made of wicker, 3/16″ in diameter. Boil it in water until pliable, bend to shape, cut to the approximate length and insert in the holes in the yoke. Make three iron rings ½″ in diameter of 3/32″ wire. Three staples can be made by bending nails and sharpening the ends. One

(*Continued on page* 938)



You don't have to have a cabinet worker's tool shop to build this model. A sharp knife is the principal equipment.

Applying the finishing touches.

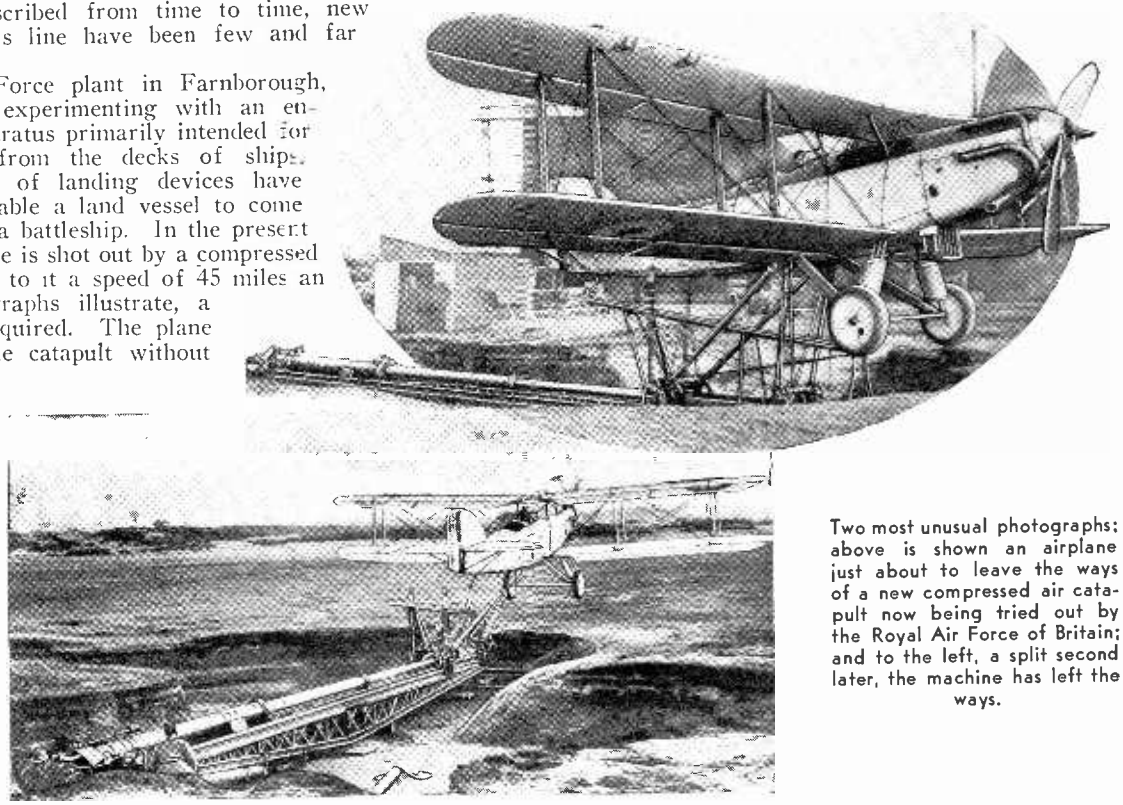
In the SPOTLIGHT of SCIENCE

Guns Shoot Airplanes Off the Ground

ALTHOUGH catapults for airplanes are fairly well known and have been described from time to time, new developments along this line have been few and far between.

At the Royal Air Force plant in Farnborough, England, officials are experimenting with an entirely new type of apparatus primarily intended for catapulting airplanes from the decks of ships. Already various types of landing devices have been constructed to enable a land vessel to come to rest on the deck of a battleship. In the present construction the airplane is shot out by a compressed air gun, which imparts to it a speed of 45 miles an hour. As the photographs illustrate, a long runway is not required. The plane leaves the ways of the catapult without damage to any part of its structure or injury to the pilot.

It is conceivable that at some future date airplane landing fields might be made considerably smaller than they are at present and automatic devices will serve to stop the long run of landing planes and catapults or plane guns will drive even heavily loaded airplanes into the air.

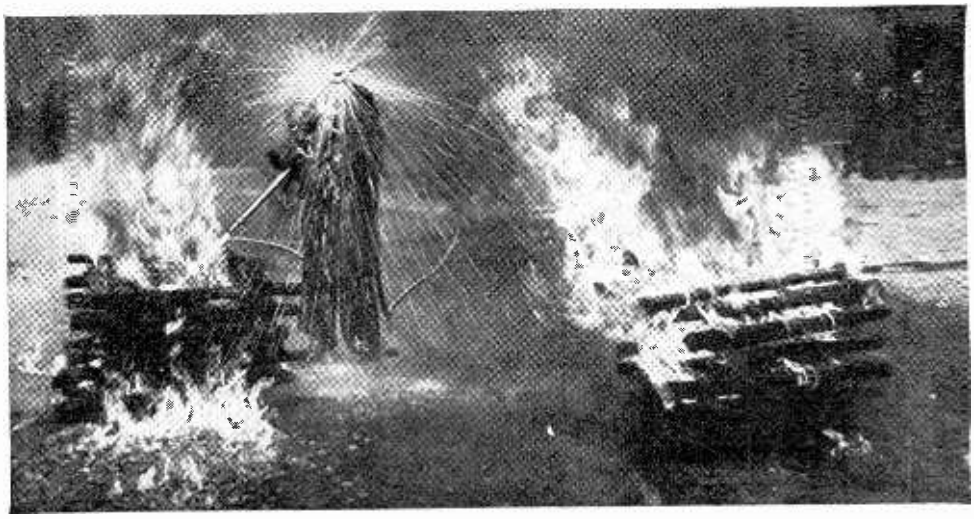


Two most unusual photographs: above is shown an airplane just about to leave the ways of a new compressed air catapult now being tried out by the Royal Air Force of Britain; and to the left, a split second later, the machine has left the ways.

Water Curtain to Protect Firemen

MANEUVERS of the Berlin (Germany) Fire Brigade thrilled the audience with what is supposed to be a novel and new kind of extinguishing suit. Several timber piles were set on fire and when the flames were well under way firemen with this suit walked right among them and sprinkled them with water. As will be observed from the photograph, part of the water from the hose runs to a spinning arrangement on top of the helmet and sprays the fireproof uniform with a continuous stream, enshrouding the fireman and also protecting anyone who may be held in his arms.

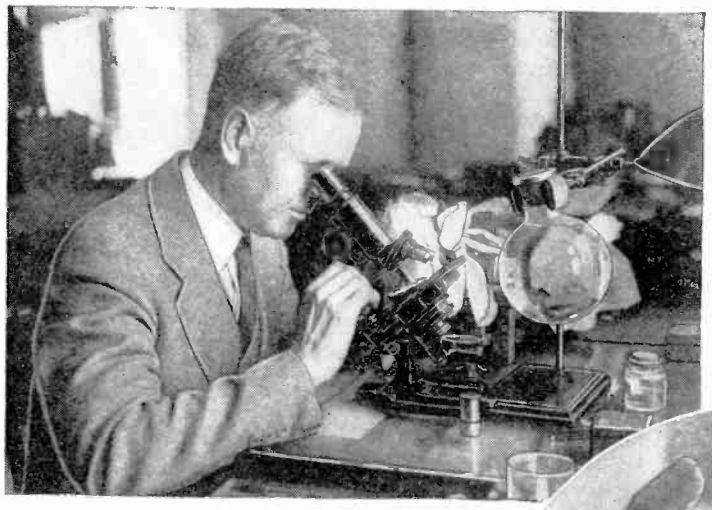
The uniform is made of fireproof canvas that has been rubberized. This suit is constantly drenched with water. The fireman experiences no difficulty in observing what he is doing because the water has a tendency to lay the smoke immediately in front of him, to quench the flames and to present no greater obstacle to vision than that due to an ordinary rain downpour. The problem of respiration has to be considered.



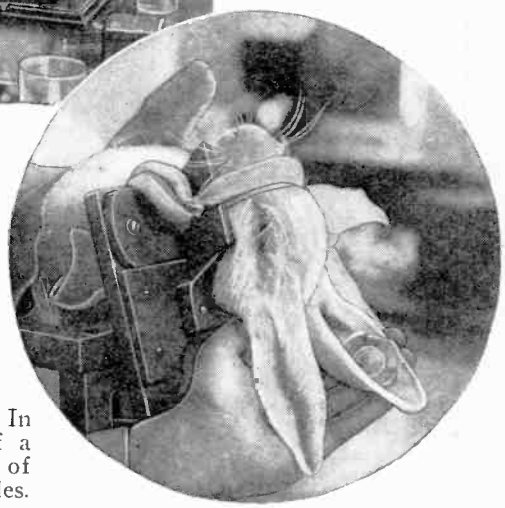
While this idea might be new to Germany, it is very old to the followers of SCIENCE AND INVENTION magazine. Back in the fall of 1920 this suit was tried out by the Cincinnati Fire Department. At that time an illustration similar to the one here depicted appeared on the front cover of the December issue of this publication. The particular suit then described had an additional feature in that it possessed two layers of water-proof canvas between which a constant stream of water flowed, in order to keep the firemen cool. An air purifier was also contained within the suit, making it possible for the firemen to breathe pure air as long as the flow of water was maintained.

Watching Living Cells Grow

CELLS of living organisms may now be watched while they are growing, and records of their reactions under various conditions have been obtained through the work of Dr. Eliot R. Clark, of the University of Pennsylvania School of Medicine, and his wife. The new technique will enable doctors to secure fundamental information regarding the manner in which abnormal cellular growths originate and develop in infectious diseases, such as tuberculosis and cancer. It is expected to be a great aid in fighting these diseases. The Rockefeller Foundation has contributed $75,000 to promote this work, and at the present time thirteen people are working under Dr. Clark.



Dr. Eliot R. Clark, Director of the Anatomy Laboratory at the University of Pennsylvania School of Medicine, studies cell growth in a rabbit's ear.



A close-up of the ear of the rabbit, containing the device which enables research workers to study living tissue.

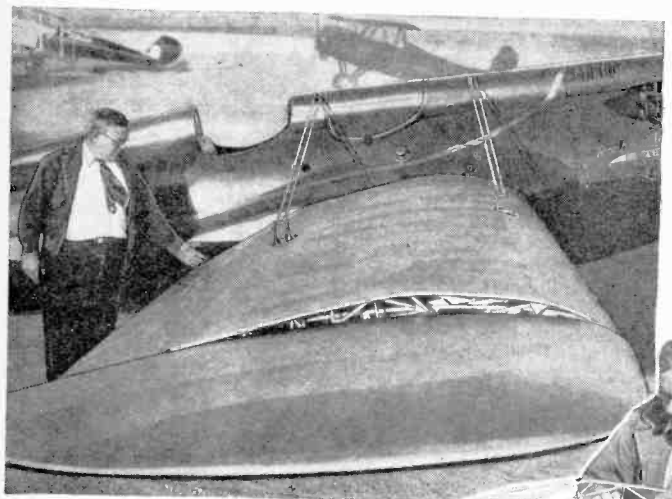
The apparatus used, in this case for studying cell growth consists of a transparent, double-walled window, which is fitted into a hole made in a rabbit's ear. One side of the window is celluloid; the other, a thin sheet of mica. Tissue and blood vessels adjoining invade the space between the partition and form a new layer, which can be observed, from time to time, under the microscope. While all the experiments have been made with tissue of animals, human tissue is to be tested shortly.

Adjustable Wing Increases Plane Efficiency

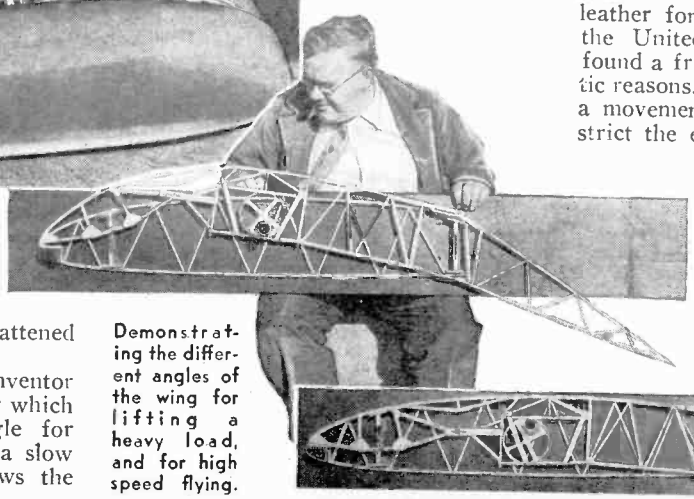
A PILOT can change the angle of attack of his plane wings in a few seconds by merely turning a crank in the cockpit, thanks to the invention of Dr. H. D. Rocheville, of Los Angeles, who has been interested in aviation since 1912. By the use of these adjustable wings one plane can both attain high speed and embody high lifting power, two separate qualities which cannot both be realized with the present models. Airplanes that have great lifting power have thick wings and a sharp angle; they take off quickly and land slowly. Those that ascend slowly and fly quickly have wings that are flattened out.

The upper photo shows the inventor pointing to the bulge of the wing which results from adjusting its angle for lifting heavy loads or affecting a slow landing. The photo below shows the wing, flattened out for high speed. In this position the cruising range of a plane which carries 1,000 gallons of gasoline would be increased 1600 miles. Here the trailing edge and the fuselage are almost parallel; they are at a sharp angle for a low speed.

A plane equipped with these wings has been accorded several test flights, and has flown successfully. Aircraft experts are confident that it is a great step forward in plane efficiency. It is claimed that 25 miles an hour can be added to the speed of a plane when the wing is flattened; when thickened, the plane will rise in half the distance usually required.



Dr. H. D. Rocheville, the inventor, inspects one of his adjustable plane wings.



Demonstrating the different angles of the wing for lifting a heavy load, and for high speed flying.

High-Powered Tree Planting

MASS production in the lumber industry has resulted in mass planting of trees by machinery. Two types are in use at present, tractor and horse drawn. The one motivated by a tractor requires two operators and has planted 5,000 trees in two hours on abandoned farmland. The other requires a team of horses, a driver and an operator; it plants trees at the rate of 1223 per hour. Both handle trees from one to four years of age with safety.

The Python's Friends

AT last the python and the monitor lizard, so much in demand for leather for women's bags and shoes in the United States and Europe, have found a friend. . . . But not for altruistic reasons. South Africans have started a movement to prohibit, or at least restrict the export of these skins. They claim that the wholesale slaughter of the snake affects their sugar cane industry disastrously. For the python and the monitor lizard are the only destroyers of plague-carrying rodents in the cane producing regions.

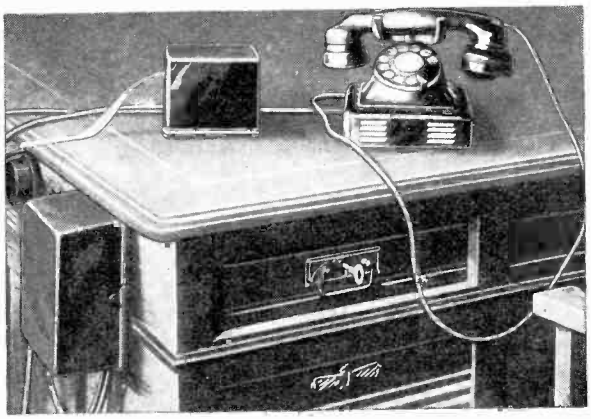
Will This Helicopter Defy Gravitation?

A UNIQUE helicopter, whose entire lifting ability and forward motion are dependent upon a single motor and propeller, has been developed by W. P. Kindree. He hopes to assemble the parts and fly this freak of the air successfully. Its motor, which has not yet been installed, weighs 235 pounds and develops 65 horse power. The propeller looks like a mushroom and includes sixty blades. It can be tipped 45 degrees in any direction, so that once the queer craft has gained altitude, it may be flown in the manner of an ordinary plane. There are 135 square feet of propeller surface, and as the propeller rotates, its pitch advances it twenty inches with each revolution.

The basic patent for the helicopter has been issued to John W. Pitts of Los Angeles, California, and he is preparing for a test flight in the near future. The late success of the Pitcairn-Cierva autogiros, although of radically different design, makes us more and more interested in ventures of this nature.

Unattended Phone Takes a Message

THE Swiss and Belgian governments have officially inaugurated a new service and placed in use a much needed instrument, the "Telephonograph," invented by a Swiss engineer. The apparatus consists of a combination telephone and telegraph, equipped with a tape recorder. If the person called happens to be out, the caller can, by a prearranged code system, send a message. It will appear on the automatic telegraph recorder attached to the phone. The charge for this extra attachment is said to be about 25 francs, or $1.00 a month. Cheap enough, to our mind!



Mysterious African Plateau Explored

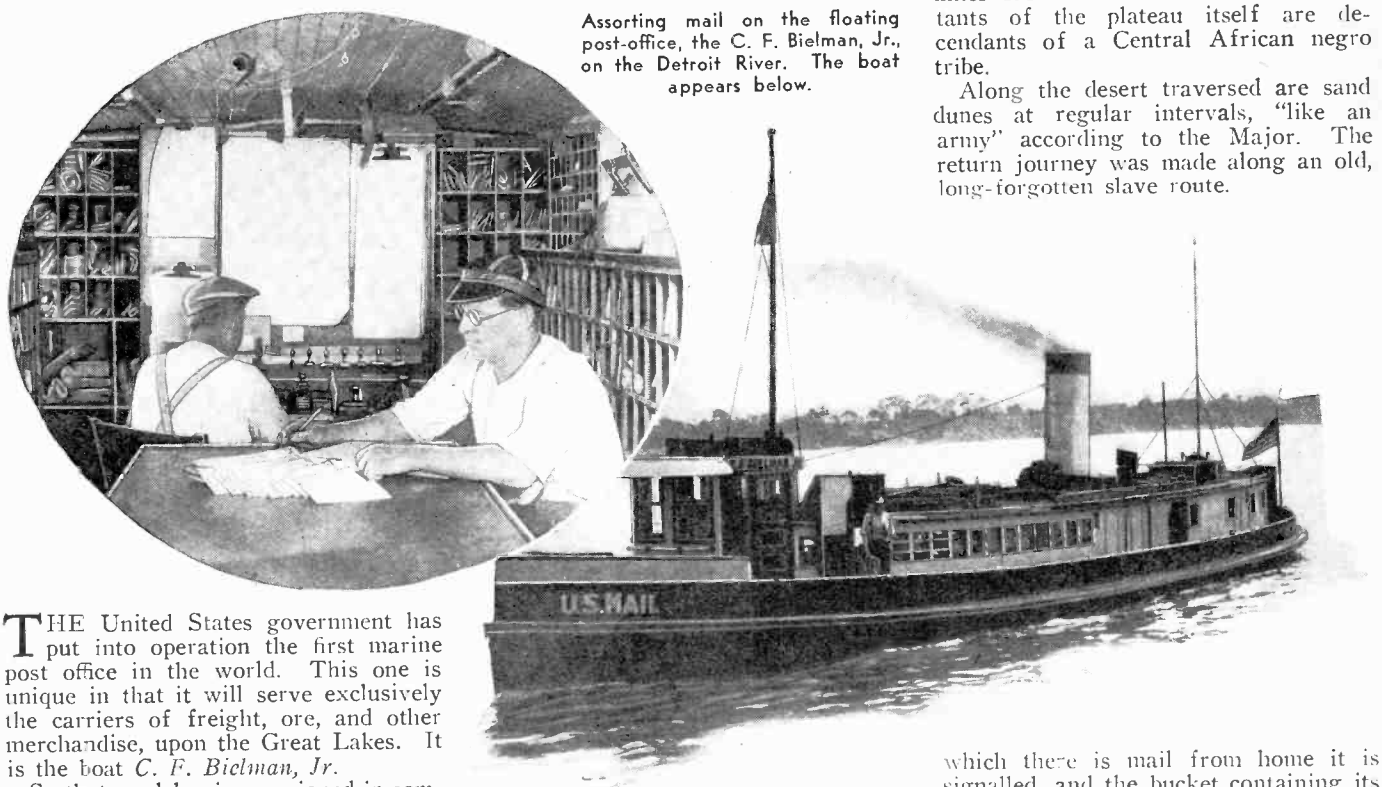
IN 1923 the Arabs discovered a rocky plateau, 6,000 feet in elevation in the Libyan desert. They named it *Owenat*. Very little information reached the outside world concerning it, at the time.

Major Ralph Bagnold of the Indian Royal Signal Corps, and three companions have just returned from the first expedition of exploration undertaken by Europeans to penetrate to this plateau. They have brought back with them valuable maps of the desert, some parts of which were never explored by white men. Major Bagnold came upon a remarkable circle of stones, similar to Stonehenge in England—three feet high and 27 feet in diameter, northeast of the plateau, near the border of Sudan. This mysterious formation is in the desert, 150 miles from water. The native inhabitants of the plateau itself are decendants of a Central African negro tribe.

Along the desert traversed are sand dunes at regular intervals, "like an army" according to the Major. The return journey was made along an old, long-forgotten slave route.

First Marine Post-Office

Assorting mail on the floating post-office, the C. F. Bielman, Jr., on the Detroit River. The boat appears below.



THE United States government has put into operation the first marine post office in the world. This one is unique in that it will serve exclusively the carriers of freight, ore, and other merchandise, upon the Great Lakes. It is the boat *C. F. Bielman, Jr.*

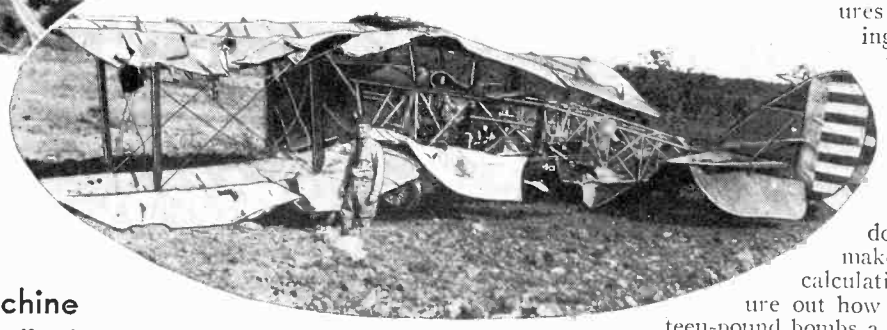
So that no delay is occasioned in commercial service, mail is loaded into the boat from passing steamers, and unloaded into them, while the freighter maintains her normal rate of speed. The mail freighter whistles her approach. All letters and packages to be delivered are hoisted to the deck of the post office steamer by means of small buckets. The mail is assorted in the floating station's office, in very much the same way as it would be in any other post office station. The stamps are cancelled with the inscription "Detroit River Station."

When a steamer approaches for which there is mail from home it is signalled, and the bucket containing its mail is hoisted to its deck for distribution among the crew and passengers. The post office boat also serves house boats anchored along the shore. This traveling river station brings to mind the branches of the United States Post Office on our huge ocean liners.

Obsolete Planes as Bomb Targets

ONE of the most effective methods of attack open to an airplane, as an offensive weapon in wartime, is by dropping high explosive bombs from the skies. Peace-time preparation for such operations necessarily entails much practice, which practice should be as nearly realistic a reproduction of actual war conditions as possible. At Camp Stanley, near San Antonio, Texas, U. S. bombing planes recently used eighteen obsolete and condemned airplanes as ground targets, thus simulating an enemy aerodrome. The destructive force of the 17-pound bombs which were used can be clearly seen from the accompanying illustrations. On the extreme left of the upper photos can be seen three planes in the centre of impacts due to direct hits, while at the right a plane can be seen burning as the result of a hit.

We do not bother you with facts and figures but according to the latest reports some Army bombers can carry a burden of 4,000 pounds. You don't have to make very many calculations to figure out how many seventeen-pound bombs a plane of this type can handle.



Above — Eighteen obsolete planes arranged to simulate an enemy airdrome, being bombed from the air at Camp Stanley.

Right—One of the planes after the practice bombardment with 17-pound bombs.

Shuffle-and-Deal Machine

A MACHINE that will shuffle the pack and deal four hands of bridge in twenty seconds has been invented by L. A. Lux, of Cleveland, Ohio. When Lux recently showed his invention to newspapermen it was announced that the machine would shortly be manufactured by the thousands. It was invented to eliminate the greatest time-waster for serious-minded bridge players, which is shuffling and dealing. The inventor has been working on the machine for two years, ever since a guest at a card party challenged him to invent a machine to do away with the nuisance of shuffling and dealing cards. It is the first card shuffler ever successfully patented in the United States. The pack of cards is placed on a small form between a spring and a pair of rollers. The dealer turns a small crank and the cards are whisked into four separate compartments. In spite of the ingenuity of this device, we venture to think that ordinary bridge players (not so serious-minded perhaps) will prefer the old-fashioned method.

Talking Film Records Film Contract

THIS photograph was taken when Mary Lewis, Metropolitan Opera star, signed a contract with Pathé Films to appear in a motion picture for them. With her is E. B. Deer. The ceremony was recorded by sound and camera, instead of by the usual method of a written contract, and the sound film is now the basis of Miss Lewis' suit against the film company in which she asks $22,500, claiming she was to have received $25,000 for the picture. She further states she received but $2,500 before studio officials refused to make the picture. Certainly a novel way of settling a contract and one which should prove conclusively one way or the other just what the parties meant.

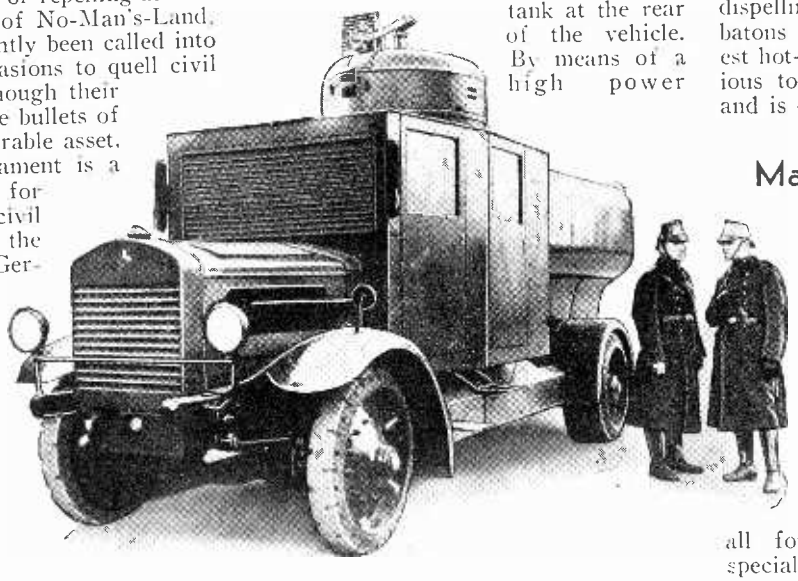
Giant Stabilizers to Steady Big Liner

ACCORDING to a recent announcement, the new 45,000 ton Lloyd Sabaudo liner "Conte Grande," now under construction at Trieste, will not only be as luxurious as a modern hotel but practically as free from uncomfortable motion by virtue of a set of immense gyroscopic stabilizers. So far, such stabilizers have not been fitted to vessels exceeding 10,000 tons. The "Conte Grande's" stabilizers will cost approximately $1,000,000, and will consist of three giant wheels weighing 100 tons each, and measuring thirty feet in diameter. These will be supplied by the Sperry Gyroscope Company. The new liner will be ready in the Fall of 1932. It will be put into operation immediately.

A photograph of an unusual method of "signing" a film contract wherein, instead of a written contract, the agreement was recorded by talking film. Miss Mary Lewis, Metropolitan Opera star, is seen shaking hands with E. B. Derr.

German Police Tank Spouts Water to Cool Hot-Heads

ORIGINALLY designed during the World War as an impregnable and morale-wrecking method of attacking infantry in trenches, or repelling attacks in the open ground of No-Man's-Land, tanks have subsequently been called into action on many occasions to quell civil disorders. But, although their impregnability to the bullets of small arms is a desirable asset, their offensive armament is a little too drastic for most occasions of civil disturbance. During the past twelve years Germany has from time to time been called upon to deal with many street disorders, and has evolved for the purpose the special form of tank illustrated here. Like its military prototype, this police tank is bulletproof, but the ugly-looking "gun" in the turret is in reality a fire-hose nozzle which receives its water supply from the large water tank at the rear of the vehicle. By means of a high power pump, water is ejected through the nozzle at high pressure, and this high power stream of water has been found by the German police to be more effective in dispelling unruly crowds that police batons or automatics. Even the wildest hot-head finds it somewhat ignominious to be bowled over and drenched, and is content to run for shelter.



Man to Become Extinct

DR. GEORGE B. CUTTEN, president of Colgate University, said in a recent speech that man will follow the dinosaur into extinction, because he is a "terminal twig" and cannot keep on developing. Man, he says, is over-specialized. One example of over-specialization lies in the fact that he walks upright. If he would avoid appendicitis he must revert to all fours. Another "fault of over-specialization" is that although he knows alcohol is bad for him he wants it to escape from life's realities. Fortunately, Dr. Cutten failed to specify a a date for the extinction of man, so it is unlikely that any sleep will be lost by those he appeals to.

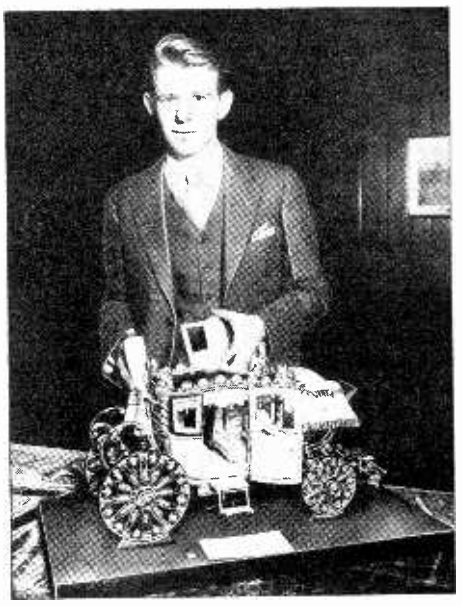
The World's Costliest Miniature Golf Course

HERE is a miniature golf course that ought to make the mouths of all good miniature-golf fans water, and their complexions turn green with envy, for it is said to be the most beautiful and costly in the world. At least, it will satisfy the cravings of all those good Americans who worship superlatives. The photograph shows the Wiltshire Links, which cost over $50,000 to construct. It is located at one of the busiest intersections in the Los Angeles district, on land which is conservatively valued at $350,000 by Mary Pickford, the owner. While the course is patterned after a French modernistic design, it incorporates the latest innovations that tend for sportiness, comfort and convenience. The little links is extremely popular with the citizens of Los Angeles, and Hollywood film stars can often be seen there trying their luck with the putter. Mary Pickford is very fond of the game and is said to be quite expert at it. The hazards are most interesting. Tiny waterholes, bridges and figure "Z" holes add interest to the game. The futuristic trees that dot the course serve as standards for tastefully shaded electric lights which illuminate the links at night. Carefully arranged shrubberies and flowers have added to the reputation of the course, which is considered by many to be the most beautiful of its kind in the world.

If this description fires your imagination and makes you long for a Tom Thumb course of your own, just turn the pages and read our *Make Your Own Miniature Golf Course* article. Obviously the finished product will not be quite as pretentious as Hollywood's biggest and best; but you can have plenty of diversion building it; though it will cost you considerably less than the one pictured here, you'll have loads of fun using it.

New Color Photo Invented

TWO thirty-year-old New York musicians, Leopold Mannes and Leo Godowsky, are reported to have discovered several new processes for the accomplishment of color photography, after fifteen years of research and experimentation. These processes are said to be as simple as those involved in taking of monochrome pictures. No details of the processes are available at present, for it is reported that control of the young inventors' interests has been acquired by the Eastman Kodak Company.



Model of Napoleon's Coach

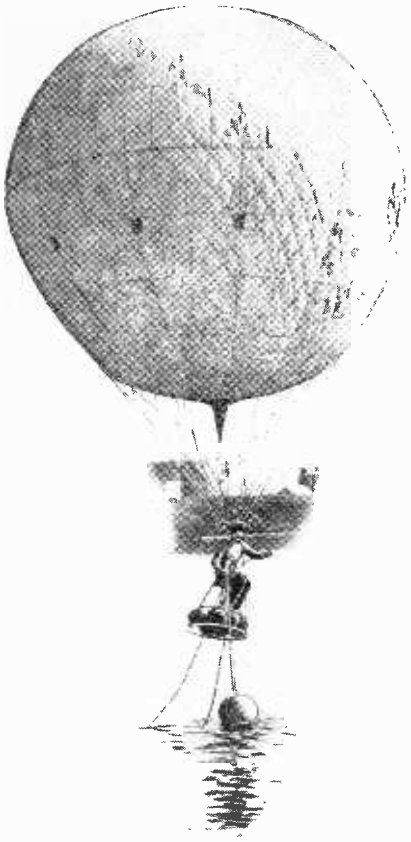
SHOWN above is a detailed model of Napoleonic coach which was placed on display at the Central Y.M.C.A. St. Louis, as a model to be copied by boys from all over the country, who will compete for the four university scholarships and 980 other prizes offered for the best models. In the photograph is shown Joseph Ehrhardt who, because of his skill as a model builder, is looked upon as a probable winner. The wealth of detail in a model such as this calls for considerable patience and skill on the part of the builder.

Balloon Bouncing—A New Means of Transportation

LITTLE things such as a six-story building, an overgrown hill, or an occasional canal shouldn't impede your progress or block your way if you use the balloon equipment which has been perfected by A. F. Godefroy.

Walking over the water is child's play to Herbert McFall, who is shown operating the novel contraption. He is holding a long stick to the lower end of which a balloon is attached. This is used as a boat hook to push off from whatever objects the balloonist may approach in his travels. As the photo shows, he is seated quite comfortably in a chair suspended from the huge bag. A more convenient basket, equipped with easy chairs and lounging robes, might be provided for more fastidious and critical users.

Despite our vivid imagination we don't seem to be able to conjure up pictures of even our fad-loving population hopping about like fleas; floating breezily through the air, and touching Mother Earth only long enough to be able to bounce off into the air again. Of course we are hopelessly Mid-Victorian and cannot seem to resign ourselves to the inevitable conclusion that times and customs will change.



New Zeppelin Costly

EACH filling with helium of the new super-Zeppelin, for which a special hangar was constructed in Friedrichshafen will cost about $100,000, according to Dr. Hugo Eckener. He estimates that the cost of the new dirigible, expected to be ready by the end of 1932, will be forty marks, (about $9.50) per cubic meter. Dr. Eckener added that he is convinced that crude oil motors will have been sufficiently improved to make their use feasible before the airship is ready!

During the winter the Graff Zeppelin will be completely overhauled so that it will be ready to resume activities in the spring. We understand that the proposed airship line to South America cannot be considered at present because of lack of capital.

Amplifying Violin Sounds

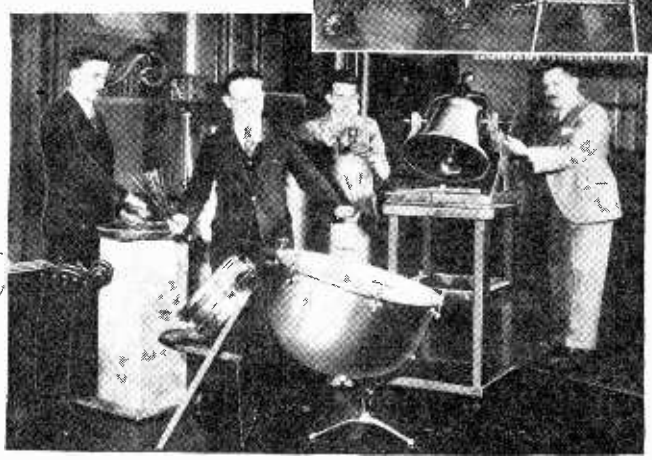
THE high sweet notes of the violin, whose true production only a virtuoso is able to master, cannot be heard at a distance. Too often the audiences that crowd the theaters to listen to a great violinist are disappointed because the most interesting part of the performance is lost to them.

To obviate this difficulty, a violin of unique design and remarkable power has been constructed. The instrument has a special attachment in the form of a microphone coupled with an amplifier whereby the intensity of the vibration and the tone resonance are amplified, giving the instrument a far greater volume than that of the ordinary violin.—*G. F. Paul.*

Madame Hansen, one of the leading violinists appearing on the Parisian stage, for whose use the new violin was designed.

A drum plus an ingenious arrangement of straps attached to an electric fan and the radio audience hears a plane landing.

Four men in a far-off studio manipulate several instruments—you hear a steam engine getting under way.



Realistic Radio Rows

THE ever critical radio audience in its demands for programs which will be realistic has brought into being a new profession—Sound Effects Engineering. The man who aspires to the degree of D.S.E.E. must be able to simulate the sounds of trains, frying eggs, football games, tap-dancing, traffic, waterfalls, wind storms, mobs, spooks, stampeding cattle, cart wheels and what have you, for the microphone.

To the left is an impressive array of instruments—some would find place in any orthodox band; others are not so productive of sweet music. One man releases jets of compressed air from a carboy. Another revolves the little truck on its circular track mounted on a resonant sounding board. A third manipulates wire brushes on the drums. A fourth pulls the bell cord and blows the whistle. Result—

Folks miles away think they are listening to the sound of a giant locomotive starting on its way. The rush of steam, the pound of piston rods, the groans of the mighty engine sound in their ears. The orchestra augments these sounds with music until the imaginary train fades away in the distance. In the photo above an arrangement of comparatively simple apparatus is used to simulate a landing plane.—*G. F. Paul.*

Twin-Tailed French Air Liner Carries 28 Passengers

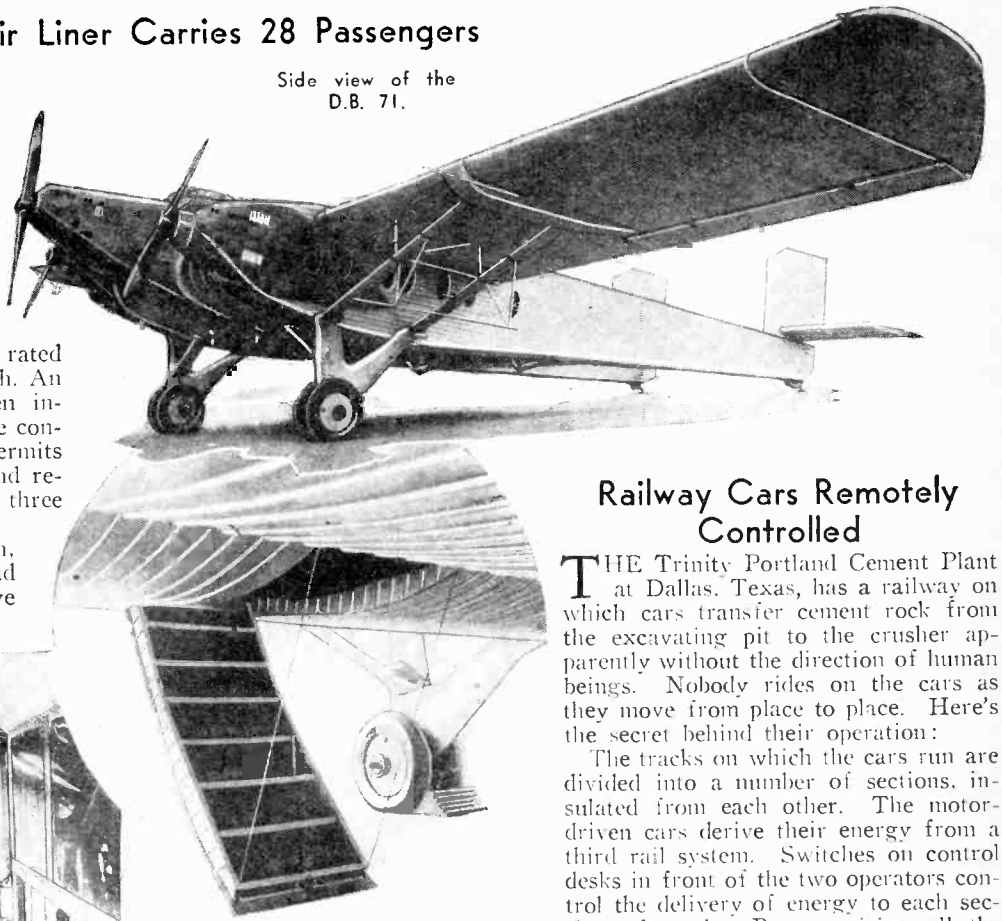
THE French, who have always been well to the fore in aviation developments have recently placed in regular service a new type of airplane.

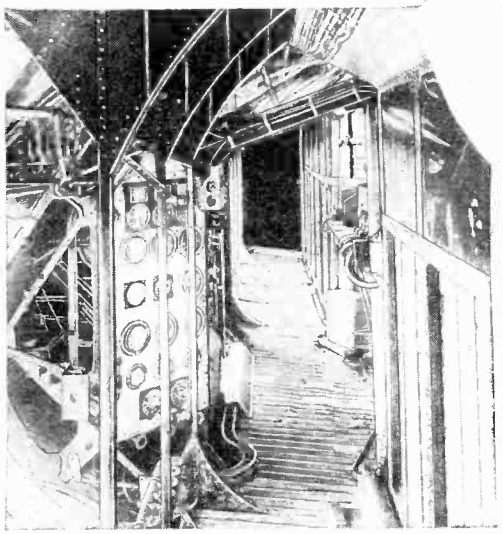
Entrance to this unusual craft is made through a trap door in the under surface which leads directly into the interior of the ship. In flight the trap is, of course, closed. The power plant includes three "Lorraine" engines, rated at seven hundred horse power each. An additional safety factor has been incorporated in this ship through the construction of a cat-walk which permits machinists to regularly inspect and repair, if necessary, any or all of the three motors while in flight.

Over all dimensions are: width, one hundred and twenty-one and three-eighths feet, length, sixty-five and one-half feet; height, nineteen and three-quarters feet.—Big enough?

We can't help feeling that one development such as this does more to advance the cause of aviation than a dozen of the foolhardy stunting shows which are so popular.

Side view of the D.B. 71.





The cat-walk from which the mechanics can reach any one of the three motors for inspection or repairing during flight. Center—The trap door, which is an integral part of the plane, is lowered upon landing, it then becomes a ladder for convenient exit or entrance.

Railway Cars Remotely Controlled

THE Trinity Portland Cement Plant at Dallas, Texas, has a railway on which cars transfer cement rock from the excavating pit to the crusher apparently without the direction of human beings. Nobody rides on the cars as they move from place to place. Here's the secret behind their operation:

The tracks on which the cars run are divided into a number of sections, insulated from each other. The motor-driven cars derive their energy from a third rail system. Switches on control desks in front of the two operators control the delivery of energy to each section of track. By energizing all the sections, a car runs from one end of the track to the other. By energizing one section only, the car runs through that section to the next. The energy supply being cut off there, the brakes automatically set and stop the car. The direction of travel can be changed as simply as the current can be turned on or off—merely by throwing a switch.

African Sandstorm Rains Mud on Paris

WE are quite resigned to rain even if it is disagreeable at times. But the good people of Paris were justly surprised and indignant when they discovered, during a recent shower, that their hats and coats were being spotted by the rain and that each drop brought with it a small desposit of red brown sand.

As the rain fell, the sidewalks were covered with slime, and even hours later courtyards were covered with a fine layer of dust. Strange enough, some parts of the city received a thicker coating than others.

An examination is being made into the cause of the phenomenon. It is believed that it may have been due to a sandstorm in North Africa, or that the sand grains were of astral origin.

Two hours before the storm reached Paris a similar muddy rain had fallen at Etanapes, thirty miles south.

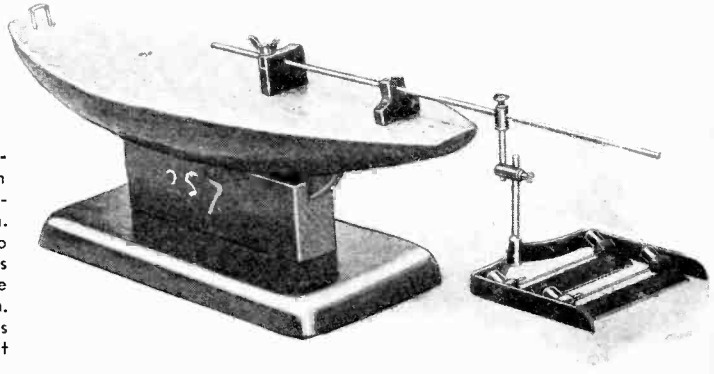
A Boat Driven by Wave Action

SINCE man was first fortunate enough to dominate our earth and rule supreme, he has sought ways and means of having his work done without undue expenditure of his own efforts.

Quite in line is the wave-propelled boat, a model of which has been placed on view at the International Inventions Exhibition held in London. The ship, which has a sail boat hull, is equipped with a pair of vanes fitted below the water line. As the boat rises and falls with the rocking motion of the waves, it is claimed that the water pressing against the vanes will push the boat along.

Usually the master mariner is only too glad when he has fair weather in store for a long trip. However, the captain of this boat will have to pray for a storm-tossed, wind-lashed sea to furnish the motive power for his extraordinary craft. Otherwise his boat will be becalmed.

In days gone by a king named Canute bade the waves go play on somebody's else's beach. The modern version will reverse this command and beg the angry waters to carry a ship into harbor.



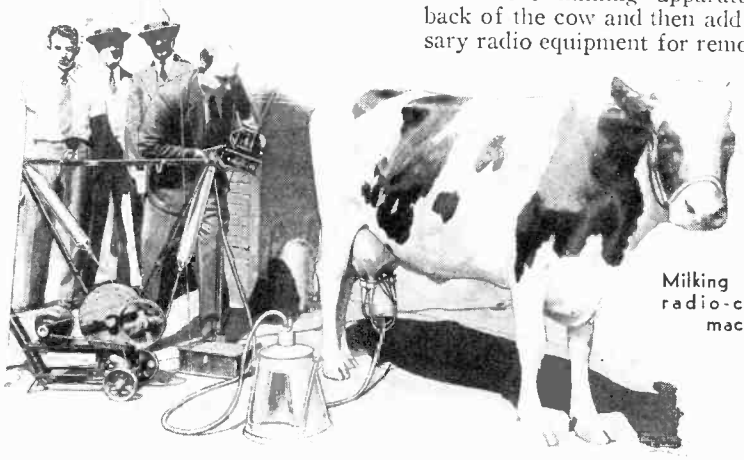
Model of wave-propelled boat which was placed on exhibition in London. As the boat rises to the waves the vanes will occupy the position as shown. When the boat dips the vanes will point upward.

Running Street Cars and Milking Cows by Radio

To the left is a close-up of a street car being controlled by radio transmitter held in the hand of Maurice J. Francill, the key being operated by Victor Miller, Mayor of St. Louis. Note receiving apparatus mounted on the front of the car.

PRESSING a small radio transmitter into service for milking a Holstein cow at a distance of several hundred feet is a stunt developed by Maurice J. Francill, a radio engineer. In his hands Francill holds a transmitter of the ordinary spark type, a 4½-foot antenna, the batteries and key. The milking apparatus is fitted with a receiver. Whenever the key is operated a stream of milk can be seen pouring into the bucket.

We presume the next stage will be to mount the milking apparatus on the back of the cow and then add the necessary radio equipment for remote control.



Milking a cow by radio-controlled machinery.

SOME time ago the readers of SCIENCE & INVENTION Magazine were made familiar with an apparatus that would mysteriously cause a hand to rap out messages, a bell to ring, or a drum to roll, by means of a small radio transmitter strapped to the back of the performer. More recently, a similar specialized apparatus has been put to greater use.

Not so long ago in St. Louis, Mo., a regulation street-car was operated on the streets without a motorman occupying his place in the cab. This stunt was a curtain-raiser for the Radio Show in St. Louis.

Using Crude Oil to Operate Motor Cars

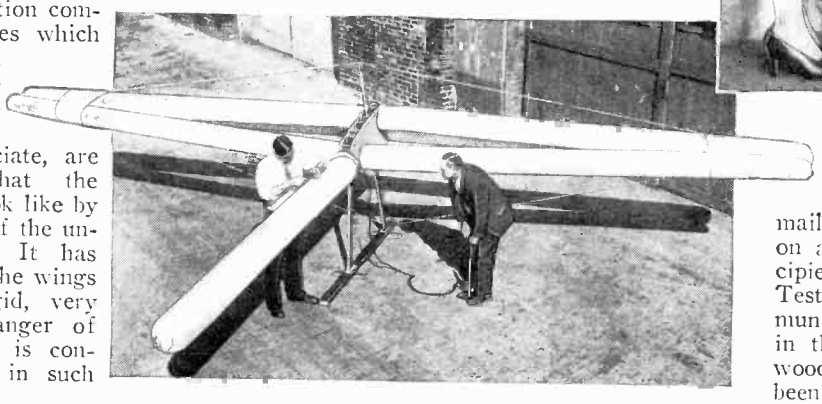
REPORTS have been circulated in this country and abroad of the invention of devices that will make ordinary crude oil applicable as a substitute for gasoline. And yet, the products rarely find their way to the market. One often questions the efficiency of the constructions or whether they are actually what they claim to be.

A recent invention, belonging to this class, has been made by a mechanic named Reichenbach, of Cassel, Germany, who, it is reported, has developed a device of extremely small size that can be inserted between the carburetor and intake valves of any automobile motor to permit the use of crude oil instead of gasoline, at a saving, according to the inventor, of fifty per cent of the fuel cost. The item itself would cost about $25.00 to install.

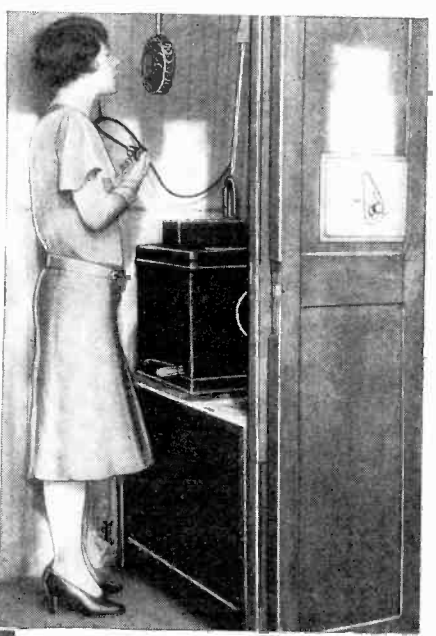
The invention consists of a duplex vaporization system. Vaporized petroleum from the carburetor, passes it through a nozzle into a chamber where a turbine-like propeller kept in motion by the suction of the cylinders above it, is said to completely atomize the oil and reduce it to such a fine state that it can be effectively used to operate ordinary combustion engines and deliver satisfactory power.

An Airplane with Rubber, Inflatable Wings

WHAT may prove to be a most radical change in airplane wings, is the device invented and designed by Taylor MacDaniel, of Washington, D. C. Mr. MacDaniel has conceived a rubber airplane, the wings, body and tail structure being made of extremely light canvas that has been rubberized. The construction comprises several tubes which are inflated with air. In the photograph Mr. MacDaniel and C. E. Phillips, his associate, are demonstrating what the structure might look like by giving us a view of the unfinished product. It has been claimed that the wings are extremely rigid, very light, and that danger of accidental damage is considerably lessened in such an airplane. Whether or not the device proves practical will be shown by the numerous tests which the inventor intends to make. We presume that pilots will have to equip themselves with rubber patches in case of accidental leakage, which would cause the plane to collapse.



Have Your Voice Canned to Order



FOR twenty-five cents one can now talk a letter. The record produced by the machine can be mailed to its destination and put on a phonograph, where the recipient can hear your very words. Tests of the new method of communication are being made now in the Gillette Studio in Hollywood. Street booths have also been installed in this city.

This Is Koenigswusterhausen

One of Germany's Radio Giants

YES, the name of this radio station certainly is a bit of a mouthful, but so is the station itself, for it contains practically every known radio communication device and is the centre of a vast communication and broadcasting network which covers the entire world and employs many wavelengths extending over the entire radio frequency spectrum.

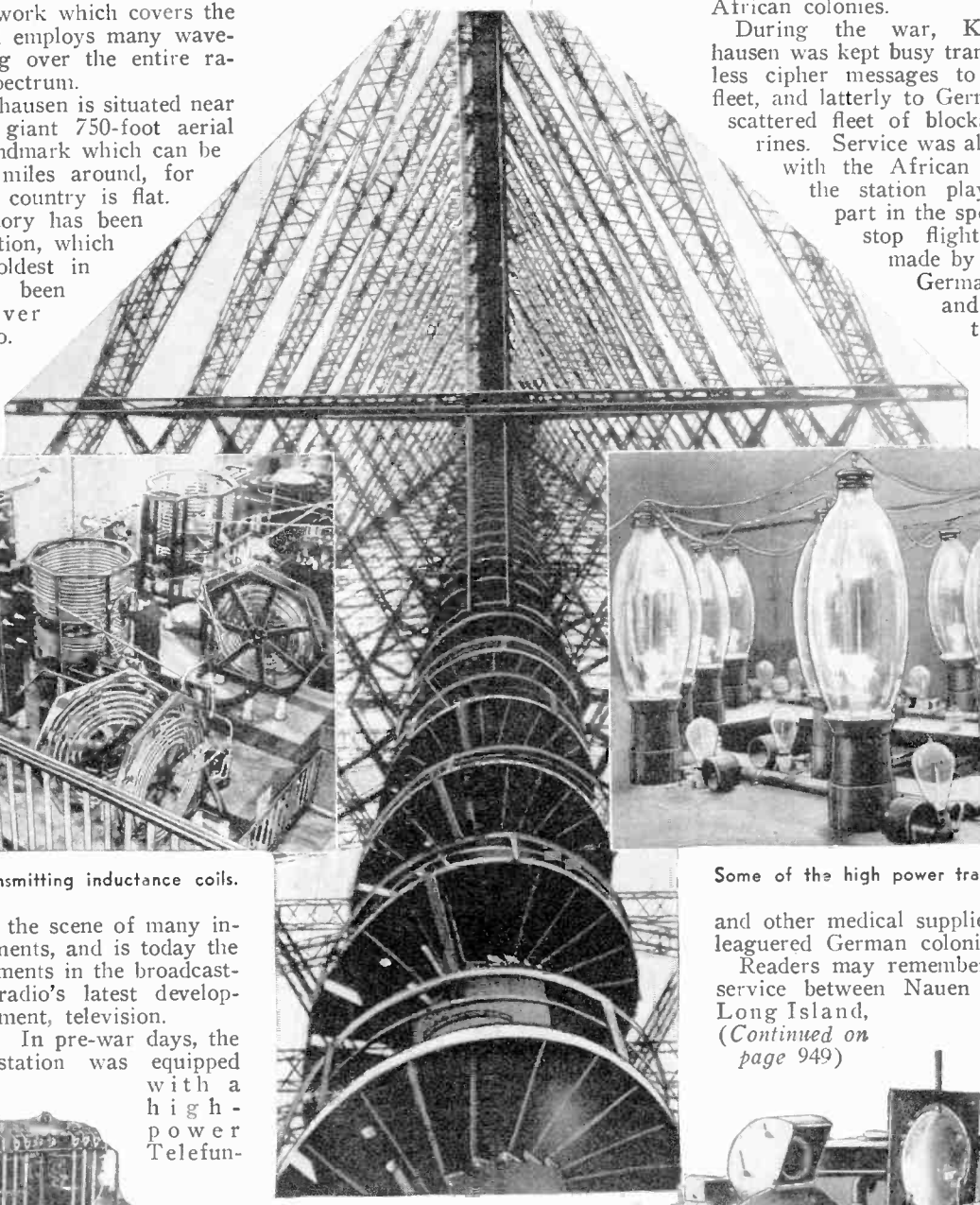
Koenigswusterhausen is situated near Berlin, and its giant 750-foot aerial masts form a landmark which can be seen for many miles around, for the surrounding country is flat. Much radio history has been made by the station, which is one of the oldest in Europe, having been established over twenty years ago. Throughout its history, Koenigswusterhausen has been the scene of many interesting experiments, and is today the centre of experiments in the broadcasting of radio's latest development, television.

In pre-war days, the station was equipped with a high-power Telefunken quenched spark transmitter, operating on a wavelength of approximately 4,000 metres, and was used largely for the transmission of time signals, weather reports, and news bulletins, sharing in this service with its nearby sister station, Nauen. It was also used, together with Nauen, as one of the links of a wireless telegraph service which the Germans were at that time endeavoring to establish with their African colonies.

During the war, Koenigswusterhausen was kept busy transmitting endless cipher messages to the German fleet, and latterly to Germany's widely scattered fleet of blockading submarines. Service was also maintained with the African colonies, and the station played a useful part in the spectacular non-stop flight which was made by a Zeppelin to German East Africa and back, when the airship dropped sorely needed quinine and other medical supplies for the beleaguered German colonists.

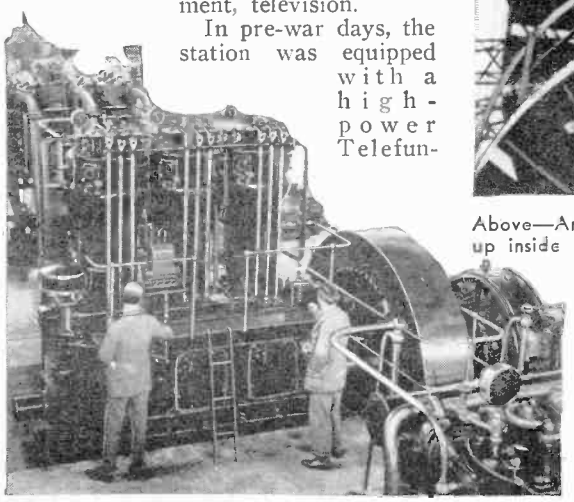
Readers may remember the wireless service between Nauen and Sayville, Long Island,

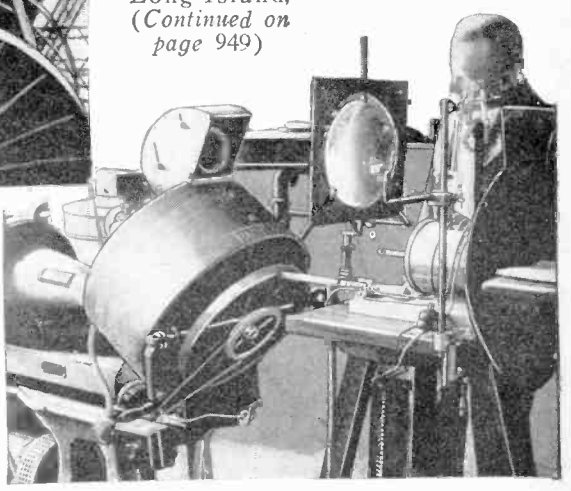
(*Continued on page 949*)



A few of the transmitting inductance coils.

Some of the high power transmitting tubes.





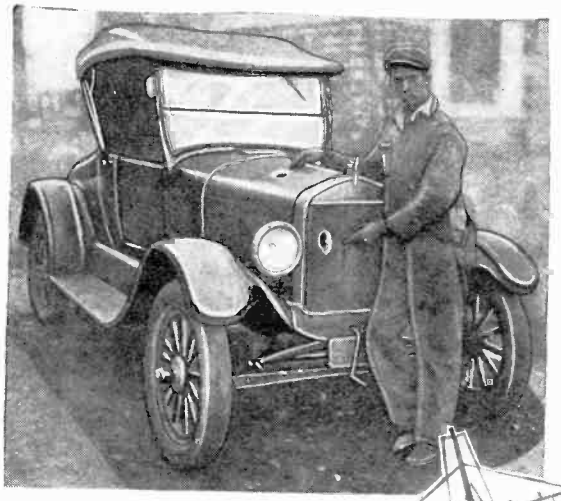
Above—An unusual view looking up inside one of Koenigswusterhausen's 750-foot aerial masts. A spiral staircase runs up to the top. Left — a small section of the station's generating plant, which employs Diesel motors as prime movers. Right — An experimental television transmitter.

Would You Believe It?

A Ten-Pound Bowl

ALTHOUGH this bowl is considerably larger in diameter than the height of the man, it is nevertheless extremely light in weight. The bowl has been constructed in Berlin, Germany, and tips the scales at less than ten pounds. It is aluminum.

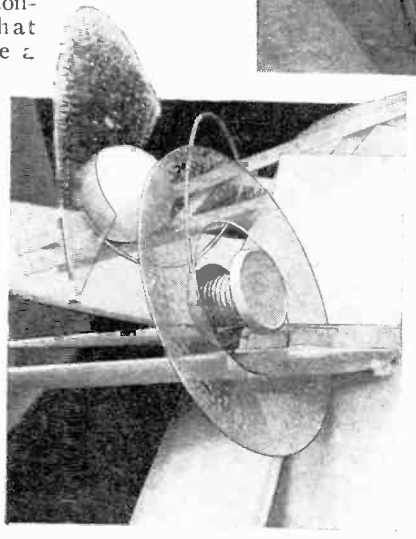
Meteor Misses Motorist by Fourteen Inches



DRIVING at the rate of 25 miles an hour on an Indiana highway, Lawrence Swank, a 17 year old filling station attendant, was terrified by a buzzing sound followed by the loud report like the noise of a shot-gun exploding next to his ear. This was accompanied by a flash of light. Examination proved that a meteor had missed his head by about fourteen inches.

What Is It?

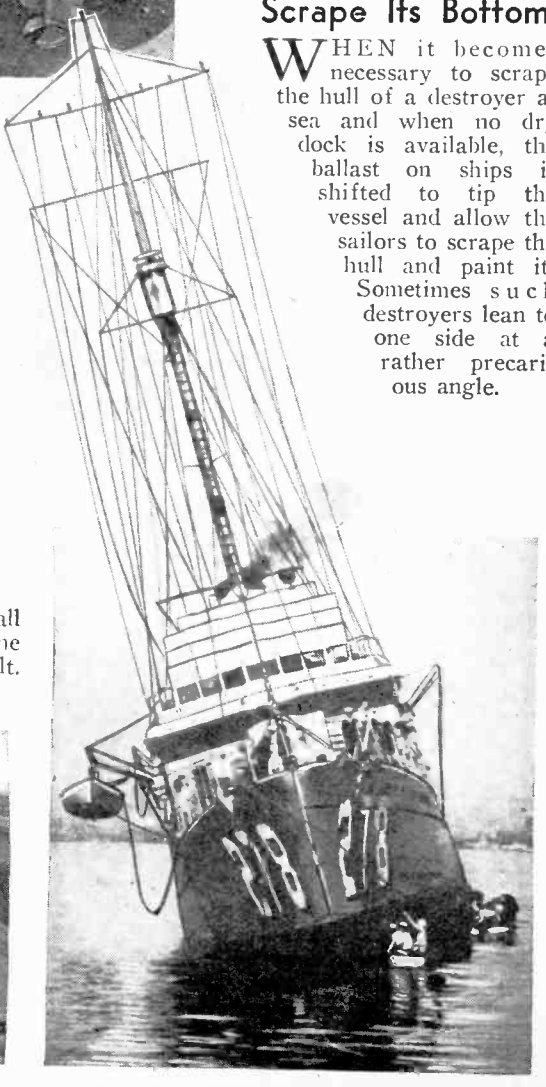
THIS weird construction that seems to resemble a close-up of a modernistic representation of a planetary system is in reality a device to permit of a composition of colors in an arbitrary rhythm and thus produce what has been characterized as color music. It is anticipated that combinations heretofore impossible can be produced by it.



We will pay five dollars for every photograph accepted and published on this page. Address, Editor, SCIENCE & INVENTION.

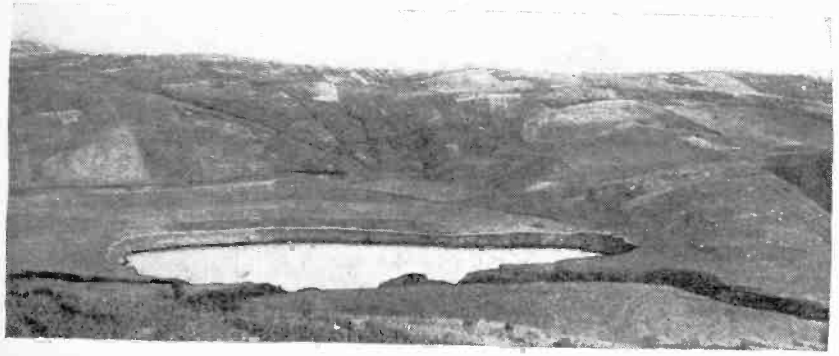
Tipping Boat to Scrape Its Bottom

WHEN it becomes necessary to scrape the hull of a destroyer at sea and when no dry dock is available, the ballast on ships is shifted to tip the vessel and allow the sailors to scrape the hull and paint it. Sometimes such destroyers lean to one side at a rather precarious angle.



Italy Has Disappearing Lake

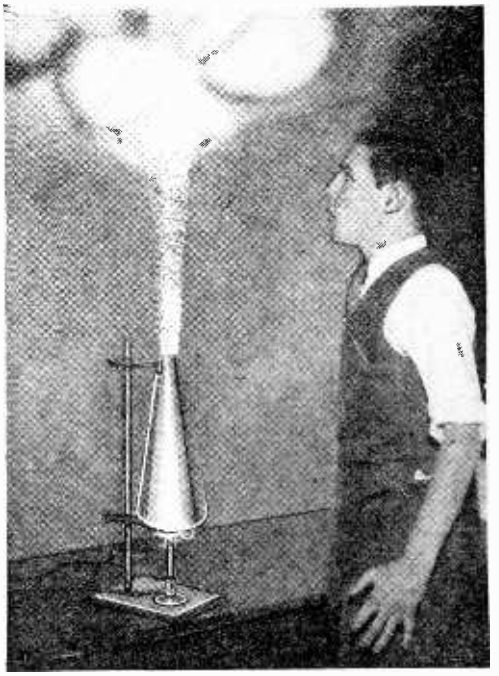
ABOUT 18 miles from Rome, near the city of Leprignano, a small stream terminated in a deep little lake. On the 8th of October the lake disappeared entirely. At the same time, a light earth tremor was felt. Twenty-four hours later, the water rushed back.



Simple Heat Experiments

You Can Stretch Iron, Wire, a Thin Bar of Copper, or a Steel Rail Without Pulling at Either End. Water Below Freezing Point Doesn't Turn to Ice. A Realistic Geyser Can Be Made In Your Own Home. Here's How

By Eugene W. Blank



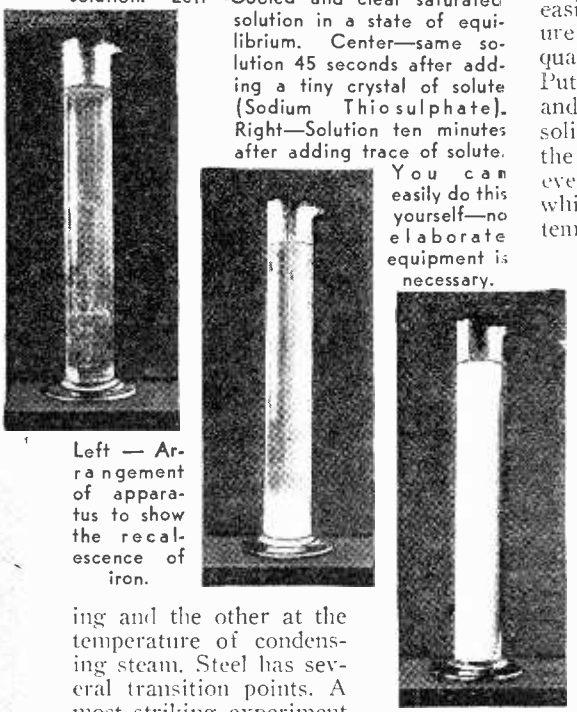
This geyser is as regular as "Old Faithful."

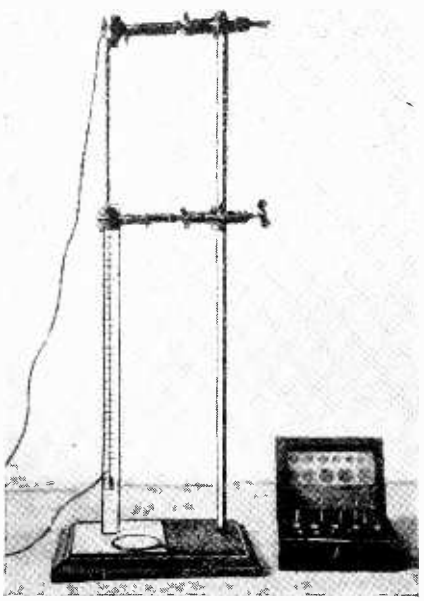
THE mighty power developed by steam engines; the extraordinary force which freezing water exerts against containing walls; the allowances for expansion which engineers must incorporate in structures; the disconcerting cracking of glassware while being washed,—all are either practical applications or examples of the tremendous reactions set up in materials by difference of temperature.

If heat is withdrawn from a mass of steam, the temperature will immediately fall until a certain temperature is reached. At this latter temperature all the steam will gradually condense without any change of temperature taking place. If heat is further abstracted from the water the temperature will drop until another certain temperature is reached. At this temperature the water will gradually solidify, without change of temperature, until the water is completely frozen.

The phenomena of the evolution or absorption of heat without a resulting change of temperature is called a transition. The temperature at which the change takes place is known as transition point. At a transition point a substance either absorbs or liberates heat, changes in state from solid to liquid, liquid to gas, or the crystalline structure of the substance may change. Water, as has been shown, has two such transition points, one at the temperature of freezing and the other at the temperature of condensing steam. Steel has several transition points. A most striking experiment is to stretch an iron wire as shown in the lower left hand illustration. On passing an electric current the wire expands and sags. When the circuit is broken the wire cools and contracts, slowly lifting the pointer attached to the wire. At a certain temperature it pauses for a brief interval and then suddenly lengthens again. This momentary expansion is due to the evolution of heat as the iron passes through a transition point. Movements of the wire may readily be followed by knotting a tiny bead in the wire and placing a graduated scale behind the bead.

Three stages in the evolution of a saturated solution. Left—Cooled and clear saturated solution in a state of equilibrium. Center—same solution 45 seconds after adding a tiny crystal of solute (Sodium Thiosulphate). Right—Solution ten minutes after adding trace of solute. You can easily do this yourself—no elaborate equipment is necessary.





Left — Arrangement of apparatus to show the recalescence of iron.

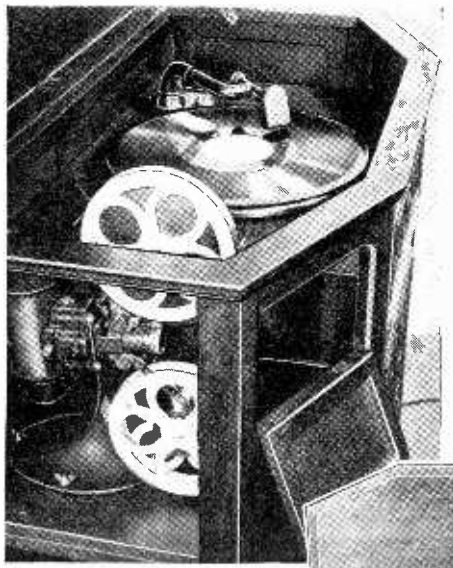
The transition points of steel depend on the carbon content; at the transition points occur various physical changes in hardness, structure and fineness of grain of the steel.

The experimenter may investigate the properties of a transition point very easily and derive considerable pleasure from the experiment. Place a small quantity of acetamide in a test tube. Put the tube in a beaker filled with water and slowly heat the water until the solid melts to a clear liquid. Remove the burner and note the temperature every minute. Note the temperature at which the salt crystallizes. Plot time and temperature on graph paper. A typical curve is shown in the illustration. The sloping curve from A to B represents the cooling of the substance in the liquid state. The short vertical rise B to C represents heat evolutions during the crystallization of the salt. The practically horizontal line C to D represents the cooling of the substance in the solid state. The lower portion of the curve AB represents a condition known as subcooling.

Subcooling or undercooling may be explained by saying that a liquid not in contact with any of the solid substance can be cooled below the melting point without solidifying. By very gradually cooling air-free water the temperature can be reduced to —16 degrees Centigrade before freezing occurs. But when solidification does take place it is extremely rapid.

The experimenter may make up a hot saturated solution of sodium thiosulphate or hypo, as it is more commonly called, and allow it to slowly cool. The solution will remain brilliant and clear though it contains more dissolved salt than normal for the temperature. But on the addition of a speck of the salt no larger than a pin head, solidification will immediately take place with extreme rapidity. (*Continued on page* 925)

What's New in Radio



The Filmophone Radio

AND now comes the last word in home entertainment! Home talkies, home movies, the radio, and the phonograph are all made available in one handsome combination instrument, the Filmophone-Radio, just announced by the Bell & Howell Company, Chicago.

A Bell & Howell Filmo movie projector, utilizing regular 16 mm. home movie size film, is used for the pictures, and a Howard chassis is the basis of the radio feature—two products famed for quality in their respective fields. A phonograph motor is so arranged that the turntable can be operated at either the standard speed for ordinary phonograph records or thirty-three and a third revolutions per minute when the records for the sound pictures are played.

The flexibility of the new combination instrument is such that talkies and also movies without sound can be projected. Again, the pictures may be shown with radio or phonograph musical accompaniments not synchronized with the film. Also, of course, the radio or phonograph is available each by itself if desired.

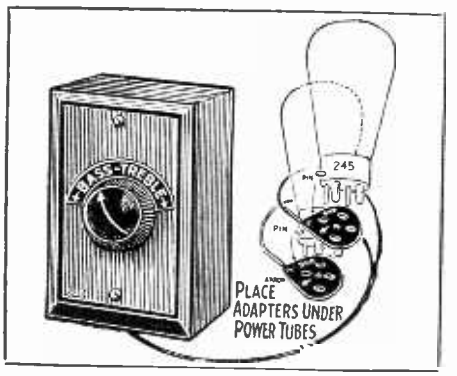
A large number of home talkie subjects can now be secured from photographic dealers. Among these are the always amusing "Felix the Cat" cartoons as well as numerous other entertaining and instructional features, including many of the famous UFA educational sound pictures. It was the growing size of this list of available sound movies that led logically to the development and announcement of the Filmophone-Radio.

Radio and phonograph combinations have already been worked out satisfactorily but the additional problems involved in balancing the other units with the movie projector have not previously been so successfully solved until this instrument was evolved.

Such a combination will unquestionably present the opportunity of entertaining the most critical home audiences. Here is a combination of quality, variety, and novelty, to say nothing of unlimited material from which to draw.

Combination installations of this order are suggestive of the day when television will be added also.

Internal and external views of the new Filmophone-Radio

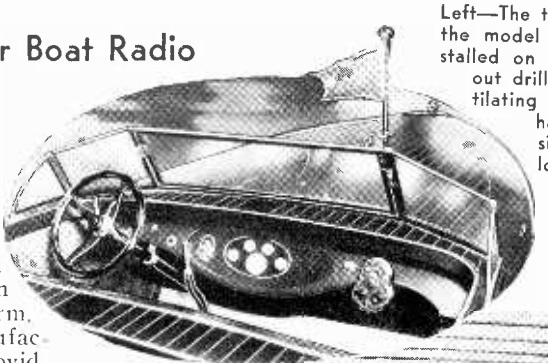


Bud Tone Control

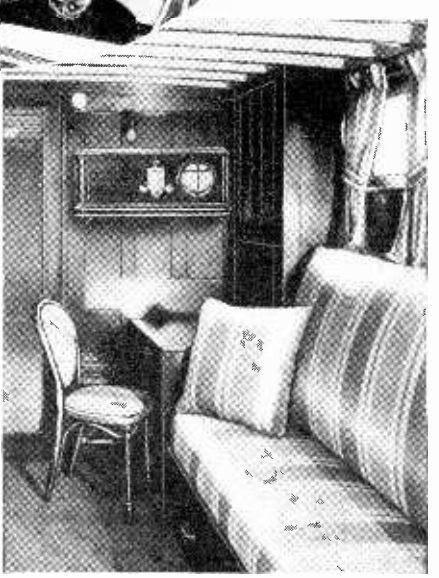
THE latest fad in the 1931 radio sets is tone control. This is perhaps by way of being an admission on the part of set manufacturers that the reproduction of their sets is not quite 100% perfect. Or perhaps it is an acknowledgement of the fact that no two people can agree on what is and what is not perfect reproduction. Anyway, without tone control, your set is not up-to-date. You really ought to have that extra knob to turn, so that you can make your loud speaker sound deep and mellow or high and thin, at will. If your set is an old one you can bring it bang up-to-date by fitting the device illustrated above. All that is necessary is to place the adaptors (which are suspended from the bakelite box) under the two power tubes in your radio set, and then set the Bud Tone Control (which is supplied with a long lead) in any position where it can be easily reached while listening to a broadcast program.

Motor Boat Radio

WE have become accustomed, these days, to taking the radio with us everywhere. At first we had to take it in portable form. Now set manufacturers are providing us with sets for every conceivable purpose and location. Radio sets are built into our automobiles, with controls mounted on the dash, and now we are being provided with sets for our motor boats. The accompanying two illustrations show the latest models produced by the American Bosch Magneto Corp. These sets, we are told, are not an adaptation of household radio, but are specially designed and constructed throughout for seagoing service. The material used has been treated to resist the effects of moisture and salt air, and all internal units are firmly assembled to withstand the continual vibration and motion of motor boat service. Careful shielding is employed, and interference suppressors are furnished for use on the motor ignition equipment. Two models are made, one a cabinet model for cabin use, and an independent chassis model for runabouts.



Left—The tuning control unit of the model for runabouts is installed on the dashboard without drilling or otherwise mutilating the panel. The unit has an illuminated dial, single station selector, lock switch and volume control.

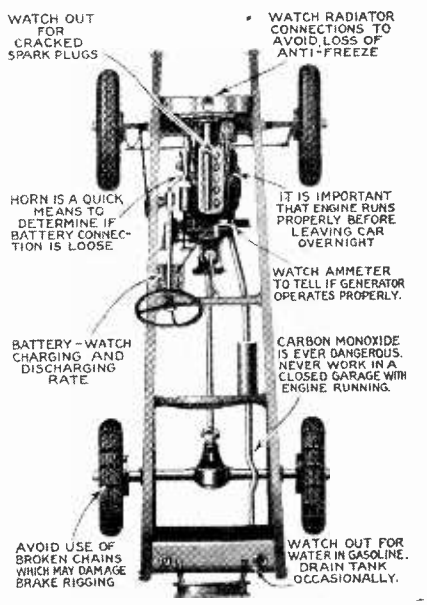


This compact radio set for a cabin cruiser is bolted on the bulkhead.

Taking Care of Your Car

Do You Want Your Car to Function Smoothly During the Cold Spell? Then Take Advantage of the Following Suggestions

By Arthur George
Consulting Engineer

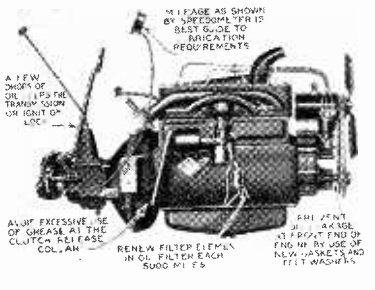


Check up on your car, using the points outlined above as the basis.

WHEN the temperature drops and your garage is too cold to work in comfortably, your car is likely to suffer from neglect. Those parts of your car which require extra care are indicated in the illustrations. If you do not attend to them, some morning your engine may refuse to start and it may cost a good deal to repair the damage. The battery is another source of trouble, quite often. The charging and discharging rate, as noted by the ammeter, is a good indication of its efficiency. The rate is usually too high in the winter and, if this condition is not corrected in time, it will result in buckled plates and a useless battery. Make sure that your engine runs smoothly and evenly when the car is put up at night; or starting cold next day will prove quite difficult. And whatever else you forget, bear in mind that the carbon monoxide generated by your engine is a deadly poison gas. Regardless of how cold it may be, never work in your garage with both doors and window shut, when the engine is running. The top illustration to the right contains other points worthy of note.

It seems that a clean car defies age; it certainly works better than a dusty one. Just tidy up your car, polish it, and take it out on the road. It will have more pep and ability to cover ground. While most of us know how to clean and wash an auto, many of us ruin the appearance of our cars through the use of strong soaps and excessive rubbing and dry polishing. In the lower right hand illustration the details for the care of the auto body are mentioned. If these are observed, the driver will not only have the satisfaction of operating a well-kept car, but the trade-in value of his automobile will be increased.

You must take care of your tires if you want to obtain the utmost in car service. Don't emulate the man who purchased a set of tires which were guaranteed for 20,000 miles. He was so sure he would get his money's worth that he neglected to test one of the



It's quite essential to know just where to oil the engine and how to prevent leakage.

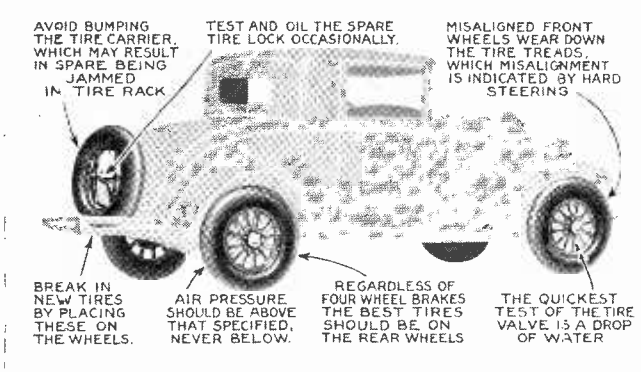
valves after inflating. During a long drive, the tire went flat. Before this was detected, the tire was utterly ruined. If you desire maximum service from your tires, if you do not want to be forced to get under your car to change tires some icy morning, heed the suggestions outlined in the lower left hand illustration.

The periodic oiling of one's car, regardless of the use to which it has been subjected, is not the way to insure the protection which proper oiling provides.

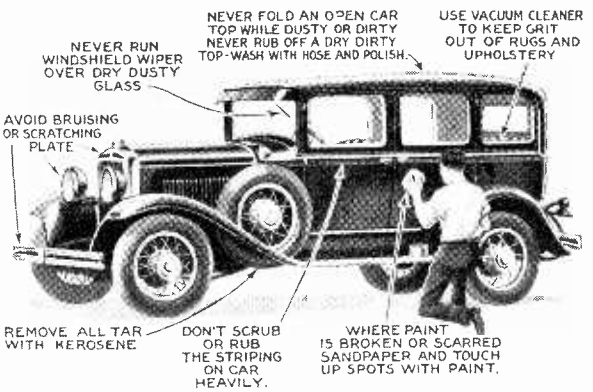
Your car may need an oiling once a week, once a month, once every two or three weeks, or twice a week. When you depend upon the number of miles clocked by the speedometer, you avoid useless oiling and are assured that no parts will go dry. Quite often over-oiling may do as much damage as insufficient oiling.

Citing an example to illustrate this: Recently one of my friends experienced a great deal of trouble with his clutch—it slipped. We found that because of excessive oiling of the clutch thrust ring of his seldom used car, grease penetrated into the clutch plates and caused slipping. Never feel too sure about the oil circulation of your car. While it is true that a motor equipped with an oil filter that has a renewable filter element seldom gives trouble, a long trip may clog the filter. It should be renewed after 5,000 miles of use.

The loss of (*Continued on page* 951)



To keep the tires of your car in satisfactory condition for a long while and save yourself buying new ones frequently, and the equally unpleasant task of changing tires, follow the tips indicated above.



If you use a vacuum cleaner to dust rugs and upholstery, if you touch up all scratched surfaces with paint, and if you are not over-zealous in scrubbing your car, it will retain its well-dressed appearance.

MAGIC

By Hunninger

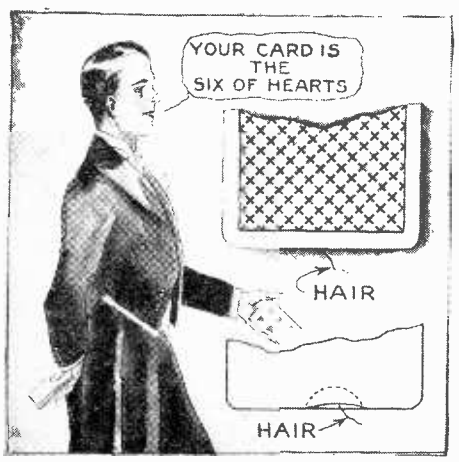
The master mind of modern mystery, who has mystified Ex-presidents Harding, Taft, Roosevelt, Coolidge, the Prince of Wales and other celebrities, presents another of his magic series.

Occult Strength

HERE is a new and impressive magical feat. A Chinaman, during a lull in his magic performance, lifts a small Chinese girl into the air, apparently holding the child by nothing more than a tiny tuft of hair. The secret of the effect lies in the fact that both the girl and the Chinaman wear a harness. The girl's harness has a ring on the back. The man's harness has a hook which engages the ring. While stooping down to grasp the child's hair, the harnesses are deftly coupled and the child is actually lifted and supported by the body of the magician and not by the tuft of hair as he would have us believe.

Digital Dexterity

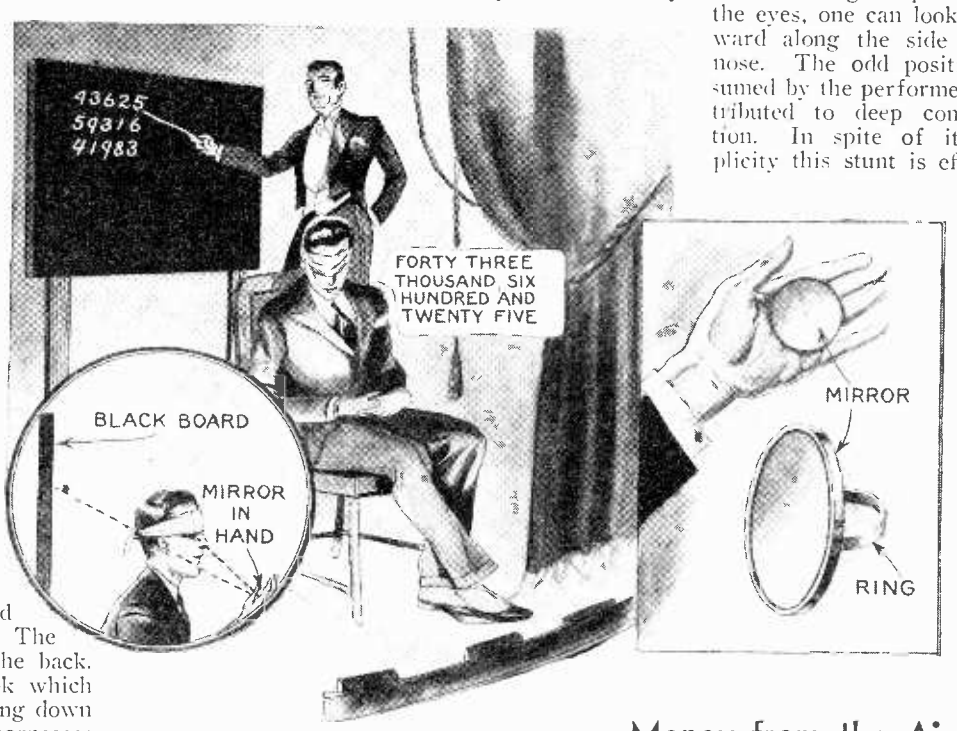
A PLAYING card after having been apparantly freely selected from the deck is noted by the spectator who is then requested to put it back into the deck and thoroughly shuffle the cards. The entire pack is returned to the magician. The wonder-worker explains that after years of dexterous manipulation he has developed a most uncanny sense of touch whereby he can locate a card behind his back by simply feeling the suit. Holding the deck behind him and under pretense of reading the mind of person to discover which card has been selected, the wizard locates it in a few seconds.



Secret: The playing card, which has been forced was secretly treated beforehand. One edge of it was split and a small hair was glued between the layers making location easy.

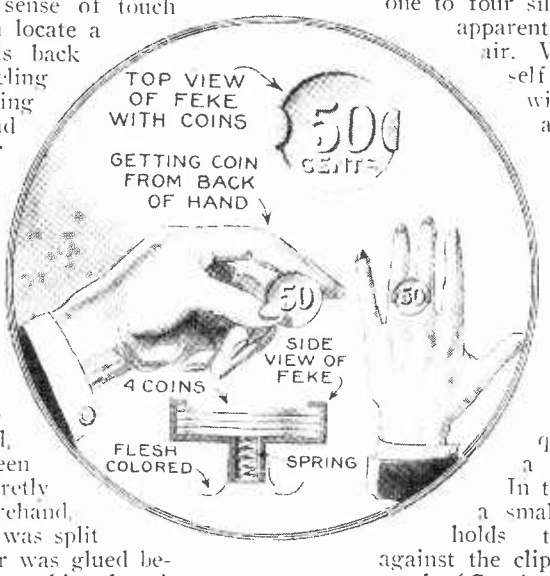
Mystifying Mind Reading Exhibition

THE magician is blindfolded, and made to occupy a chair in front of a large blackboard. Spectators are now asked to come upon the stage and write series of five or more numbers. After they leave the platform the magician's assistant points to any row of figures and the mind reader promptly announces the numbers in order and adds up the total. The effect is produced with the aid of a small hand mirror that has been soldered to a ring. Usually when a bandage is placed over the eyes, one can look downward along the side of the nose. The odd position assumed by the performer is attributed to deep concentration. In spite of its simplicity this stunt is effective.



Money from the Air—Money Everywhere

HERE is a new feke especially adapted for use by the amateur, with which he can produce from one to four silver half dollars, apparently out of the thin air. While the feat itself can be produced without the use of a feke, such a simple device gives an amateur an air of being an expert in manipulation. The illustration describes the feke in detail. It is flesh colored so as to make it quite invisible at a short distance. In the base there is a small spring which holds the coins up against the clips, holding them securely (*Continued on page* 925)



* No. 89 of a series on magic appearing monthly.

Scientific Aids to Your Comfort

By Mary Jacobs

Massaging Made Easy

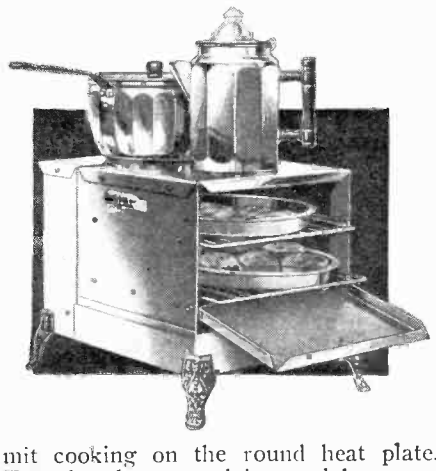
THIS electric patter can serve the whole family. We women need it for facial massages; men will find it especially useful after shaving. Padded rubber tips insure gentle strokes that will stimulate circulation. Those troubled with dandruff will be interested to know that special tips are provided for scalp treatment. Tested and approved in our laboratory.

It Beats, Stirs and Mixes

BEATING cake batter in seven minutes, whipping cream in one minute, mixing a meat loaf in six minutes are ordinary operations with this electric mixer, which has an attachment for fruit juice extracting. A four quart aluminum bowl comes with the set, which includes a double beater for usual mixing, and a single one for mixing drinks in a tumbler. Tested and approved in our laboratory.

Electric Table Stove

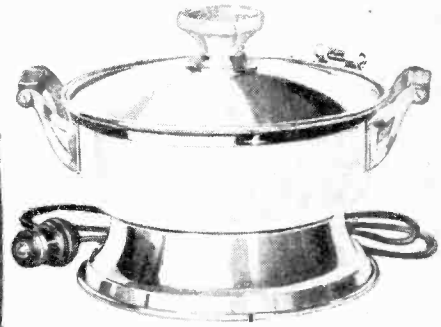
FOR the small family, why not a portable electric stove? Though it occupies a space of only 12×15 inches, this one has two food racks in its oven, its top acts as a warming shelf. Regulation sized cooking and baking vessels can be used. The oven lifts off to permit cooking on the round heat plate. Tested and approved in our laboratory.



One-Piece Kitchenette

THIS kitchenette cabinet closed, resembles a walnut secretary-desk. When opened, there is a completely equipped modern buffet kitchenette, in a space 41 inches wide, 20 inches deep and 6 feet 9 inches high. You can store, cook your food, and then keep it fresh in the refrigerator.

The top contains three shelves, 12×37 inches, for china and provisions and two drawers for linen and silver. An insulated cooking compartment, finished in natural lacquer, is directly beneath the shelves. There is enough space to accommodate a grill, toaster and percolater. Its drop leaf cover provides a working table 35×31½ inches. The bottom is an electric refrigerator finished in white enamel with two food compartments and three ice cube trays.



Your Food Can't Burn

JUST put enough water in the lower compartment to cook your soups or vegetables; your rarebits or chafing dishes in the upper; turn on the current, and forget all about cooking. An even temperature will be maintained. The current automatically shuts off when the water has boiled off. Tested and approved in our laboratory.

Improved Strainer

THIS set eliminates the discomforts of straining. An adjustable stand, a frame fitted to the stand to hold the straining bowl, three graded mesh straining bowls, and a roll pestle for forcing food through the strainer, are provided. Tested and approved in our laboratory.

Quick Breakfast

TOAST, coffee, bacon and eggs, are prepared on the same appliance

(*Continued on page* 946)

Cooks and toasts simultaneously.

Names and addresses of manufacturers will be furnished upon request.

How to Build a Telephone Niche

By Doritha F. Lanctot

The telephone niche, when completed, is very attractive-looking and yet is flush with the wall and out of the way. Pencil and pad can be kept on the shelf so that you can conveniently record any messages.

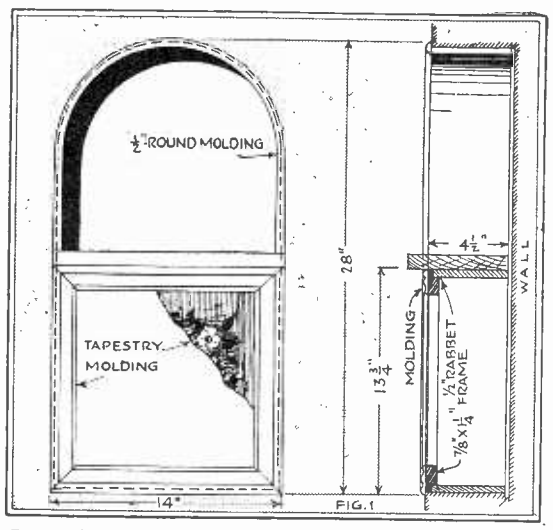
A TELEPHONE niche is often included in the original design of a house, but countless houses already completed have to resort to a telephone table and chair. These take up valuable space in a small home where space is at a premium. A telephone niche requires no floor space, and can be completed by a chair already belonging to the ensemble of the room.

Although the process of cutting a niche in the finished wall is more of a task than if it were planned when the house was under construction, it is comparatively simple.

This telephone niche is narrow enough to fit between two studdings, so sound out where the studdings are and mark the places. Draw the curve of the arch on pattern paper and cut out. Place the pattern on the wall between the two studdings, with top of arch 14 inches above the top of the telephone shelf. (See Fig. 1.) Extend the two side lines down by rule until the proper dimensions are reached. The entire opening is 13½″ × 27½″.

The necessary tools are a wood chisel, hammer, compass, saw and brace and bit.

Chisel the line around the entire opening, tapping lightly on the chisel with the hammer to insure an even break through the white coat plaster. Proceed with the hammer and chisel through the plaster making each a clean cut. Go slowly to keep the edge even. Chisel at an angle to meet the cut and get the plaster out of the center. Bore a hole to start and with the compass saw, saw a clean edge around the entire opening.



Front elevation and cross section through the finished telephone niche

If you find a studding in the way which you had not counted on, chip it off with the chisel carefully until you are nearly through it and saw the remainder with a flooring saw.

Cut a piece of wood veneer or any flexible wood to fit the back 13½″ × 27½″, arched at the top. Nail it in. Cut a piece 4½″ × 32″ for the sides and nail it in, fitting the center to the center top of the arch.

The wood should be the same finish as that in your home.

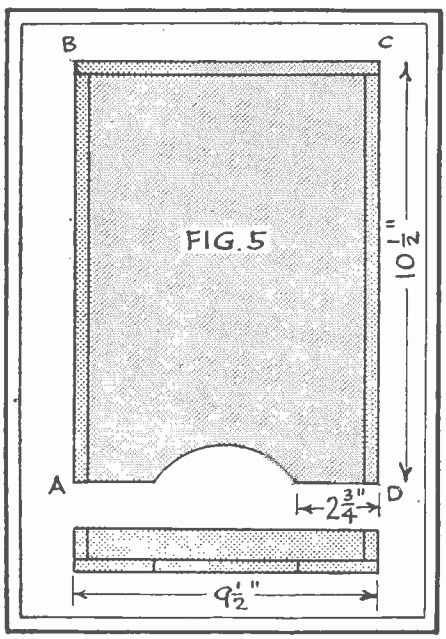
The shelf upon which your telephone sets is 1½ inches thick and shaped as shown in Fig. 2. In the lower half of the niche a wood form (Fig. 3) is nailed. Soft pine is all right because it will not be visible. Its purpose is to hold the telephone box. Next nail the shelf, Fig. 2, on the top of form. (Fig. 3.)

The telephone can then be connected, the wire being run through the wall, through a hole bored in the lower board, as shown at B, Fig. 3, and the connecting wire from the box run through a hole in the top of Fig. 3 at A, and thence through Fig. 2 at A to the telephone.

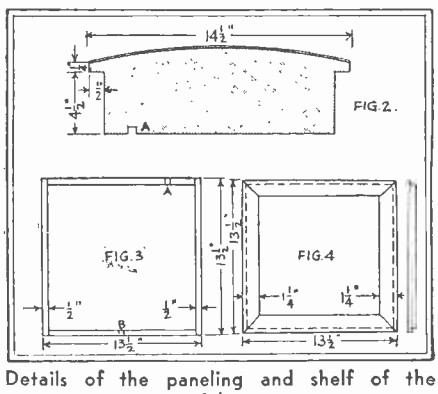
It is a regulation of the telephone company that there must be access to the box, so the front panel (Fig. 4) must be removable. The wood frame is made of 7/8″ × 1¼″ stock mitered at the corners and rabbeted ½″ inside. The tapestry is tacked in and ½ inch molding tacked in to cover the edges of the tapestry.

Remnants of tapestry can be purchased at little expense from an upholstery shop, and a suitable part of the design used for the frame. Fig. 4 can either be fitted snugly so that it stays in well, or it can be fitted with inside hinges.

If desired, the wood behind and at the sides of the telephone can be papered with the same paper as the rest of the wall, (*Continued on page* 929)



Details of a telephone directory shelf which, as explained in the text, can be fitted under the telephone chair.



Details of the paneling and shelf of the niche.

Prize Puzzles to Polish Your Wits

By Sam Loyd

THE Puzzle King presents the fourteenth of a series of problems, the solving of which will show if your mathematical ability is bolstered up by logical reasoning. Prize winners of the November puzzles and solutions will be found on page 942.

TWENTY-FIVE DOLLARS IN PRIZES

A FIRST PRIZE of $10 will be awarded to the person sending correct answers to the three puzzles, accompanied by the best expressed analysis of the Poultry Problems.

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

TEN PRIZES of $1 each will be awarded to the ten persons who send the next best analyses of the Poultry Problems, together with correct answers to the three puzzles.

Answers must be received not later than noon, February 16, 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.

Poultry Posers to Ponder

I HAVE a letter from a young couple who escaped the complexities of city life by putting their savings into a nice little country place and launching into the poultry business.

The letter goes on to say: "We started with a mixed flock of twenty-five chickens and geese. The chickens have increased three times as fast as have the geese, and we now have eight times as many birds in our flock. How many of each kind do you think we had to begin with?"

While on the subject of poultry let us inspect the following proposition, which is advisedly qualified by "if":

If a hen and a quarter can lay a quarter's worth of eggs in a day and a quarter, how many hens will it take to lay $3.20 worth of eggs in two days? There are two poultry posers to ponder.

Sheep and Goats

THE odd numbers representing sheep, and the even numbers goats, it will be seen that the two flocks are fraternizing freely.

To shepherd the sixteen animals into bands of their respective breeds is our puzzling task, and certain rules will govern the undertaking.

First let us number sixteen bits of paper or cardboard, and place them upon corresponding numbers in the diagram.

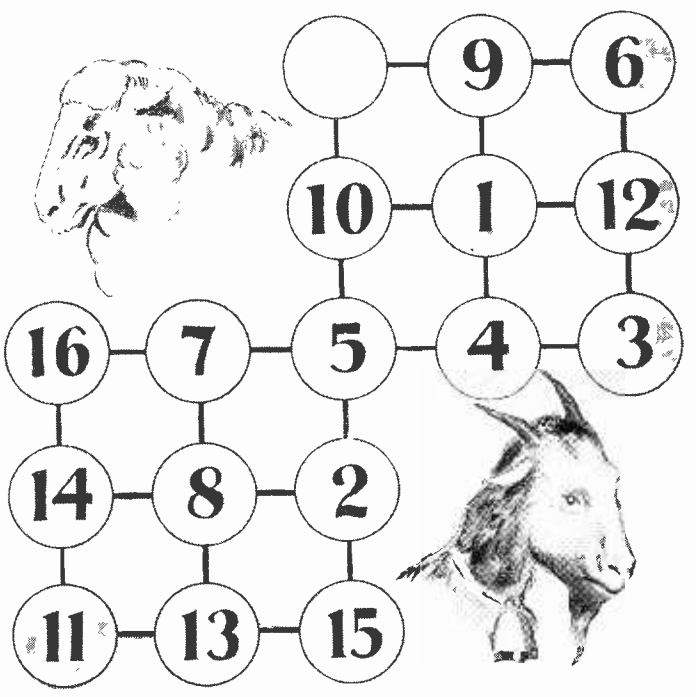
The markers are then to be moved and jumped, one at a time, and never off the board, to effect the desired separation. A marker may be jumped over only one other to the vacant circle. Moves and jumps are all to be in direction of the connecting lines, which means that diagonals are barred.

It will be noted that one has the choice of four opening plays, viz.—Move 9, move 10, jump 6, or jump 5, to the vacant circle.

At the end of operations, the circle upon which number 5 is posed in our sketch is to be left vacant and the groups between which it stands will be composed, one exclusively of odd numbers and the other of even numbers.

Sheep and goat need not be moved alternately. Move or jump in any order you like, so long as direction is vertical or horizontal.

In recording your sequence of moves and jumps, it will be sufficient to note the number of the marker moving or jumping. For example: 6 jumps, 12 moves, 5 jumps, etc. At top of solution sheet set down the total number of moves and jumps required. Now to separate goats from sheep in the least possible number of operations.



For the Home Machinist

Correct Methods for Cutting Compound Curves, Large Curved Surfaces, Cones, Irregularly Shaped Cylinders and Turning Balls, Both on the Inside and Outside, Are Explained

By George A. Luers

Supervisor of Ordnance Design, Naval Gun Factory, Washington, D. C.

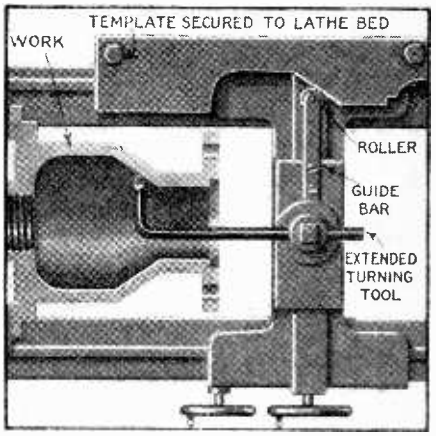


Fig. 1—A template, milled to the required shape, is used for a compound curve.

FOR compound curves it is not practicable to use radius bars. The accepted method is to use templates, these being milled to the shape required for the job. In Fig. 1, the work of cutting the compound curve is indicated and the related parts of the set-up are shown. The template is secured to the lathe ways, either in front of or behind the carriage, depending upon the preference of the mechanic. It can be made either as an outside or an inside curve.

After securing the template, a contact guide is mounted on the cross slide to rest and move against the guide face. A roller is serviceable in the end of bar, attached to the tool slide, to provide easier movement. The lathe tool is fed to the work, using both feeds of the lathe. For alternate cuts the tool is moved forward in the post between cuts until the desired amount of metal is removed.

The turning of a cylinder whose center section is of a larger diameter, and the addition of tapers and curves in the concealed portions is not an unusual job. Buffer cylinders, expansion chambers, or pumps sometimes require this type of work. Fig. 2 solves this problem for the lathe hand. Here a template is used as a tool guide. This template is milled out to the exact shape desired inside the cylinder side wall. A boring tool for the lathe is selected, with sufficient length to reach the limits of the job, unless it is desired to bore in two cuttings, from opposite ends. The template is so secured to the lathe bed as to clear the carriage. A bar with a roller is fixed to the tool slide, in a position where it will contact with the template properly.

As the cutting progresses, the tool is moved deeper into the work, until the desired diameters are obtained. Of course it is not practical to make many measurements inside the center of the cylinder, but the end measurements are sufficient to judge by. If these are correct and the template is right, the concealed diameters will be right.

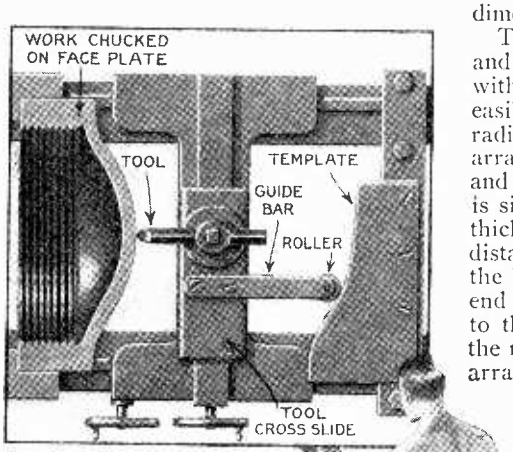


Fig. 2—A boring tool and a template are useful in turning a cylinder of large diameter.

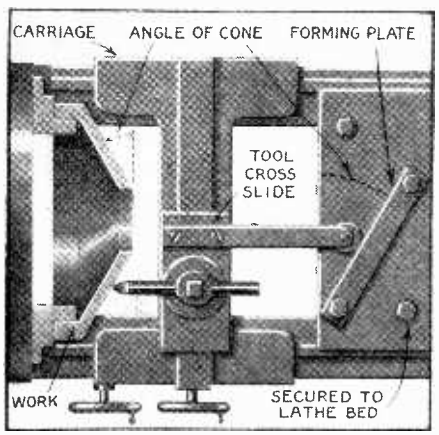


Fig. 3—To the left is a complete set-up of guide strips for cutting conical surfaces.

Many jobs have conical surfaces and it is not possible to complete these accurately, using the cross and longitudinal feeds of the lathe alone. With a guide strip or forming plate you can develop a cone, accurate in angle and with a surface finish that will serve for high-class work. Fig. 3 illustrates the method of setting up a guide strip for cutting the cone. With this, either an inside or an outside cone may be cut, using lathes equipped with the plain rest.

The guide strip is a straight bar, secured by a plate to the ways of the lathe bed. This guide is aligned, with a protractor, to the correct angle. A bar secured to the tool slide is positioned so that one end rests against the guide bar. This bar may have a roller at the sliding end. Using the two feeds, the work is cut, keeping the bar in contact with the guide strip. The tool is moved forward between cuts until the required dimension is obtained.

The tops of pistons, cylinders, heads, and many other jobs require a curve with a large radius. This curvature is easily obtained through the use of a radius bar as indicated in Fig. 4. This arrangement is correct for both convex and concave surfaces. The radius bar is simply a bar of steel, not necessarily thick, drilled for two pivot pins. The distance between the two holes equals the length of the required radius. One end of the bar is attached by a pivot pin to the tool slide. The opposite end of the radius bar is attached to a pivot pin, arranged and supported upon a plate secured to the lathe ways.

For a concave surface the bar is set at the rear of the lathe carriage. For convex work the bar is placed in front of the carriage. The only requirement for accuracy is to have the tool point at the center of the (*Continued on page* 949)

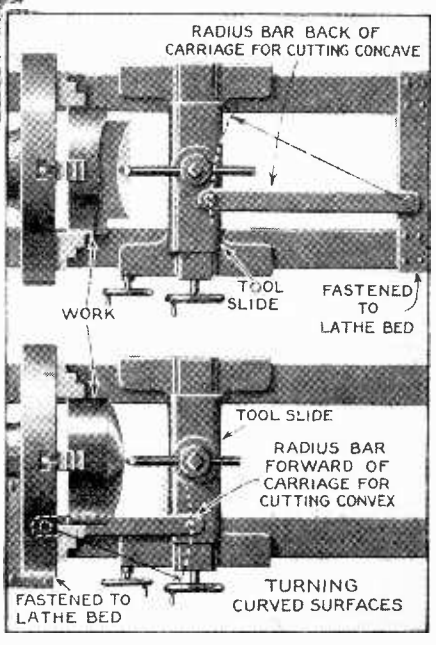
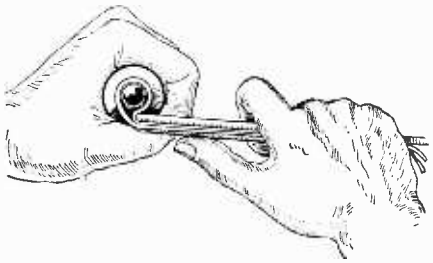


Fig. 4—Two ways of getting clean curves, concave or convex, with a radius bar.

Wrinkles and Recipes

To Loosen Small Metal Caps

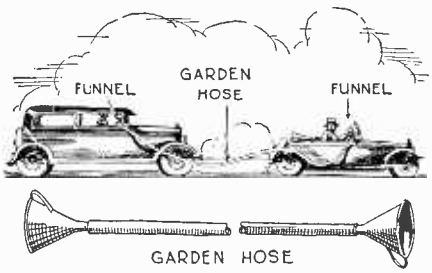
A SIMPLE and excellent method of unscrewing small metal caps from tubes or cans is indicated in the illustration.



Wrap a small piece of leather strap around the cap as shown and "take a hitch" in it with the thumb or finger. If the cap is unusually tight use a small piece of wood (as shown) on the side of the hitch and the most stubborn cap will be removed easily.—*R. C. Demary.*

Novel Use for Garden Hose

WHEN my car is being towed or when I am towing someone else's car I provide for a piece of garden hose to connect the two machines. In each

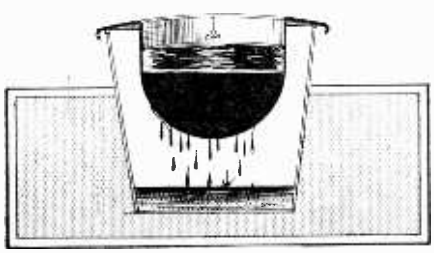


end of the hose I insert a funnel. By this means we can communicate, and because of the few signals which the driver is able to give ordinarily under the circumstances, it proves very helpful.—*C. Baerwalde.*

Home Made Oil Filter

OIL from the crank case of automobiles and tractors can be filtered and used in numerous places about the shop, farm, or home, where a high priced oil is not necessary. A tin pail and an old felt hat combined as shown make a good oil filter.

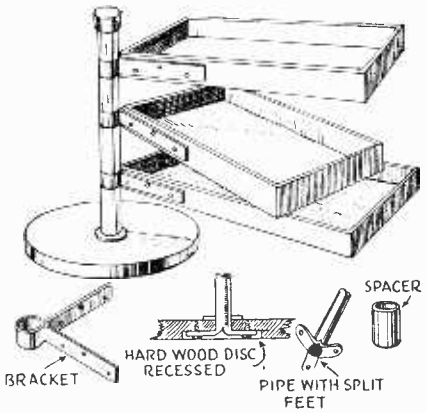
Should there happen to be holes in the top of the hat, pieces of felt from the brim can be stitched over them. —*R. C. Demary.*



First Prize, $5.00

Desk Stand or Bench Trays

IT is a very simple task for the handy man to make the stand illustrated from several cake tins, a piece of hard wood and brass piping. It can also serve as multiple receptacle for odds and ends on the workbench. Of course, after constructing the stand it's a good idea to paint it to suit your taste.—*Chas. H. Willey.*



Painting Your Roof

WHEN the corrugated galvanized roof on the shed begins to rust, it should be painted. One of the best ways to prevent the paint peeling and blistering, as it often does on this kind of surface, is first to apply vinegar to the galvanized surface, using a paint brush. Three or four days later the iron may be painted. Paint of any color will stick to the metal without peeling. —*H. E. Chrisman.*

Writing Confidential Reports

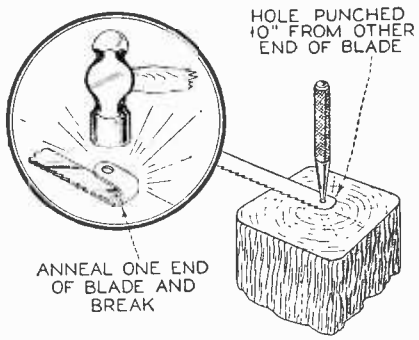
WHEN traveling I use a portable typewriter for preparing special reports. I find it simplifies my writing on the train. It is not infrequent to find some passengers interested, who are not satisfied with a glance, but stand close and look on. As the reports carry confidential data, I find it convenient to remove the ribbon or use stencil shift, and by use of carbon sheet I soon finish my "copy" without "hurting" the spectators' feelings—they soon tire of looking at a blank sheet of paper and move on. Then my carbon copy is removed for mailing. —*Mendel Cohen.*

$5.00 is paid each month for the best Wrinkle or Recipe accepted and published in these columns. All others used are paid for at regular rates. Address: Editor, Wrinkles and Recipes.

More Wrinkles and Recipes on Page 959

Fitting Hacksaw Blades to Frame

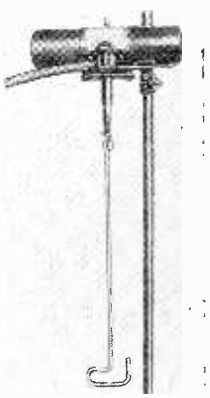
I RECENTLY had occasion to use a hacksaw with a solid frame for 10-inch blades, but the only blades I could get were 12 inches long. I annealed one



end of the blade in a flame (a piece of burning coal will do just as well) and broke it as per the illustration. Then I punched a hole just 10 inches from the other end. If there is a burr formed by the punch, grind or file it down. —*R. C. Demary.*

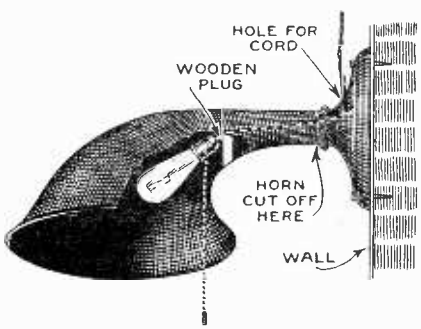
Mechanical Stirrer

YOU can easily construct a mechanical stirrer from an automobile windshield wiper. One end of the glass rod is bent into a small eyelet and the other into balanced vanes. A loop of fairly stiff wire passes through the arm hole in the shaft of the wiper and through the eyelet of the glass rod. —*Kenneth R. Gray.*



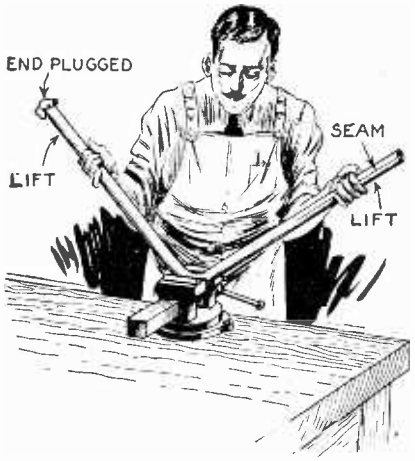
For a Lamp

HERE is a way of making use of last year's radio horn. The electrical unit is removed from the horn and a wooden plug fitted into the neck. The lamp socket is fastened to this wooden plug and the lead wires are passed through a hole drilled through it.—*Harry M. Steele.*



Try These in Your Own Workshop

Mechanics Are Able to Complete Difficult Jobs With the Tools Found in the Average Workshop If They Take Advantage of the Various Tricks of the Trade. Knowing How to Do a Job Well the Easiest Way, Is the Fundamental Basis of This Series



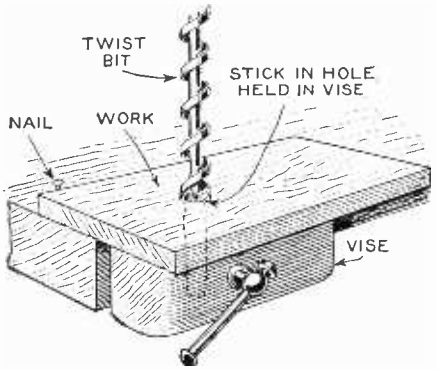
Pipe bending is a cinch when you know how—try this.

VERY few mechanics are acquainted with this easy way of bending iron pipes. The only tools required in this method are a forge and a strong bench vise. Suppose we are handling a piece of one-inch pipe which is to be bent in the form of a right angle and the bend is to be in the center of the piece which is seven feet long.

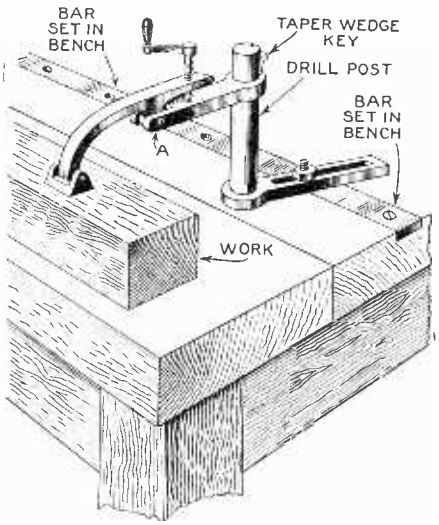
Mark the pipe seam with white chalk. Plug one end of the pipe with a piece of rag to prevent cooling by air currents. Heat the pipe in the forge evenly for about five inches about the point where the bend is to be made until the pipe attains a bright red color. Quickly place the pipe in the vise with the seam on the side, as shown in the sketch. The vise should be opened beforehand just far enough so that the pipe will fit between the jaws easily. Close the vise until it pinches the pipe lightly and lift both ends of the pipe at the same time to approximate the position as shown in the sketch. These operations must be made as quickly as possible. It is interesting to note that the pipe will not slip out while you are lifting the ends.

Release the pipe and examine to see where it will be necessary to reheat. Two heats should be sufficient. After some practice you ought to be able to make this type of bend with one heat.

Twist bits cannot be used to enlarge a hole because the cutting end cannot grip the wood and therefore will not feed into the work. If such a job is fitted even loosely over a stick held in the vise and the work kept from turning by means of a nail, the feed screw



Save yourself the aggravation of watching your bit turn uselessly when enlarging a hole . . . simple enough.

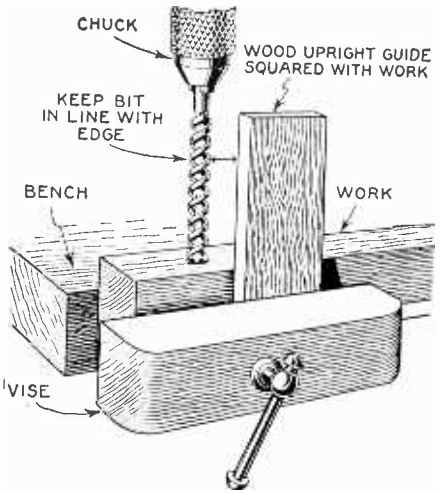


A bench clamp serves as a third hand which never gets tired.

end of the bit will have something to "take" upon and lead the cutting edge into the work.

Those workmen who do a lot of bench work should be interested in this bench clamp. It does not require much effort to build, because the main part consists of the universally known and used ratchet drill post or "old man."

The arm A of the post is slotted to take a curved lever. On this lever a tongue is forged as indicated to be pivoted in the slot and one end is tapped for a screw to operate it. A bar of iron, drilled and tapped with holes in various places along its length, permits its use along the bench, the iron being set into the bench flush with the top. The taper wedge key on the



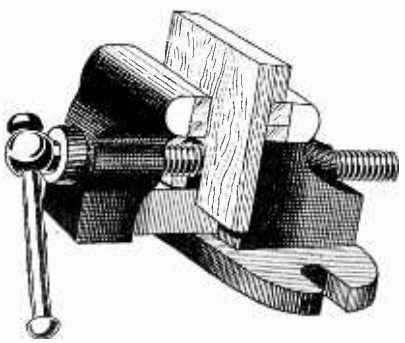
It's easy to keep the bit squared up with the edge of your work this way.

vertical part of the "old man" permits vertical adjustment, so that it will serve for work of various heights. The efficiency of this bench tool well repays the work of making it.

When boring through a narrow strip of wood the average worker finds it quite difficult to keep his bit in line with the edge of the wood. An easy way of insuring the success of this operation is to clamp the material which is to be drilled and an upright piece of wood together in a vise. It is now quite easy to keep the bit lined up with this second piece of wood.

The next time you saw a board, try this stunt. Place the saw upon the surface of the board. Now if you look into the saw blade you will see the reflection of the edge that the teeth strike. Set the saw until the board edge reflected in the saw appears to meet the same edge of the board on the opposite side of the saw. If you get this reflection in this manner, you will be able to cut the board perfectly square.

A block of wood fitted over the rear jaw of the vise acts as a buck-up when drilling holes in thin metals which have a tendency to bend under the pressure of the drill. A half circle cut in the buck-up board will allow it to straddle the screw of the vise and so maintain its position.



A block of wood, fitted to your vise, as illustrated, will help you when drilling thin metals.

If you have any ideas for our workshop page, send them in to the Workshop Editor. We pay for them at our regular rates, if acceptable.

Making a Compact Oak Bedroom Suite

Part III

By J. E. Lovett

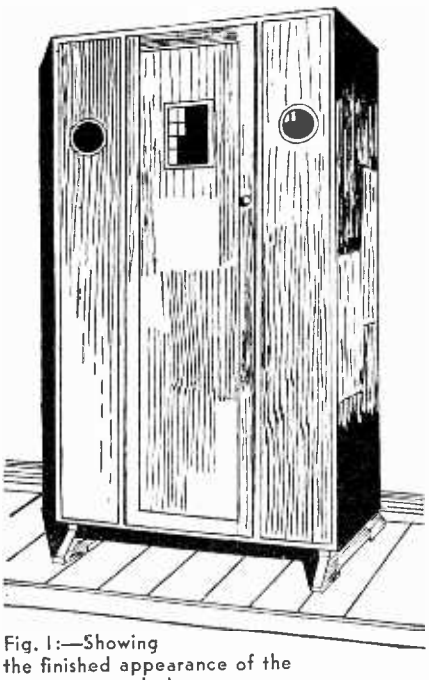


Fig. 1:—Showing the finished appearance of the wardrobe.

THIS is the third and concluding installment of our series, in which we describe how to make a full bedroom suite. The other two articles which appeared in our December, 1930 and January, 1931 issues, respectively, gave complete instructions for the building of the dressing table, bedstead and tallboy cabinet.

Good straight-grained, quartered oak should be selected as first choice for the carcase ends (E), while for the top and bottom (D) plain oak would suffice. For a cheaper article, the top and bottom might be of chestnut with lippings of oak to a width of one inch on the front edges. As the width of the top, ends and bottom will necessitate jointing, cross-tongueing is advisable.

The top (D) and ends (E) might be dovetailed together, dovetails to a length of ½ inch being allowed on the top into the 13-16ths inch finished ends. The dovetails should first be cut on the top and corresponding dovetails marked from these and cut on the ends.

When placing the top and ends together for dovetailing, it will be noticed that there is a discrepancy in the widths. This difference is caused by the top and bottom (D) standing in at the back 9/16ths of an inch to allow for the back framing.

Two lengthwise grooves will be required on each of the ends (E), one on the front of each for the haffit panels (M) and one on the back edge of each for the back frame stiles (G). Corresponding grooves on the top and bottom (D) for the haffit panels (M) should be stopped 8½ inches in from each end. The sizes allowed for these grooves to the face edges of the top, bottom and ends is ¼ inch. A glance at Fig. 4 will make this grooving etc. much clearer.

The top and bottom will also need mortising for the haffit pilasters (F) as shown in Fig. 6. These pilasters will also need grooving to take the haffit panels, the grooves in size and detail to be exactly similar to those already cut into the carcase ends.

The haffit panels should be moulded all round to the enlarged detail given in Fig 6. Good quartered oak should be selected for these panels so that they may match when in pairs.

The bottom edges of the ends (E) will need rabbeting for the bottom board (D). The rabbets are stopped 1¼ inch from the front, but are right through at the back (see Fig. 4). This saves the rather laborious task of dovetailing while it will be found that with the top and ends dovetailed, the bottom and ends screwed and glued, and the back framing screwed into position, this carcase will prove more than sufficiently strong.

When all this constructional work has been completed the main carcase might be glued and clamped up, not forgetting to clamp up the haffit panels and the adjoining pilasters with the top, bottom and ends. These pieces make up the skeleton carcase.

Dealing next with the back framing (G, H, I, J), this might also be in oak for a first-class job, otherwise in chestnut or ash. The overall sizes and details are given in Fig. 10. The stiles (G), rails (H), muntin (I) and rails (J) should be grooved to a depth of ⅜ inch by ¼ inch wide to receive the back panels (C).

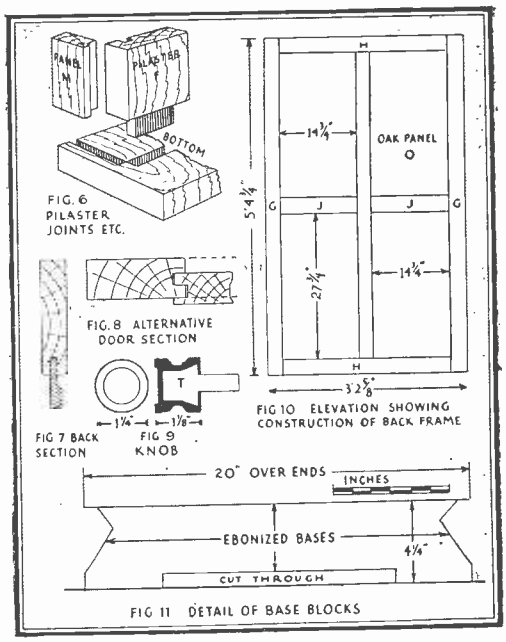
Tenons 1 inch long are allowed for the top and bottom rails into the stiles; the vertical muntin into the top and bottom rails, and for the cross rails into the stiles and muntin.

The back panels (O) might be of oak or chestnut or even of oak ply, and should be rabbeted on all four sides to drop into the grooves worked in the other members of the back framing. This back might now be glued and cramped up and when dry, screwed into position on the main carcase.

The shaped blocks (A) might next be fitted to the main carcase, details and sizes being in Fig. 11. The timber for these blocks might be of birch, since they are to be ebonized or black enameled. Care should be taken in slot-screwing them to the bottom, so that the main carcase above has free play to shrink.

The door now remains to be made and fitted. Details and sizes are given in Fig. 5. The stiles (B) and rails (C) should be of straight-grained, quartered oak and haunch tenoned together, as in the enlarged detail at Fig. 3. The center cross-rail is just tenoned (not haunched) in the usual way.

An oak-faced plywood panel (N), ¼ inch in (*Continued on page* 928)



Showing various constructional details.

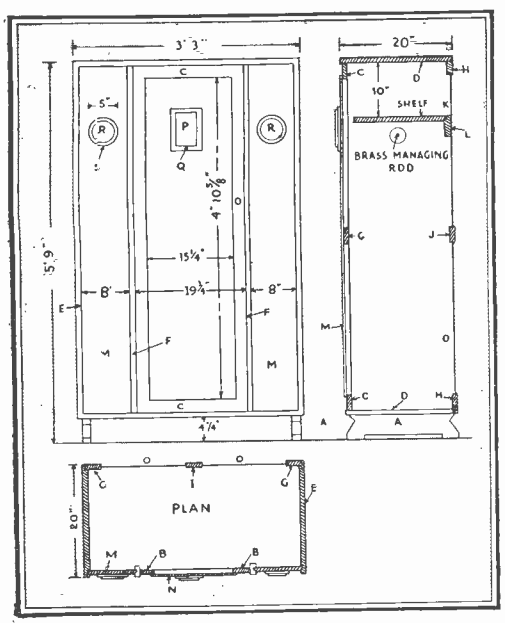


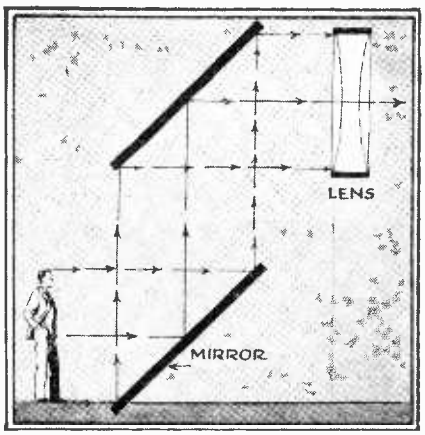
Fig. 2:—Front elevation, plan, and sectional end view of the wardrobe.

How to Produce Miniature Images

(2376) Mr. C. D. Whiteworlf, Los Angeles, Calif., writes:

Q. 1. How can I accomplish the illusion of seeing a person in miniature, so that the image might be visible to several people at the same time. I have seen this thing in show windows. Frequently the same device serves to amuse the populace at side shows?

A. 1. The effect which you wish to achieve may be produced very simply. The person whom you wish to feature is placed in a cabinet and a strong light



is played upon him. In front of and facing him, a mirror is placed at an angle of 45° to the horizontal. Above this mirror, another mirror is placed parallel to and with its reflecting surface facing the first mirror. A double convex or reducing lens is located in front of the second mirror and persons looking through this glass will see the image in miniature.

The Earth's Atmosphere

(2377) Mr. I. G. Riddle, Jackson, Tenn., writes:

Q. 1. Why is it that the earth, with an equatorial velocity of about 1,000 miles per hour, does not act like a fan and carry trailing winds with it? Also why can't an airship go up and remain motionless for twelve hours and come down on the other side of the earth.

A. 1. As the earth rotates about its axis, it carries with it a stratum of air which moves at the same average rate of speed. As the earth turns friction between its surface and the particles of air closest to it forces them to turn with it. Friction between this layer of air and molecules of air which make contact with it, cause still another layer of air to move in the direction of the earth's rotation. In this way the atmosphere keeps pace with the earth.

Conducted by Seymour A. Davidson

People who inhabit the world are acted upon by the forces which propel our globe and cause the air to travel along with it. In exactly the same way we may remain seated in a railroad train which is moving at 60 miles per hour.

As an aviator leaves the ground, he is still under the influence of the force which acted upon him while he was at the earth's surface. By the laws of inertia, he continues to move in the same direction in which the earth is proceeding and at the same rate of speed. His own direction of motion is secondary to that of the earth.

If an aviator were able to fly into space past the influence of the earth's gravitational force and beyond the point where the air moves along with the earth and were he able to remain there for a definite time and could he control his ascent and descent then he could travel half way around the world in twelve hours as you suggest.

Copper Plate Coating Solution for Photo Engraving

(2378) Mr. A. H. Tan, Penang, S. S., writes:

Q. 1. What is the composition of the solution which is spread on copper plates in the photo engraving process?

A. 1. The solution used for coating copper plates for photo engraving purposes is generally composed of fish-glue, ammonium bichromate and liquid ammonia, albumen occasionally being added. The copper plate has to be prepared by removing all grease and foreign matter. It is usual to heat the plate and rub it back and front with caustic potash, finishing off by polishing it with charcoal. The sensitive solution is then poured on the plate and placed in a whirler to distribute the coating evenly. The fish-glue solution, or as it is usually termed "enamel," forms an acid resist.

The Oracle is devoted to questions of general interest to our readers. Direct mail answers will be given at the rate of fifty cents per question.

At What Speeds Are Auto Engines Most Efficient?

(2379) Mr. Delmore Wechter, Decatur, Indiana, writes:

Q. 1. Recently I held a discussion with one of my neighbors regarding the efficiency of an automobile at different speeds. I claimed that under the same conditions a car will go further when driven at a speed of 20 miles per hour than it will on a given quantity of gasoline if driven at 40 or more miles per hour. Will you please settle this matter once and for all?

A. 1. Your friend was quite right in his contention that an automobile will not always run the greatest number of miles per gallon when driven at a constant speed of 20 miles per hour.

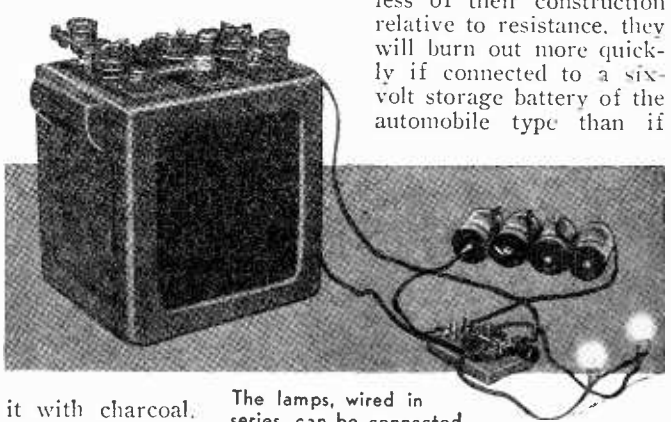
The efficiency of any motor depends upon the ratio of input to output. Some automobile engines have a smaller ratio of gas consumption to horse power derived when driven at a high rate of speed. Other motors are more economically operated at low speed.

This is a characteristic of the individual motor itself and is not an indication of the efficiency of the engine.

Why the Lamp Will Not Burn Out

(2380) C. A. Hardking, M.D., Ph.G., writes:

Q. 1. Will you be good enough to settle an argument. Here is the case. If two three-volt flashlight bulbs are wired in series, I contend that, regardless of their construction relative to resistance, they will burn out more quickly if connected to a six-volt storage battery of the automobile type than if



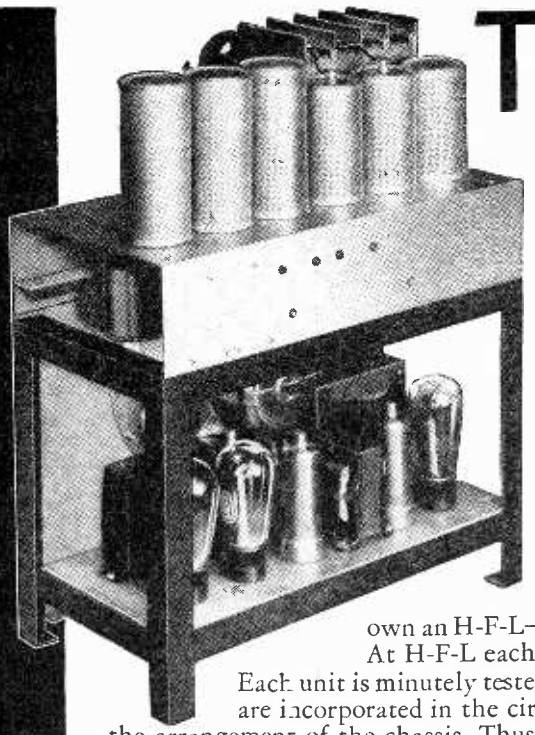
The lamps, wired in series, can be connected to the storage battery or flashlight cells.

their current source were a six-volt flashlight battery. I think that the life of the lamps will be shortened by the high amperage of the storage battery. My nephew says that no matter how high the amperage if the potential is proper the inherent resistance of the lamps will protect them.

A. 1. Your nephew was quite right

(*Continued on page* 955)

NEW IN EVERY WAY



The Difference is in the Making!

The Advantage is Yours the H-F-L Way

The fine things are always hand made. This is especially true in radio. The art advances so fast, that huge factory-set-ups for mass manufacture cannot keep pace. Only a few may ever own an H-F-L—such quality receivers cannot be built in quantity. At H-F-L each receiver is hand made to the precision of a watch. Each unit is minutely tested before inclusion in the set. The latest discoveries are incorporated in the circuits. The most advanced designs are followed in the arrangement of the chassis. Thus, your H-F-L receiver gives you all that radio has to offer. Buy H-F-L in these great expectations—you will not be disappointed!

THE LITTLE GIANT MASTERTONE

MAKES ITS FIRST BOW TO FAME IN THE FIELD OF FINE RADIO

HOPKINS BAND REJECTOR SYSTEM

Entirely new! New in circuit arrangement—new in chassis design. America's outstanding builders of fine radio now produce a supremely fine low-priced superheterodyne receiver for everybody.

A real sensation is this set. It challenges all comparison. Quick as a flash, it falls into tune with the station selected. With microscopic fineness, it accepts that signal to the exclusion of everything else in the air. Even background noises cannot creep in. With bounding power, it reaches to the outposts of the world in its reception range. With enrapturing tone, it transports you to new heights of musical enjoyment. New miracles of this wizard-like art are brought to produce an entirely new superlative performance. Yet, all this you get at surprisingly low cost. No more to spend than for ordinary radio!

Sensational New Circuit!

To combine 10-kilocycle selectivity with beautiful tone quality has been the dream of every radio engineer. But, not until the perfection of the Hopkins Band Rejection System was this possible. Now in the Mastertone this is accomplished. Far away stations, on bands adjacent to powerful locals, are brought in with clarity, volume and full strength. No compromising of tonal reproduction by side band clipping. Tune to the station desired and *all* the energy in that channel is accepted and reproduced. All adjacent stations are entirely avoided. Reception is *precise*, *definite*, unhampered! The Hopkins Band Rejector System is exclusive with H-F-L and is found in no other receivers.

WORLD WIDE RECEPTION POWER

Extreme Selectivity

The full value of screen grid tubes brought to perfection. Reach out to the far corners of the earth for unforced, clear-as-a-bell reception. The sensitivity is greater than 1 micro-volt per meter—*all over the dial*. This sensational circuit arrangement always provides the reliable 10-kilocycle separation at all volumes—high or low, at all wave lengths, on local or far distant stations.

Single-Unit Chassis

A cascaded, one-unit chassis of great ruggedness. Built like a skyscraper of steel and aluminum. The dynamic speaker is integral with the chassis. All delicate parts enclosed and protected from accidental injury. All units securely anchored so that after years of use it still functions perfectly. Very compact, measuring only 21 inches high, 16 inches wide and 8 inches deep. Ideal for use in consolette or for inbuilding in the wall.

Beautiful Console Model

This wonder receiver is now available in a modern, walnut console in striking design. Neat, compact, but a fitting companion to the finest furnishings the home might have. And, best of all, it comes at a price lower than the market has ever offered. Here we have a complete, ultra powerful, beautiful tone superheterodyne receiver at a cost even less than must be paid for an ordinary trf set when secured through the usual channels.

SINGLE UNIT CHASSIS

Write for Whole Story

Learn how you can test this record-breaking, sensational new receiver and see and hear for yourself. Know the amazing price. Find out about the great new circuit embodied in it. Hear the enthusiastic praise of those who have already tuned it! All this will be brought to you in a little Brochure which will be be sent to you FREE on request. *Mail* the Coupon now and soon begin to enjoy radio in all its possibilities.

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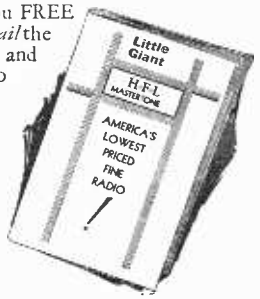

10 KC STATION SEPARATION

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PATENT ADVICE

CONDUCTED BY JOSEPH H. KRAUS

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

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

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

MANY readers of this column have asked why we do not advise patent procedure more frequently than we do. The answer is obvious.

1. Questions accompanied by the usual remittance never find their way into this column.

2. If an idea is considered worth while, we protect the inventor to the fullest extent. We do not publish the idea even though such publication would definitely establish a claim of priority. We thus give the inventor every opportunity of filing not only American but foreign patents.

3. By our pointing out the objectional features, inventors may be able to redesign their products, so that they will be as nearly perfect as their ingenuity may make them, and so that they will overcome all objections.

4. An inventor once failing to commercialize on his invention usually exercises overmuch caution the next time he develops what might be a really worthwhile idea; he may allow the possibility of a suitable financial return to slip through his grasp.

Yet, there is money in patents.

Perhaps the clearest summary of the general situation is given in the following excellent article by Edward Thomas, an attorney of note and the author of the book entitled "The Law of Chemical Patents."—EDITOR.

Are Patents Worth While?

MANY people have "guessed" that ten percent of the United States patents are profitable. Other people have guessed that only five percent are profitable, but I have never heard any one of the guessers give a more satisfactory basis for his guess than a mere "hunch."

I think that I can show that "hunches" and "guesses" are unnecessary. I think that I can prove on circumstantial evidence that between ten and eighteen percent of the United States patents are more than reasonably profitable. I am of the opinion that even more than eighteen percent are worth the money put into them. And since many of these profitable patents have brought to their owners millions of dollars in royalties and other returns, I am sure that patents are well worth while.

To get my proof that eighteen percent are profitable I turn to my law books and in these I find printed something more than fifteen thousand reports of law suits on United States patents. But some of these law suits were decided last week, and others were decided a hundred and twenty years ago. The United States Supreme Court decided its first patent case, Tyler v. Tuel, in February, 1810, and some of the recent suits are on patents granted this year, that is the year in which they were issued. On careful study I find that there are, in the law books reports of about ten thousand suits on the patents numbered from 1 to 1,000,000. Some of these million patents were sued on several times, like the patent to William Woodworth of December 27, 1828, for a method of planing, tonguing, grooving, and cutting into mouldings, either plank, boards or any material.

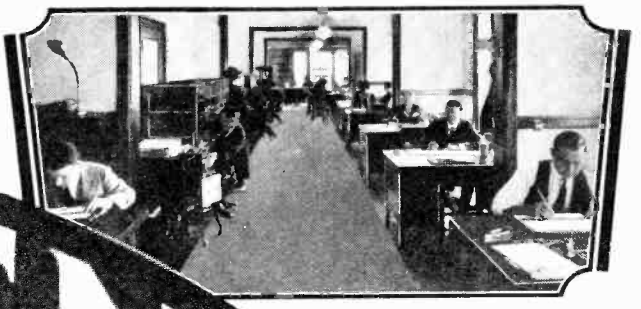
The law books contain reports of fifty-four law suits on that patent, including thirteen decisions of the United States Supreme Court. But that patent stands out as an exception. Though many patents have been sued on two or three times, most patents however were sued on only once, and, after I eliminate all suits beyond the first on each patent —after I eliminate all litigation except the first suit, I find that of the patents numbered from 1 to 1,000,000 a little less than 8,000 are given in the law books as sued on.

It is well known that many of the patent suits decided by the judges are not even mentioned in the law books or law journals either because they made no stir in the legal world, or because the editors of the law books did not consider that they were of enough legal interest to be worth mentioning. I have testified as an expert in a patent suit which has never been reported in the law books or the law journals. The suit turned on chemistry and on mechanics rather than law. Some of the chemical experiments so interested the judge that he asked me to have them repeated so that he could observe the details more closely. The judge decided in our favor but the editors of the law books and law journals did not find the decision legally interesting enough to publish, so that suit is not mentioned in their books.

(*Continued on page* 924)

PATENTS

At the right is a view of my drafting and specification offices where a large staff of experienced experts are in my constant employ.



All drawings and specifications are prepared in my offices.

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If you have a useful, practical, novel idea for any new article or for an improvement on an old one, you should communicate with a competent Registered Patent Attorney AT ONCE. Every year thousands of applications for patents are filed in the U. S. Patent Office. Frequently two or more applications are made for the same or substantially the same idea (even though the inventors may live in different sections of the country and be entirely unknown to one another). In such a case, the burden of proof rests upon the last application filed. Delays of even a few days in filing the application sometimes mean the loss of a patent. So lose no time. Get in touch with me at once by mailing the coupon below.

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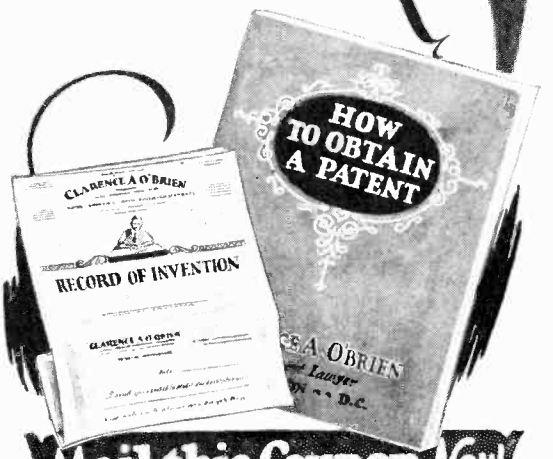

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Are Patents Worth While?

(*Continued from page 922*)

Well-posted salesmen of legal literature say that the law books include only about two-thirds of the decisions of the judges in patent cases, so we estimate that the printed decisions in those 8,000 cases prove that about 12,000 patents were the subjects of cases actually decided by the judges.

But many patent suits are started against infringers by owners of patents and are dropped by mutual consent long before the suit reaches the judge. My experience indicates that only about one patent suit comes to trial before a judge out of every three suits started, so for every suit decided by a judge there are two or more which end somewhere along the formalities which have to be gone through with before the trial begins in front of the judge in the court room. This makes three patent suits started for every decision made by a judge. Thus multiplying our 12,000 decisions by 3 we find therefore 36,000 patents out of the first million deemed valuable enough to cause legal action.

Poorly Drawn Patents Cause Litigation

It should be mentioned here that most of the fighting in patent litigation is occasioned by poorly drawn patents, or patents of dubious strength, for no owner of a patent and no infringer ordinarily cares to spend money in a patent suit when he feels sure of losing it. We can put this in other words and say that the 36,000 patents on which suit was actually started were mostly such imperfect patents that the patentee and the infringer each felt he had at least a gamble of winning a suit based on the patent involved.

It is my experience that a polite request to an infringer asking him to stop trespassing is often all that is necessary for the reason that a patent is often infringed by a person who is not aware that a patent has been issued. Where the polite request to stop infringing has failed to produce the desired result a well worded threat to sue has often proved effective in my experience. I estimate that such requests and threats are sufficient to stop at least two out of every three infringers, and possibly as many as four out of five, all depending very largely on how perfect the patent is.

The 36,000 patents computed above as those on which patent suits were started must therefore be multiplied by at least 3 and possibly by 5, so as to give us our final estimate of the number of patents profitable enough to put into a lawyer's hands for the purpose of stopping infringers. Thus the final estimate is that 108,000 to 180,000 patents out of the first million were profitable and infringed, or 10.8 per cent to 18 per cent. To this must be added the many patents which are profitable in other ways; for example, those many patents which cover inventions which the owner of the patent supplies to the market himself without competition, and the many other patents for inventions which a single voluntary licensee supplies to the market without competition.

It is true that many inventions are financial failures, but it is also true that there is many an invention which the average person has never heard of and yet which has brought in a return of millions of dollars to the owner of the patent on it. One of these inventions was the process of smelting iron with dried air, that is air from which the moisture had been removed by freezing it out in the form of snow. It is said that if iron is smelted with dried air there is an average saving of one-fifth of the coke ordinarily needed. That patent therefore must have been worth many millions of dollars to the owners, yet it was never sued on, so far as I am aware, and it is not included in the computation of patents above. I believe that it was owned by the United States Steel Corporation.

Another of these profitable, and yet almost unheard of patents, was the patent to Tilghman for the process of manufacturing fat acids and glycerine from fatty bodies by the action of water at a high temperature and pressure. That patent was sued on more than once, and in 1887 the Supreme Court ordered one infringer to pay damages amounting to $266,153.86, plus interest. Doubtless many other patents have been more profitable than this Tilghman patent.

The moral is clear: A patent is well worth while. But it must be a strong and well-drawn one. The attorney must know what other inventors have done so as to steer clear of old inventions, and he must know how to word the patent to protect his client. A good patent is the only kind worth having. An inventor can not expect to get such a patent unless he pays both for research work and for legal advice.

$5,000 FOR PERPETUAL MOTION

The editors have received thousands of different designs of perpetual motion devices, and have received hundreds of circular letters soliciting finances for the building of perpetual motion machines.

The editors know that if they receive these letters, there are thousands of others in this country who get similar letters and who fall for the claims made in the numerous prospectuses giving the earning capacities of the various machines.

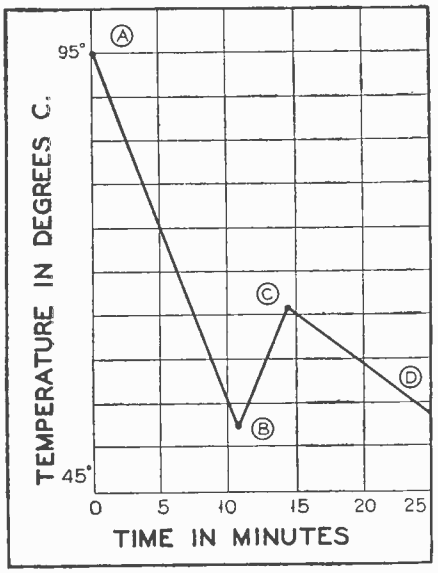
Most of the shares of stock for these perpetual motion machines are being sold at a rate of $1.00 per share, although some inventors are trying to sell shares of stock at $100.00 per share.

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

Simple Heat Experiments

(*Continued from page* 909)

A substance in changing from the liquid to the vapor state takes from its surroundings a certain amount of heat, known as the heat of vaporization. Therefore evaporation is a cooling process.



Acetamide Time and Temperature Chart.

Geysers owe their action to the fact that water under great pressure must be heated considerably above 100 degrees Centigrade before it boils. Geysers consist of a deep, irregular well, filled with water and heated at the bottom by the internal heat of the earth to a temperature far above the ordinary boiling point before the vapor pressure is sufficient to form steam bubbles. As these are formed the water column is lifted slightly. At first the water merely flows away at the top. Relieved of this weight the highly heated water below bursts into steam with explosive violence and throws upwards a column of boiling water and steam. The water drops back and after a few hours it becomes sufficiently heated to repeat the operation and the geyser again "spouts."

The experimenter may easily own his own geyser! Make a metal tube approximately three feet in length, three inches in diameter at the closed end and tapering to about three-quarters of an inch at the top. If this tube be filled with water and strongly heated at the bottom it will spout at fairly regular intervals. The experimenter who is handy with tools might construct an artificial geyser in his front yard!

Magic

(*Continued from page* 912)

in place, yet permitting them to be removed one at a time. The feke is held between any two fingers on the back of the hand. This enables the conjurer to show the palms of his hands quite empty. The clip can be disposed of by dropping it into a pocket in the table or by resorting to the usual method of palming.

Among the Inventors

Notice to Readers:

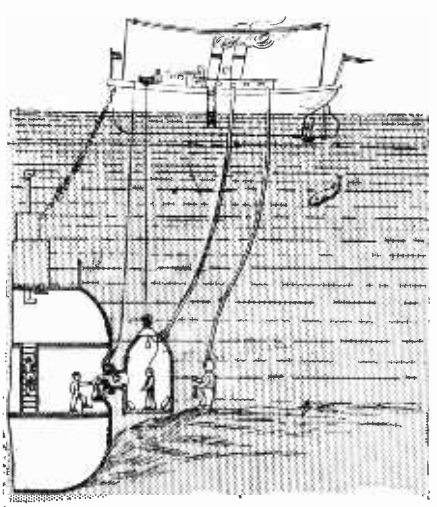
AN appreciable period of time elapses between the filing of a patent and the date upon which the patent is granted. During this interval inventors frequently move. We regret that it is quite impossible for us to supply the correct addresses of persons whose inventions appear on this page, nor can we furnish information about when the product may appear on the market. Attorneys who prosecuted the patent cases can furnish the most reliable data. Copies of patents are available at ten cents each from the U. S. Patent Office, Washington, D. C.

Steering an Auto With Both Hands Off the Wheel

AT last the problem of the one-arm driver, so bitterly persecuted in most states, has been given attention. Z. H. Williams has taken out patent No. 1,777,189 for a device which enables the auto driver to guide his car without using his hands. As noted in the patent papers, "This invention aims to provide a means whereby the driver of a motor vehicle may control the steering wheel with his knees . . . thereby leaving the hands free for operations other than steering." Should prove popular with the younger generation.

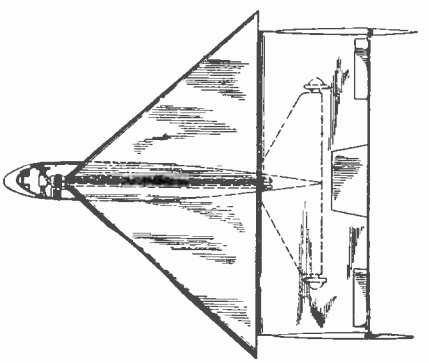
Safety Exit for Submarines

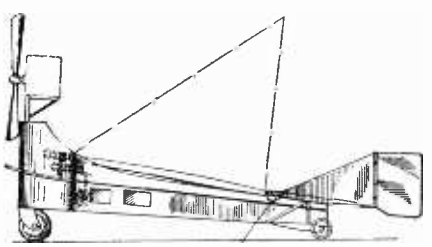
SUBMARINE escaping devices appear to be popular with inventors nowadays, whether any of them are adopted, remains to be seen. After all a submarine is a war vessel, not a submerged picnic ground. This one is the invention of H. H. Stamper, patent No. 1,777,184. Essentially the device consists of a diving bell fitted with a tube protruding on one side which tube can be connected to a manhole which gives access to the interior of the disabled submarine. In operation the tube is bolted to the manhole under water by a diver; a plate which has closed the tube and the manhole cover also are removed and a watertight avenue of escape from the submarine to the bell is established. A number of escape tubes should be incorporated in the submarine so that all parts of the ship can be easily evacuated.



Airplane Wings Do Double Duty as Sails

JUST as soon as one man perfects a new device another follows swiftly in his wake and announces that he has made the latest machine fool proof. Mr. Emil Just has endeavored to do exactly that very little thing for the airplane, if we interpret letters patent No. 1,773,361 correctly.





The inventor has provided his novel ship of the air with wheels both fore and aft so that it can safely make contact with Mother Earth, pontoons to allow it to ride the waves and a pair of wings which have been so joined to the fuselage that they may be raised and used as sails, converting the plane into a sailboat should the motor fail.

Making a Compact Oak Bedroom Suite

(*Continued from page 919*)

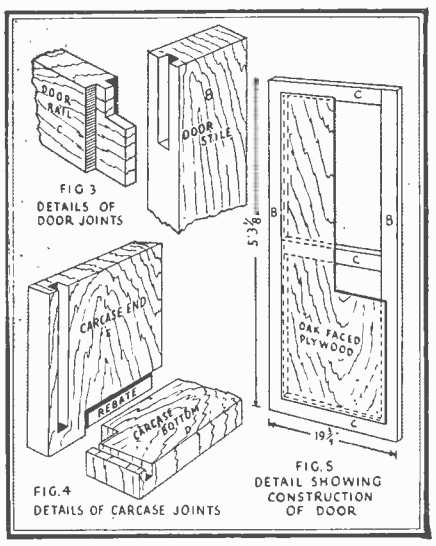
thickness, should be pinned on to this door frame and the pin holes stopped with grey wax filling. This panel should overlap the inside edges of the rails and stiles by ¾ inch.

For fitting to the carcase, ⅛ inches is allowed on the width of the rails and stiles. An alternative method of construction is to frame a solid panel into the stiles and rails Fig. 8. This is the best way but is more costly and entails much more work, and is therefore given as a second choice.

The decorations on the door and haffits (P, Q, R, S) are not very elaborate. The white panel and haffits are raised to a thickness of ⅛ inch. Those on the haffits are to be circular fret cut. The top facings (R) and (S) are also raised off the white sycamore facings to a thickness of ⅛ inch. These are allowed in ebony or might be of birch and ebonized. The facings should be glued and pinned only to the panels, and the pin-holes stopped. Lastly, rub the whole job down carefully with fine No. 2 glass paper, taking care not to cross the grain of the wood.

A suitable section for an ebony turned knob is given in Fig. 9. This could be carried out by a local turner very cheaply. The knob is not intended to turn a latch, but simply fixed to the door-stile by screwing and glueing.

The interior fittings comprise a shelf (K), hanging rail (L) and brass rod and hooks. The shelf might be fixed about 8 inches or 10 inches down from the underside of the carcase top on bearers.



Details of the carcase and door.

The hanging rail should be screwed to the back framing (G) and (I) directly under the shelf, the brass rod being secured central lengthwise of the job, about 2 inches down under the shelf.

The amateur polisher after a little practise, will find this finish quite simple. The wardrobe should first be well brushed the way of the grain with a stiff dusting brush, to remove all surplus dust in the grain and on any arrises. The whole exterior should be treated with a coat of grey water stain or diluted walnut water stain. When dry, it will be found necessary to rub down the raised grain with a fine flour paper, this to be done very lightly. Afterwards treat with another coat and leave till quite dry. A coat of French white polish should then be rubbed on and papered down till dry. This coat of polish is essential as it prevents the open grain of the oak from absorbing too much of the preparation applied for the finishing coat.

To make this preparation obtain some of the best white lead and two or three cubes of Reckitt's blue.

Thin down to the consistency of paint, grinding the blue cubes to a powder. Gradually mix this blue powder with the white lead until a light blue color is obtained.

A wad of soft cloth should be made up into a pad and soaked in the mixture. The whole exterior of the wardrobe might now be covered with a coat, except the bases, which are to be ebonized.

When the coat has been on for about five minutes or less, wipe off the entire job with a piece of chamois. The wiping off must be well and thoroughly done, and the blue paint should be left in the grain when the surface is clean.

Afterwards get a good soft cloth and well polish the job until a gloss is obtained. No coat of French polish is needed on top of this preparation. This finish is final, and when dry will never rub off or rub out of the grain, not even when washed.

It is well for the beginner to try a couple of sample panels first in order to get the right blue shade and the right way of applying it. The effect, when finished correctly, is a pleasing harmony of white, blue and black, as well perhaps as something distinctly modern.

THE CUTTING LIST

	Long Ft.	Long Ins.	Wide Ins.	Thick Ins.
A—1 Block	1	8	4¼	1¾
B—2 Door stiles	5	3⅜	3	⅞
C—3 Door rails	1	4¾	3	⅞
D—2 Top and bottom	3	2½	19½	13/16
E—2 Carcase ends	5	4¾	20	13/16
F—2 Pilasters	5	4¼	2	13/16
G—2 Back stiles	5	4¾	3	⅝
H—2 Back rails	2	10½	3	⅝
I—1 Muntin	5	0¾	3	⅝
J—2 Cross rails	1	4¾	3	⅝
K—1 Shelf	3	1½	17½	⅝
L—1 Hanging rail	3	1½	3	⅝
M—2 Haffit panels	5	3⅞	8⅞	9/16
N—1 Door panel	4	10⅝	15¼	¼
O—4 Back panels	2	4½	15½	5/16
P—1 Facing			8	⅛
Q—1 Facing			6¼	⅛
R—1 Facing			5¼	⅛
S—1 Facing			4½	⅛

Metal fittings as follows: Three 2½ inch brass hinges; one wardrobe cupboard lock 1 inch to pin, to left; one brass thread escutcheon; one ¾ inch diameter brass rod, length 3 feet, 1⅜ inch; six sliding brass coat hooks; six fixed ditto; two French pyramid catches for doors; four 1-inch silvered domes of silence for blocks.

The above sizes are strictly net, with the exception of the door stiles and rails which are allowed ⅛ inch wider for fitting to carcase. Allowance must be made therefore for planing, cutting and general cleaning up.

A Telephone Niche

(*Continued from page* 914)

or it may be lacquered or finished in other artistic ways.

The half round molding is cut in the arch curve as a finish for the upper half of the niche and nailed on. The same half round molding is made to form a square 14″ × 14″, mitered at the corners and nailed on the outer edge of the lower half of the niche. The removable panel, Fig. 4, fits in this square. One inch brads should be used and the holes filled with putty tinted the same color as the woodwork.

A practical place was found for the telephone directory underneath the chair seat. (Fig. 5). It can be pulled out easily by placing the palm of the hand under the chair seat and slipping it out. It can be easily replaced, is out of sight and always accessible.

The directory holder is shaped as shown in Fig. 5, and made of soft pine. The front is left open to insert the directory, the curve being cut out so that it can be more easily slipped in and out. Two pieces of pine, ¾″ × 1″ × 10½″ for the sides and one ¾″ × 1″ × 9½″ for the back were nailed from A to B, B to C, and C to D. This gives ample height for the directory of this community to slip in and out. If the directory is thicker increase the height of the three strips to insure ease of manipulation.

Molding Hollow Concrete Posts

A NOVICE often finds difficulty in getting a good surface on cast concrete, especially if the molded surface is in a vertical position.

The following procedure proved successful on a pedestal with a 10-inch diameter.

Insert a hollow tube, such as a rain spout, into the center of mold to act as a core. Fill the core with dry sand: Then cast the concrete very wet and as fast as it fills the mold draw up the core, being careful not to advance the position of the tube too fast. Cast a few inches of concrete at each pouring.

The gauge soldered on the bottom of the tube permits you to keep the bottom of the tube about 1 inch below the surface of concrete.

As the concrete is poured the tube is raised, permitting the sand to absorb the surplus moisture, avoiding laitance and segregation which are always present in a very wet mixture.

Removing surplus moisture makes a strong, dense mixture causing the cast to take its initial set quickly. Without an absorbing core the top portion of the cast will be disturbed by the passing of surplus water from the portion of concrete beneath, as water always works upward causing the top layer to be very weak and ugly.

This method of casting has the following advantages: It gives speed, economy, strength and beauty and can be used to advantage on columns, urns, boxes, posts, etc.—*C. L. Sample.*

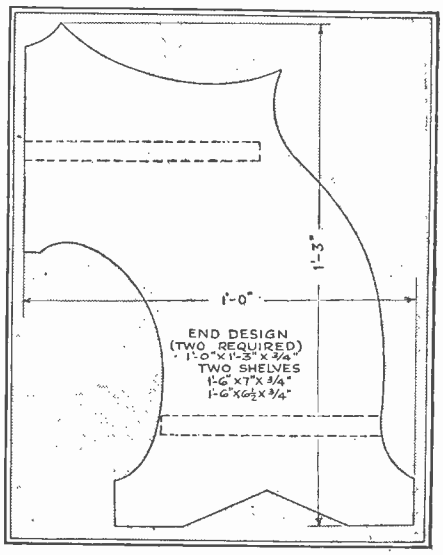
How to Make a Cut-Away Bookcase

By Dale R. Van Horn

IF you have an overflow of books you'd really like to keep handy, you can do it, even if your wall shelves, bookcases, and book racks are crowded. Just make a cut-away bookcase. It's child's play to construct, and, properly finished, will be an ornament for your living-room table, for standing against the wall, or for putting on your dresser.

All the bookcase consists of is four pieces of wood—two of which are alike. It will take but a short time to cut out and put them together. Scrap lumber is an excellent source of material, but you can get a white pine board six feet long and twelve inches wide for very little. This will insure good, clean lumber to work with.

The end pieces are of the size and shape shown in the accompanying cutting chart. The design is transferred to one end of the board and cut out in a jiffy on the band saw. Lacking this, use a coping saw. Then smooth up the edges with sandpaper. In addition to the two ends you will need two shelves 18 inches long. One is 6½ inches wide; the other 7 inches wide.



This drawing shows clearly the outline design of the ends and the staggered method of fitting the shelves. Full dimensions are also given.

Assemble with 8-penny finish nails, countersunk, and apply best quality liquid glue to the shelf ends. Run a thick line of glue along the ends midway between the sides, then nail, and the glue won't ooze out. Countersink the nail heads and cover flush with putty.

Note that the bookcase sets away from the mop board and a step effect is created. Yet the job has pleasing lines and while it naturally belongs against the wall, it will set out without support, with or without books on the shelves. If you have a spindle shaper, the edges of both the shelves and the ends can be made nicer, but as it is, the result is sturdy and substantial.

The finished cut-away bookcase. Note the pleasing, unusual lines and the sense of stability, even though it does not look cramped when placed against the wall.

The shelves shown were painted gray, then edged with Chinese red—a pleasing combination. The finish can be done equally well in gum, either sap or select and stained. Or walnut or oak stain can be used and the usual clear finish applied afterwards.

As a matter of fact, you may find this little case very useful for carrying out a color scheme in a room. As it is quite small, painting it a bright color will liven up a room, without giving it the bizarre effect some larger brightly-colored object might. If you wanted a particularly pretty case, you could use a transfer design for the sides.

One of these small sanders placed in a lathe will make short work of the smoothing up of the band saw cuts, and impart a clean finish.

Side Bands and the Stenode

(*Continued from page* 889)

the same way if we have a wireless transmitter sending out a carrier wave of constant frequency n, which is modulated by a microphone so as to produce fluctuations of amplitude with frequency m, the effect on a receiver at a distance would be just the same as if two carrier waves were being simultaneously emitted having respective frequencies of $\frac{1}{2}(n+m)$ and $\frac{1}{2}(n-m)$.

Since we cannot detect electric waves except by some receiver, it is impossible to decide whether the transmitted effect travels as a modulated single wave or as two unmodulated constant-amplitude waves, or whether the two components of the single wave are treated by or due to, the receiver itself.

A subject however which is extremely practical and important is the discussion of the qualities the receiver should possess in order that it may reproduce as accurately as possible the sounds made before the transmitter microphone, and which are transmitted as a modulated carrier wave train.

Every wireless receiver, no matter how complicated, is equivalent to a single oscillatory circuit having a certain inductance, capacity and resistance. The resistance absorbs energy and tends to damp out free oscillations.

The logarithm of the ratio of the amplitude of two successive free oscillations in the receiver is called its decrement.

Receiver Response

When a carrier wave falls on a wireless receiver, if the latter has a large decrement, the oscillations will take a relatively long time to work up to their maximum. If the carrier wave is stopped, then the receiver oscillations will die away quickly because of the high degree of energy dissipation. On the other hand, in a receiver with small decrement the oscillations will build up quickly but will tend to persist after the carrier wave impulse has been withdrawn.

When the receiver is picking up broadcast music or television impulses, there is a very rapid change in amplitude of the carrier wave incident on the receiver aerial.

Hence, in order to reproduce accurately, the receiver must respond to these rapid changes, or be very nimble. But the ordinary receiver cannot do this well. It has no sooner adjusted itself to one amplitude and frequency modulation than the incoming wave changes to another amplitude and modulation frequency.

The irregular variation of amplitude may however, in virtue of Fourier's theorem in mathematics, be resolved into the sum of a number of components of simple harmonic modulations, each of constant amplitude and frequency. Each of these in turn can be resolved into the sum of a pair of unmodulated constant amplitude carrier waves of different frequencies which constitute a pair of the so-called side-band components. The whole complex, irregularly modulated carrier wave is resolvable, then, into the sum of a number of pairs of constant amplitude carrier waves of different frequencies.

The ordinary receiver seems to be able to swallow this complex spectrum of carrier waves each element of which is of invariable amplitude and frequency, and to reproduce approximately the effect of the incident modulated carrier wave by their combination, provided it is not too selective.

Hence it is common to say that, in order that a wireless receiver may reproduce music well, it must be able to respond to the whole range of frequencies in the width of the component wave-bands.

Selectivity Versus Quality

But that implies that the receiver cannot be very selective and hence it will also be liable to be disturbed by picking up other carrier waves of wavelength different from that of the station it is desired to receive.

If on the other hand we employ a highly selective receiver with very small decrement, then each modulation of the carrier wave tends to persist even after the modulation has changed in frequency.

In neither case therefore would the receiver, whether of large or small decrement, reproduce with great accuracy imparted sounds to the microphone in the transmitter circuit, in the case of the receiver of large decrement, because there is a delay in building up the modulation oscillations, which most affects those of low modulation frequency, and in the case of the receiver of small decrement because there is a persistence of oscillation after the driving force is removed or changed to another frequency or amplitude.

In either case there must be a certain overlapping of the effects due to the individual notes of the music being transmitted and to a certain distortion of the sound, and hence neither the very selective nor the rather unselective receiver will reproduce perfectly the sounds which act upon the transmitting microphone.

It might be thought to be an impossible thing to combine these two different qualities due to large and small decrement in one receiver.

But Dr. James Robinson has found a number of ways in which this can be done, and has embodied them in his Stenode Radiostat.

In this invention, by the use of a source of interpolated electromotive force in the receiver, properly introduced, he so to speak nullifies the resistance or energy-dissipating power and gives to the receiver the power of building up very rapidly the oscillations corresponding to any particular incident wave.

This alone, however, is not enough. Dr. Robinson goes one step further.

He applies also an appropriate counter-electromotive force to quench out the modulation oscillations as soon as the driving force is withdrawn or changed.

The result is to produce a receiver which is not only very highly selective but which responds instantly to changes in modulation frequency or amplitude.

This is very important in connection with television transmission.

In this case, as the scanning spot of light in the transmitter runs over the object or subject we have a very rapid and irregular variation in the photo-electric current, that is in the amplitude of the carrier wave. The complete period is large—say about 1/16 or 1/20th of a second.

This irregular variation can, by Fourier's theorem, be resolved into the sum of a number of simple harmonic oscillations of constant amplitude and frequencies in the ratio of 1, 2, 3, etc.

To reproduce in the television image all the necessary detail we have to transmit and make use of the higher harmonics in the Fourier analysis of the irregular modulation. Now this involves, on the side-band theory, a very great frequency difference between the two side-bands. But on the broadcast waveband we are limited to an overall side-band width of ten kilocycles.

Hence we have to use either a very short carrier-wavelength, with corresponding disadvantages, or else we have to sacrifice detail in the image.

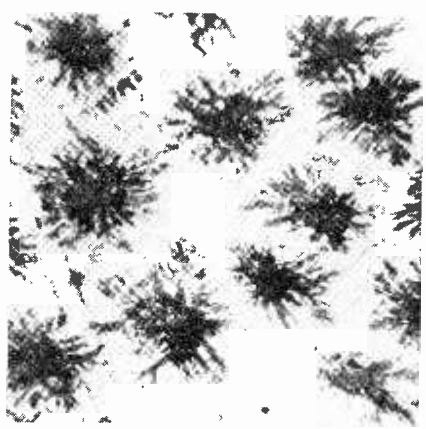
The Stenode Radiostat offers a way out of the difficulty by providing a receiver which is highly selective and at the same time highly responsive to rapid changes in modulation amplitude or frequency superimposed on the carrier wave which then need not have extremely short wavelength.

What Gives Fish Their Colors?

Following Up Last Month's Article on Butterfly Wings, Here Is Data on Fish Colors

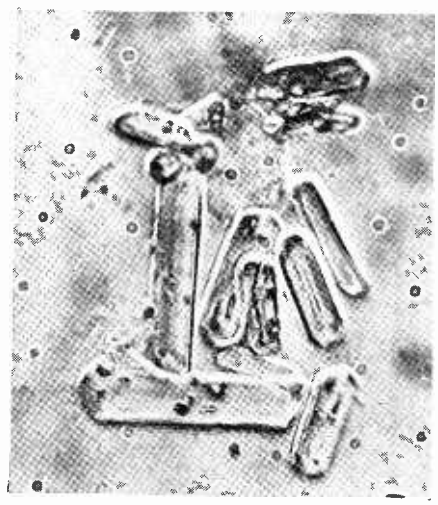
By Don Silver

That which we call color originates in different ways in various orders of animals as well as insects. In fish the tints are obtained by means of either lipochromes, which are fatty pigments chemically united to the fat of the dermis (the connective tissue found just below the epidermis or outer skin) or color is produced by special cells (the chromatophores) which give the fish the ability to maintain a constant color or enable them to change color rapidly. The chromatophores are much branched star-shaped cells containing pigments which can expand or contract. They are active without the knowledge of the animal, for they are under the influence of sympathetic nerves.



Chromatophores of fish, enlarged 320 diameters.

Within the chromataphore are tiny grains of brown, red, yellow and black pigments which follow the motions of the chromataphores, or color cells. Green and blue pigment cells are absent, these colors are produced by running one pigment over another. If, for instance, the chromataphores with a red pigment expand, that part of the body will be colored red. When these pigment cells contract, the red color disappears. As a general rule, the colors of the fish are quite variable, especially the vivid coral fishes which can, and do, change their color so rapidly that within a few minutes they can not be recognized.



The Guanine crystals seen through a microscope.

The silvery sheen of the fish is produced by minute crystals of guanine found in special cells situated on the under surface of the scales. From the optical point of view this silvery glaze is an important protective medium. When the fish is swimming near the surface, an enemy at a distance below him can not see his prey, for the crystals reflect the light just as the light is reflected from the surface of the water. The fish becomes visible only when the enemy is close. Nor is the fish silvery when seen from below; it takes on the color or tint of its surroundings, just as the water takes on the color of its surroundings.

New Tools That You Can Easily Make

By Joseph Pignoni

A Perfected Screw Driver Bit

AN ideal and practical problem for the student or home machinist is detailed in Figs. 1 and 2. This useful tool is purposed as a bit attachment for the push type of automatic screw driver. Its main advantages over the common bit, is that it can not slip out of the screw slot, and that it cannot offset in the slot, to tear a wide hole around the screw head. Likewise, it possesses advantages over other perfected attachments of its class, in that no manual adjustment or manipulation is essential for its proper functioning. After inserting the driver blade in the screw slot, no further attention is required, even to drive screws below the wood surface. As a result, we might safely term this a fully automatic device.

As is apparent in Fig. 1, the bit is comprised of four main parts; Firstly, the shank with one end formed as a screw-driving blade. Secondly the knurled sleeve, freely rotating around this shank, one end of which is bored and turned to a bell form, and the other end of which rotates freely around the pinned, stepped collar. Thirdly, a spring with washers bearing against each end, and fourthly, we have the stepped collar tightly forced over the shank and pinned to it. This pin also serves as part of a bayonet lock used to permit the bit to be used as an ordinary driver by retaining the blade exposed as in Fig. 2.

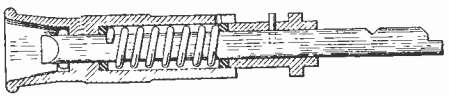


FIG. 1

FIG. 2

The shank can be made in either of two ways. It is easier to procure a drill rod 9/32 inch in diameter (or of a diameter to fit the available driving tool chuck) and about 4¼ inches long. Forge one end to a screw driver blade form, and shape the other end to fit the particular chuck of the tool at hand. Harden and temper it properly, then shrink over the shaft immediately behind the blade, a small collar ⅜ inch in diameter by 3/32 inch thick. This collar bears against the bottom of the bill and prevents the knurled sleeve from being sprung out. The other way to make the shaft, is to turn down a ⅜ inch drill rod to the same dimensions and form as the previously described assembly.

Figs. 1 and 2 amply describe the component parts although a few suggested dimensions might aid. The knurled sleeve is 1⅜ inches long and its external diameters are ⅝ inch at the bell and 15/32 inch at its inner end. Internally the sleeve is ½ inch at the bell and ⅜ inch around the spring.

To use, grasp the knurling and draw the sleeve up to expose the blade; insert it into the screw slot, and release the knurled sleeve. At some point during the course of the screw's insertion, the bell of the knurled sleeve will touch the wood surface. The friction resulting will cause the sleeve to cease rotating with the shank, and no marring of the wood surface is possible.

A Clock and Watch Oiler

A DECIDEDLY superior and most efficient tool for oiling fine mechanisms can be made by simply grinding an old worn out ruling pen to a slender, tapering point as shown in Fig. 1.

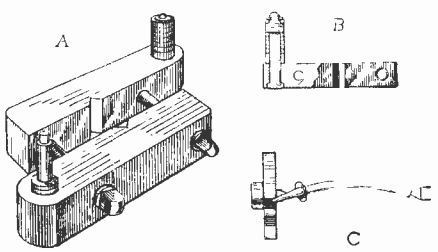
The quantity of oil discharged at a touching depends directly on the screw which ordinarily controls the thickness of line when the device is used as a ruling pen. You will observe that it will retain a vast quantity of oil which will not drip prematurely.

Clamp Dog

WHILE the lathe dog is an efficient and practical tool of itself, very frequently it is called upon to drive long, slender work which should be handled by a collet. Inevitably, the ordinary dog or clamp dog will twist the work as in C of Fig. 4.

A very practical clamping and driving tool is shown at A of Fig. 4, which, it will be noted, is perfectly balanced to start with. The driving force is transmitted to the work through both arms of the dog.

As at B of Fig. 4, both arms are constructed identically, except that one has tapped holes and the other, clearing holes. An important innovation to be noted, is that, each driving stud is covered with leather or fiber washers. The purpose is, to reduce, if not eliminate chattering which is injurious to dead smooth final cutting on small diametered work. Be certain, before hammering them in place, that the washers will fit in the face plate slots.



Miniature Golf Course

(*Continued from page 892*)

a few suggestions on some of them may be of help.

The "Cloverleaf" hazard is very easily made, and calls for an inclined board set up with braces on the back, and with two or more holes cut through it, these holes being sawed out with the coping saw.

The "Tunnel" calls for more skill in construction perhaps than any of the other hazards. This piece is made up in two sections lengthwise and glued together. There are many ways in which these semi-circular troughs can be cut. They can be sawed and chiseled out, and smoothed up with a file and coarse sandpaper where only hand tools are available. Where a circular saw can be used, many cuts of varying depths will remove most of the stock to be taken out. At one end the bore of the tunnel must be flattened out on the bottom, and tapered down to permit the ball to roll up into it.

The "See-Saw" is exactly what the name indicates. It must be so balanced that the ingoing end is the least bit heavier and will remain down until the ball passes up over the incline. The pivoting journal is made with two screw eyes and two round head screws.

The "Bridge" is a two-way incline tapering in width to the top on each side.

The "Bank Shot" is one that perhaps should be tried out during construction. If the right angle for the corner piece is not secured, the ball will probably roll back down the same section into which it is driven.

The ball in the "Come Back" hazard will not come back if the player is lucky or skillful, the game being to send it on toward the hole beyond, rather than to let it return to be shot over again.

The "Gate" is a very simple hazard to build, but not such an easy mark to shoot at. The problem, of course, is to hit the swinging gate and pass on through without passing out at either side. The gate is hung or pivoted on nails or screws.

The "Hoop" is an incline with sides, leading up to a small barrel hoop mounted on a standard through which the ball must pass. Lacking a small hoop for this standard, a large one may be soaked in warm water and bent to any size desired.

The "Trough" is nothing more or less than two flat pieces nailed together forming a trough set up at an incline.

The holes, for indoor use particularly, are made from pieces of wood about 1⅛" in thickness and 8" square, beveled on all four sides, with a 3" hole cut through the center. This hole may be cut either with the coping saw or by mounting the block on a face plate and boring out in a lathe. A standard made from a piece of ⅜" dowel, with a small numbered flag on it, should be mounted on each base.

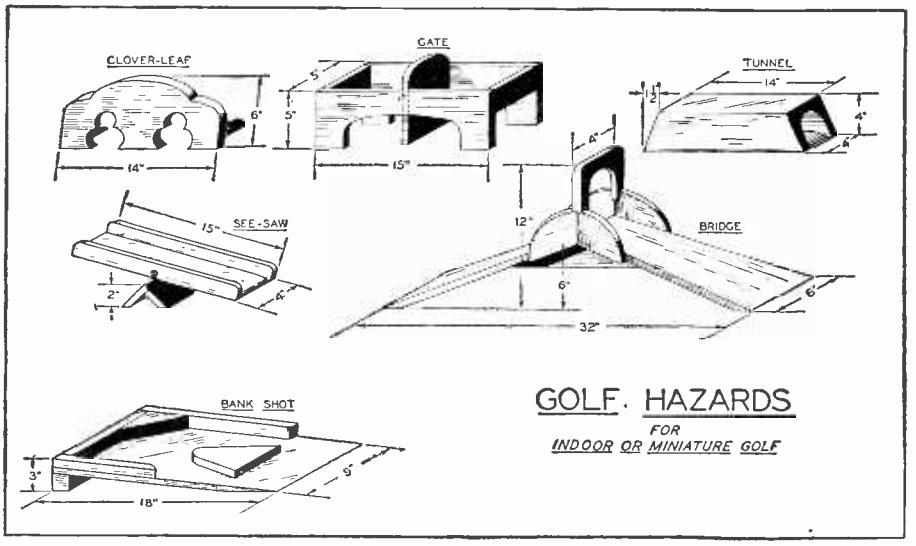
Where space is limited, the six hazards may be sufficient. Only general dimensions are furnished with the drawings, but the builder after making one or two hazards will find no trouble at all in proportioning them.

A short nap rug on the floor will give a better surface on which to play than the bare floor itself, and a close clipped lawn will do very well for outdoor use.

Painting the different parts in one gay bright color, and trimming in another, will add very greatly to the attractiveness of the golf hazards.

The flags may be made of tin painted white, with the number painted on in a dark color, or they may be made from heavily sized white cloth, such as that used by sign painters.

As to equipment, the writer has found very satisfactory golf sticks at fifty and seventy-five cents, and balls for twenty-five cents each.



Showing the details of construction and dimensions of the various hazards.

Speedy "Pumpkin Seed" Outboard Motor Boat

(*Continued from page 897*)

bottom portion of the boat should be painted, followed with several coats of varnish, each smoothed down with fine sandpaper. And if you want a real fast job you can sift powdered graphite into the final coat of varnish, which can then be rubbed in and polished after it is dry. Ordinary lacquer mixed with a thinner in the proportion of 2:1 will tighten up the canvas deck in perfect shape, and make a trim looking job.

Bear in mind that as these little boats will not be subjected to the strain of excessive power, the construction can be simple and light. The boat as outlined here, however, is sturdy and well built enough for any sort of going as long as it is not overpowered. It is essentially an "A" class boat suitable for use by boys. It has extreme maneuverability and can be stored in almost any nook or corner of the garage attic.

A suitable trophy will be posted by the Association to be awarded at the close of the Florida season to the driver making the best record in this new class.

This snappy little racer has been adopted by the A. O. A., as the official Junior "A" Class hull. It is the product of the combined efforts of the author of this article who has won 49 first places in his last 55 starts, Dick Pope who designed the Boyd Martin "Bullet," Century "Cyclone" and many other World Champion boats, "Doc" Schurmacher, Editor of *Modern Boating* and several books on outboard racing, and George Smith, who does the plans.

SCIENCE AND INVENTION is giving its readers a scoop on the plans for the new boat, weeks and months ahead of the rest of the boating world. The Fold Light Motor for Juniors and the Elto, Lockwood, Johnson or Caille for regular "A" class racing are recommended.

Highlights of the Science and Invention Tool Contest

The judges are now busy with the thousands of entries that have been received in the SCIENCE AND INVENTION Ideal Home Workshop Contest. Names of the prize winners will be announced in the April issue, on the newsstands March 10th.

$3,250.00 worth of tools will be delivered to the fifteen winners, five will receive $400.00 worth of tools each, five $200.00 worth of tools each, and five $50.00 worth of tools each.

Prize winning entries will be published, the names of the tools and the names of the manufacturers of those tools, as well as the list prices, will be itemized.

Unless otherwise specified by the prize winners, the tools selected will be the very ones forwarded to them.

The Wonders of the Moon

(*Continued from page* 891)

down to tiny ones a few thousand feet across, which are scarcely visible even in the most powerful telescopes. In some parts of the moon these craters are so closely placed that they are literally piled one upon another in apparently aimless confusion. Older craters are partially or almost completely obliterated by the encroachment of newer ones. Many of the largest craters have peaks with tiny craterlets at the center. The walls of these gigantic pits tower to enormous heights; some rise as high as 20,000 feet, while individual mountain peaks may rise even higher. The rocks composing the lunar surface, in spite of their apparent brilliance, reflect on the average only about seven per cent of the sunlight that falls upon them.

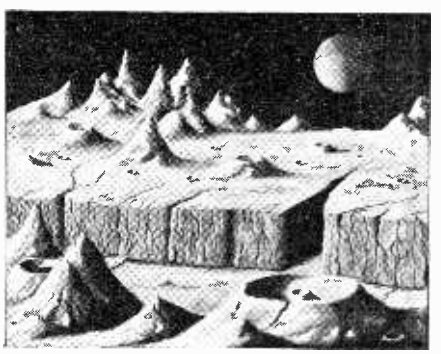
The Moon Has No Atmosphere

The moon is now a waterless and airless world. We know this because its surface is always clearly visible and because a star, when the moon passes in front of it, suffers no appreciable loss of brilliance, as it would if the starlight had to traverse an extensive lunar atmosphere.

Why does not the moon possess an atmosphere? It seems improbable that the moon should not have originally received a fair share of the gaseous elements. Certainly the volcanoes must have blown out gas and steam. Once, in the dim prehistoric, almost pregeologic ages, it is not unlikely that the moon possessed something of an atmosphere, but the lunar gravitation, one-sixth that of the earth was insufficient to hold it.

A man who on the earth is capable of leaping twenty feet in a running broad jump would be able to leap 120 feet upon the moon. To escape entirely from the earth's gravitational pull, a body must possess a speed of 7 miles a second; to escape from the moon a velocity of only 8,000 feet a second is required. The average speed of molecules in air is about 1,600 feet per second. Very occasionally a molecule may attain sufficient velocity to escape from the earth, but the rate of escape from the moon must have been much more rapid. These considerations explain why the moon has lost most of the molecules that ever went to make up its atmosphere. They do not necessarily mean that the moon possesses no gaseous envelope whatever; they simply signify that the present lunar atmosphere is at least 100,000 times thinner than the earth's. Even so low an amount as this is far from being a perfect vacuum.

The active terrestrial erosive agents, wind and moisture, being absent from the moon the mountains are just as jagged and rough as they were the day they were formed. There are several great gashes and a number of narrow, valley-like formations through the mountains, but it is almost certain that they are not old river beds. The surface of the moon is covered with cracks—great crevasses some several hundred miles in length, half a mile across, and of enormous, undetermined depth. Portions of the topography look for all the world like a sun-baked mud-flat magnified to a tremendous degree. It is not unlikely that these formations have been caused in part by shrinkage of the moon's interior and consequent cracking of the crust. The rough-hewn nature of the lunar mountains is best ascertained by observations, not of the mountains themselves, but of the jagged shadows they cast when the sun is just rising upon them.



A lunar landscape. Note the great cleft in the background. The jet-black sky is seen though the sun is shining, since there is no atmosphere to diffuse the sunlight and dim the stars.

What is the cause of these vast craters? Opinion has been, and still is, divided upon this question. A meteorite, an enormous mass of iron and stone, falling from the depths of space and crashing into the surface of the moon with a tremendous explosion would, no doubt, form some sort of crater. At least two craters of this origin are known upon the earth—one in Arizona and the other (formed in 1914) in Siberia. But there is at least one major objection to this hypothesis. The craters are not distributed with even approximate uniformity over the lunar surface, as one would expect them to be if they are mere chance collisions. The maria (plural of mare), for example, are almost barren of craters. Then, too, most of the peaks at the centers of the large craters have tiny craterlets within them. Note, in Figure 3, the regular line of small craters near Copernicus. The arrangement could hardly be the result of random collisions, though they might well be caused by localized volcanic activity. For these and other reasons, I favor the theory that these craters are, for the most part, ancient volcanoes, although the eruptions must have occurred on a scale far exceeding that upon the earth.

On the earth there is our atmosphere, which during the day protects us from the blazing sun and which blankets us during the night. We also have great

oceans, which absorb heat in the daytime and radiate it at night. The airless, waterless moon, consequently, gets very hot when the sun is shining and very cold when it is not. Careful measurements show that the temperature of the point just below the sun is some 30 or 40 degrees hotter than boiling water (212°F.) while that of the night side is probably colder than liquid air, about —375°F. This extreme range of temperature, together with the absence of water and air, speaks against the existence of any form of life there.

What a magnificent sight would have greeted our telescopes ages ago, when a thousand volcanoes were belching out smoke, fire, and lava. The lunar fires no longer glow and it is not improbable that our satellite is cold to its very core. We have watched carefully; we have compared recent photographs with old ones, but no signs of change have ever been detected. The moon is a dead world!

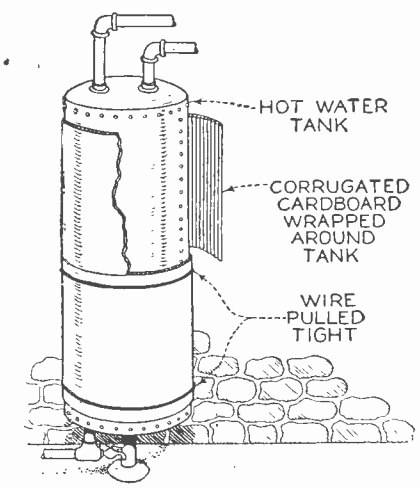
Insulating the Hot Water Tank

Are You Paying Too Much for the Hot Water You Are Getting?

By Raymond B. Wailes

NOW A DAYS when thought is being given to every item on the family budget in an effort to save money wherever possible, and curb expenses, we suggest that you inspect your water heating plant. Too often the hot water system warms that section of the basement which it occupies instead of serving its purpose. If the heat which uselessly escapes could be retained, a great saving would be effected in fuel cost.

The uncoated, undressed hot water tank is a great waster of heat. With its metallic walls and shiny outer surface, conditions are present which are ideal for the escape of heat from the hot water within. The least one can do is to paint the outside of the tank with a flat black paint. This will cut down the heat given off by radiation and thereby save fuel, but it should be remembered that all heat is not radiated directly outward from the tank and that such a black paint heat insulator is not by any means efficient.



A layer of corrugated cardboard wrapped around the tank will go a long way toward making your hot water reservoir an efficient unit.

If magnesia or some asbestos product cannot be used to cover a hot water tank, one will secure good results in keeping water hot in the tank by wrapping the tank with corrugated cardboard. Still air is an excellent nonconductor of heat. Corrugated cardboard, by virtue of its construction, is an excellent inexpensive thermal insulator, for it entraps a column of air in which circulation is almost nil.

In applying corrugated cardboard to a hot water tank, cloth strips will be found suitable for holding the sheets in position as they are wrapped about the tank. A roll of first aid bandage about three inches wide can be used.

One or more layers of the corrugated cardboard can be used, but if more than one layer is to be applied, it is best to wire the first layer on very tightly, biting the wire deeply into the cardboard. This will mash the corrugated walls, and make short lengths of air tubes between the corrugations. The motion of the air being thus restricted, the insulating efficiency is increased. If one or more layers are to be applied, one should bind the top and the bottom, about an inch or so from the end of the tank, with wire, wrapping the wire on so tight that crimping of the cardboard channels result. This will prevent up currents of air traveling through the corrugations and abstracting the heat from the inner surface.

You can also apply this insulation to any of the hot water or steam pipes that run through the house, and even to those pipes which extend out-of-doors and are exposed to the elements. However, when you insulate a pipe outside of the house it is best to bind the cardboard to the pipe with chicken mesh wire after which the entire job can be covered with a thin layer of concrete. It is an excellent idea to waterproof the concrete. The waterproofing mixture is made as follows:

First of all, take the ordinary thick syrupy water glass (sodium silicate) and mix two parts of it with five parts (by volume), of water. Stir and paint the finished concrete surface with the solution. Another coat can be given. It does not discolor the concrete and can be applied with a broom that is no longer usable for sweeping.

Serve Your Fruit in Model Ox Cart

(Continued from page 898)

ring goes in the bottom of the yoke and the other two are used to secure the ox cart to the base which represents part of a barn floor.

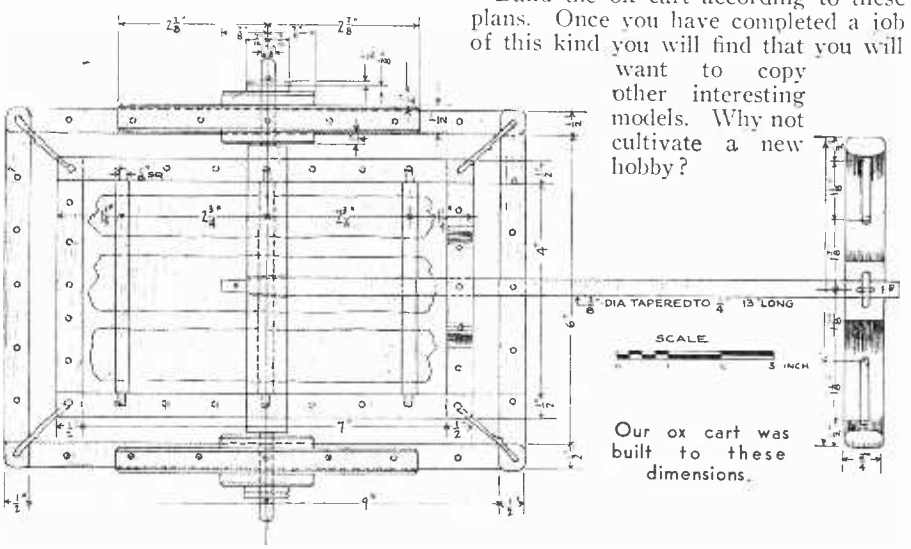
The base can be made to suit your own wishes. In this case it consists of three wooden floor beams, ¾″×10½″. On top of the beams are flooring planks, ¼″ thick.

After you have all the pieces made, take your knife and sharpen it. Then go over each piece; whittle and trim little chips out until the model looks as if it had been hewed out of large timbers with an adze. After that cut small grooves here and there with the grain.

The inside of the yoke and the bows and sides of shaft are sand papered smooth and waxed as though oxen had worn these pieces smooth. Then take each piece and give it a coat of dark oak stain. Let this stay on for just a short time and then rub it off. Black stain is used to touch up the grooves that you made with your knife, after which they are rubbed off with a rag. In other spots, just here and there, dab a little white lead and rub it in until you have black, gray and brown colors running into each other.

Then assemble the parts, using small brads and glue. Don't let any of the glue show. To mount the ox cart on the base cut a narrow piece of chamois skin about three feet long and ⅛″ wide, dip it in varnish or shellac and wring out the excess fluid. Then lash the cart to the rings in the barn floor base. That finishes the model and you can now place it where your friends can admire your craftsmanship.

Build the ox cart according to these plans. Once you have completed a job of this kind you will find that you will want to copy other interesting models. Why not cultivate a new hobby?



Our ox cart was built to these dimensions.

The Everlasting Riddle of India

(Continued from page 883)

production, might entail a loss difficult to repair.

Many interesting facts are recorded concerning the craftsmen of India and Ceylon. In the latter country, whole villages often were occupied by men practicing the same craft. As many as 500 carpenters thus worked in common at a single point. These craftsmen built houses to order for the surrounding country, handling the process from the logging work in the forest to the erection and finishing of the structure. Voyaging up a river, deep into the woods, they felled trees and prepared the lumber. Then in the forest they erected the house, numbering each part. In dismantled form they brought it to the home site and re-erected it.

Ceylon is also the locale of the institution of "King's Smiths," which flourished in ancient days. These were blacksmiths authorized by the King to handle all the work in heavy metals for a certain territory. Everyone in a King's Smith's district had to order all his blacksmithing done at the shop of the district smith, and both the customer and the infringing craftsman were fined for departure from this rule. This practice put the King's Smiths in the position of racketeers, and they soon learned to take advantage of it. They presently required their customers to bring their own iron, blow their own fires, and under directions, given no doubt from a reclining position, to hammer their own hot metal; when the rough work had been completed, the King's Smith deigned to inspect the job on the anvil, now and then putting in an expert tap.

Kingly patronage and social security have caused the Indian worker in fine materials to assume the attitude of an artist regarding his product, and to be less concerned about the time than about excellence.

That Cut May Cost Your Life

(*Continued from page* 888)

fence. His mother used an antiseptic but it failed to reach the invading germs in the depths of the wound. The entrance seemed to heal over rapidly while the infection beneath began its deadly work. The boy finally had to have his foot amputated. This wound should have been treated by a surgeon, who, if consulted earlier, could have opened the puncture so that the antiseptic would have reached all parts of the wound and prevented further trouble.

Many of us may have been conscientious in attending to cuts and scratches; yet painful and dangerous infection has resulted. Why is this? Frequently it is because we use antiseptics which are valueless as far as preventing infection is concerned. A number of these are widely used by the public. In fact, the United States Department of Agriculture recently issued a warning against fake and valueless antiseptics.

Major Edward J. Abbott, M.D., in a radio talk under the auspices of the New York City Health Department, declared that *intelligent speed* in giving first aid often means the difference between a *mere scratch* and *septicemia* (blood poisoning). "There are now many proprietary skin disinfectants which are widely advertised," said Major Abbott. "Most of them as prepared and if used as advertised are of doubtful value. Brilliant color or powerful odor may lead to a sense of security which a subsequent serious infection may prove to have been misplaced."

Insurance companies tell us that more people are injured by accidents right in the home than outside of it. Small abrasions of the elbows and knees in children, when treated with a weak, inefficient antiseptic, often develop into dangerous infections of the lymph glands. Many a housewife, in this era of the can-opener, has found that useful weapon to be her sworn enemy. I saw one woman whose hand had swelled to twice its normal size when infected, from a cut of this kind after the use of an inferior antiseptic. It was only with difficulty that her hand was saved from amputation.

Effective Antiseptics

But how are we to know *which* are *effective* antiseptics?

Tests have recently been made in some of our large hospitals and laboratories to determine the comparative value of various antiseptics in killing or arresting the action of common harmful bacteria. In these tests, tincture of iodine and Dakin's solution ranked highest in effectiveness in killing germs. Alcohol came next. The dyes proved least effective.

Dakin's solution was used during the World War for treating infected wounds with much success. However, in effective strength it is irritating to the skin and not so practical for general use as tincture of iodine. Ordinary rubbing alcohol also proved an excellent antiseptic.

While some antiseptics lose their force as they stand, tincture of iodine actually becomes stronger with age. This is due to evaporation of the alcohol in which the iodine is dissolved. Old tincture may smart when you use it (because it contains 8 or 9 per cent of iodine instead of the official 7 per cent), but there is no loss of antiseptic efficiency.

What do eminent surgeons, physicians and health authorities say about the importance of using effective antiseptics, such as iodine? They are practically unanimous in their opinions.

Treating Minor Wounds

Dr. Howard Lilienthal, eminent New York surgeon, is cited in a *Health Department Bulletin* as saying, "In the first aid treatment of accidental open wounds of any kind it is important to sterilize so far as possible not only the open surface itself but the surrounding skin, which always harbors bacteria which may easily infect the injured surface. Mechanical cleansing is of the greatest importance; but even before the soap and brush are employed I paint the surrounding skin as well as the wound itself with iodine."

The American Red Cross, in its first aid directions, says, "Iodine is the only disinfectant suitable for general use which is of sufficient strength to be efficacious. Painting iodine on wounds is unquestionably of value in preventing infection, but only if applied within two hours after the accident."

Iodine should not be cast aside lightly for some substitute which may stingless, which may stain the skin a prettier color or not at all, but which may lack the all important dependability in killing dangerous microbes in the skin.

Great industries have realized the importance of first-aid treatment for cuts, scratches, abrasions and other minor injuries to their employees. It has greatly reduced the number of days of time off of injured employees.

The treatment of minor wounds can be carried out intelligently at home as well as in business. Here are a few simple rules which anyone can follow:

1. Cleanse the scratch, cut or tear with soap and water. A reasonable amount of bleeding is not harmful. It tends to sterilize the wound by washing away dirt and dangerous germ invaders. If you are not near water, as for instance, on an automobile trip, apply rubbing alcohol or iodine immediately without waiting until you can cleanse the wound.

2. Where there is a large amount of dirt or foreign material in the wound itself—as in a knee bruised from a fall—remove this carefully.

3. Paint the skin around the wound and then the wound itself with tincture of iodine. Frankly, alcohol or iodine

will sting, whereas the ineffective antiseptics may not. But isn't it "better to be safe than sorry"? Iodine and alcohol penetrate the tissues so deeply that they decidedly lessen danger of infection.

4. Apply a piece of sterilized gauze as a dressing and bind up the wound. Sometimes it is most convenient to hold a small dressing in place with adhesive tape. Never apply court plaster or adhesive tape directly to the broken skin.

5. Wounds heal more rapidly if they are at rest. For instance, a wounded finger subject to constant motion should be held quiet with a small splint.

6. If a wound has healed over the top but shows signs of inflammation, see your doctor quickly. Prompt treatment may save you serious trouble from blood poisoning.

After the cut or bruise has healed, the iodine stain can be easily removed by dipping a small piece of cotton in a little diluted household ammonia and wiping over the surface.

For Fourth-of-July wounds and dog bites, application of tincture of iodine is helpful as a first aid measure. However, it is imperative that a doctor be consulted at once. Tetanus antitoxin may be needed to prevent lock-jaw in the case of the firecracker or blank cartridge injury. And a dog that has bitten must be kept under observation until the authorities are sure that it is free from rabies, because the Pasteur treatment—used in time—may save the victim's life.

Every home, every motorist, camper or traveler should have at hand a simple first aid kit for prompt treatment of cuts, scratches and abrasions. Such a kit can be easily assembled at home.

Take a small box with tight-fitting cover. At any drug store you can get the few things which are necessary to put into it: a wrapped sterile bandage two inches wide, a small roll of absorbent cotton, a package of sterilized gauze, a two-ounce bottle of tincture of iodine (with rubber stopper), a small roll of adhesive tape, a dozen wooden applicators (or toothpicks) to make cotton swabs for applying the iodine.

Remember that prompt treatment of a small cut or scratch may prevent much suffering. Its neglect may cost your life. Remember, too, that cleanliness and the use of an effective antiseptic are necessary if blood poisoning is to be prevented and rapid healing assured.

Scientific Book Reviews

THE SCIENCE OF BIOLOGY, by George G. Scott; Professor in Biology; College of the City of New York. Published by the Thomas Crowell Co., New York City. Pages XX; 632. Price $3.75.

We always have had a soft spot, way deep down in our heart, for biology. So we gladly welcome each addition to the long list of texts on the subject. When the new book is set in large clear-face type, contains three hundred and ninety illustrations, and the subject matter is neatly arranged and as masterfully prepared as in this one, it deserves our appreciation.

Professor Scott's text is not a rehash of his previous work. Important additions have been made. Wherever necessary illustrations have been corrected to present newly discovered material. The subject matter has been divided into three sections: Biology of Plants, Biology of Animals, and General Biology.

Although the field covered is large and the scope of work wide, the material is detailed. Items such as Embryology, Genetics, and Cytology which are merely outlined, in a great many books, receive special treatment and considerable attention. The satisfactorily complete index and appendices are most helpful.

SONS OF THE EARTH, by Kirtly F. Mather, Professor in Geology, Harvard University. Published by W. W. Norton Co., Inc., New York City. Pages XV; 272. Price $3.50.

The average man is interested in the calculations which scientists make and the deductions at which these savants arrive. When he glances at his morning newspaper over the breakfast coffee and notes that Professor X states that the earth is many millions of years old, he would like to be able to say, "Just as I thought." Or, were he to read that the President of Backwater College predicts that the world will surely end in another billion years, his self esteem would rise immeasurably could he say, "Wrong again."

As it is most of the figures bewilder Mr. Average Man and he cannot comprehend many of the statements which appear in the press. With this in mind whole series of books have been written to acquaint the general reading public with the broad problems that face the technician and the solutions, whenever available. Good—we endorse and approve the movement. But we feel that a book of this nature should in no way be a textbook. A work of this kind should reduce matters scientific to every day terms. If part of the subject matter does not lend itself to this type of treatment—omit it. The man who finds the introductory work inadequate will seek more detailed sources of information. On the other hand, the average reader for whom the book is written is too often entangled in a mesh of polysyllabic words whose actual meaning he does not understand even after he has seen Webster's definition.

Now that that's off our chests let us say that we liked Mr. Mather's work. Mr. Mather undoubtedly expended time, effort and thought on his explanations of the geological terms which he used. However, he seems to disregard the fact that when a previously well-defined term crops up fifty pages after his clear exposition, the average

reader has completely forgotten its meaning. We feel that technical terms have dulled an otherwise most interesting piece of reading.

ALCOHOLOMETRY, by Francis G. H. Tate, Published by His Majesty's Stationery Office, England, XVIII: 93 pages.

When we read in the newspapers of an uneducated prohibition agent testing the alcoholic contents of beverages by a silly apparatus which gives the boiling point of beverages, and that punishment is to be meted out according to what this utterly inaccurate and unreliable instrument shows, we can see the importance to the average man of an accurate method of determining the alcoholic content, under the provisions dictated by the wisdom (Wisdom of our Legislators). One-half percent of alcohol *plus* or *minus* might mean imprisonment, fine, or the closing up of a business: the law allows specific percentage of alcohol on the basis of its being non-intoxicating. One-half percent more, curiously makes it what you might term "contraband." The absurdity of the law in attempting to define whether a beverage is intoxicat ng or not, is manifested clearly when you consider how individuals vary in their reaction to alcohol.

This book is written by an English author. In England the full contents of liquor has to be known for taxation purposes. It is a very full and valuable treatise of this subject.

HEREDITY, by F. A. E. Crew, M.D., Sc., Ph.D., F.R.S.E., published by Jonathan Cape and Harrison Smith, New York, N. Y. Pages 119. Price, $.60.

"He has his father's eyes and his mother's nose, but his hair is just like his grandfather's." Little bits of conversations like this are often heard when mothers attempt to describe their offspring. It is quite natural that they often wonder why "baby" has inherited these certain characteristics, why "Junior's" hair is similar to that of his paternal ancestor two generations removed, why his eyes are colored exactly as his father's, and why his mother's nose seems to be reproduced in miniature on his face.

Mr. Crew demonstrates that there are definite laws governing heredity and then attempts to explain why some characteristics (dominant) appear more often than others (recessive) and the conditions necessary for their production. He has divided his book into six chapters.

The Germ-Plasm. The Architecture of the Germ-Plasm, Heredity and Sex, Variations—Inborn and Environmental, Heredity and Animal and Plant Breeding, Heredity and Human Affairs.

It is our opinion that more space could profitably have been accorded to the chapter on Variations.

We feel that it is very difficult at times to follow the thought. While this can be ascribed partly to the inherent intricacy of the subject, the text could have been written in more popular style.

THE GREEN LEAF, by D. T. MacDougal. Published by D. Appleton & Co., New York; 142 pages. Price $2.00.

The functions of the plants are of enormous importance to the world. It has been aptly said if mankind covered the world with his roads and structures so as to abolish plant life, the oxygen of the air would soon be replaced by carbon dioxide, and man would have to perish. In this book is interestingly told what chlorophyll does in the life of the world; what part it plays in maintaining animal existence, in supporting plant life. The green leaf, from which this book takes its name, is the subject for a true romance of science.

The book is written in a popular way and we certainly feel that it can be safely recommended to our readers. The history of the earth is a story of plant life which has to be balanced against animal life. Each is doing its part in maintaining the other and this book's well-planned description of the relation between them is a good presentation of an all-important subject.

CONQUEST OF LIFE, by Theodore Koppanyi. Published by D. Appleton & Co., XII 263 pages. Price $2.00.

This book falls into the same class as the preceding one, one of a series of scientific publications termed "The New World of Science Series," under the editorship of Watson Davis. It touches on all phases of animal life from the general biology down through the functions of the almost mysterious ductless glands.

When the author refers to the point that the lowest animals can propagate themselves by simple division, cutting themselves in two, the question arises, "Is Sex Necessary?" which opens a very interesting chapter. This same chapter is certainly depressing in places. But it concludes with a warm appreciation of the married state as it affects raising and educating the offspring.

The chapter on the "Souls of Animals" is extremely interesting and the final chapter, "The Conquest of Disease" gives a fine idea as to what has been done for humanity by the medical and surgical scientific practitioners. It ends up with a good word for a really wonderful book "The United States Pharmacopaeia" the author being opposed (as was to be expected) to what are called patent medicines.

Reviewed books can be secured from the publishers or directly from our Service Department.

Answers and Prize Awards in November Puzzle Contest

First Prize, of $10, is awarded to:

E. D. Chisholm, 30 Grove Street, Rockland, Me.

Second Prize, of $5, is awarded to:

Andre E. Levy, Apartado 390, Mexico City, D. F., Mexico.

The ten prizes of one dollar each, are awarded to the following:

Roger F. Jacob, 1708 Mabert Road, Portsmouth, Ohio.

Norman W. Cote, 4 Grove Street Waterbury, Conn.

Margaret May, 4315 Twelfth Place, N. E., Washington, D. C.

Everett G. Barber, 709 So. Ninth Street, Salina, Kansas.

Carleton Gamage, 9 Jewett Street, Skowhegan, Me.

Edwin R. Shaw, 506 Lyon Street, N. E., Grand Rapids, Mich.

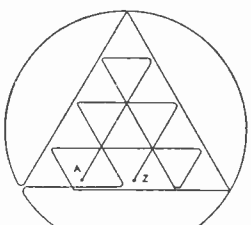
James B. Colson, 2nd. Lieutenant, Infantry, Fort De Lesseps, Canal Zone.

Charles H. Payne, 3272 Beresford Ave., Cincinnati, Ohio.

I. Cohen, 1415 Green Street, San Francisco, Cal.

Oscar K. Goolsby, c/o First National Bank, Waldron, Arkansas.

Solution to "The Seal of Ahmes"



THE accompanying diagram shows how the Seal of Ahmes can be constructed by drawing a continuous line of 14 strokes, counting the circle as one. Starting at A and ending at Z, the only part retraced is the little space between A and Z.

Twenty-seven different triangles of varied sizes are to be found in the design, viz.: 16 of the smallest, 7 of the next larger, 3 of the size still larger, and then the largest triangle, containing all of the others.

In that simple arithmetical question, since 19 represented a number plus one-seventh of itself, 19 divided by 8 gives us one-seventh of the number, viz.: 2 and ⅜, and the number itself must be 16 and ⅝.

Solution to "Speculating in Oil and Vinegar"

IT was told that at the time Tony had sold six of the seven barrels of oil and vinegar—oil selling at three times the price of vinegar—his respective cash receipts from the two liquids were alike. At the ratio of prices, it is obvious that he must have sold three times the quantity of vinegar that he did of oil.

One quarter of the number of gallons sold must have been oil, and three-quarters vinegar. This ratio necessitates the total quantity being divisible by four. Thus far our reasoning establishes that, omitting one barrel from the group, the others must have a total number of gallons that is divisible by four.

Four possible groupings of the seven barrels will qualify to this extent, viz.: 9, 12, 14, 19, 21, 29; 5, 12, 14, 19, 21, 29; 5, 9, 12, 14, 19, 29; 5, 9, 12, 14, 19, 21. But, when we come to test these groups for division into two quantities, one three times as great as the other, we discover that only one group, the first, is susceptible of such a division.

The six barrels disposed of must have been those containing 9, 12, 14, 19, 21 and 29 gallons. The barrels containing 12 and 14 gallons, a total of 26, held oil, and those containing 9, 19, 21 and 29, a total of 78 gallons, contained vinegar.

The 5 gallons which I bought for $4, must have been vinegar, for if Tony had disposed of his oil at such a low price (one dollar a gallon, with the exception of my barrel which brought 80 cents) he could not have made a profit, which it was told he had realized.

Selling his oil at $3 a gallon he took in $78. Of the vinegar he sold 78 gallons at a dollar a gallon, and 5 gallons at 80 cents, a total of $82. He invested $100, and sold off the stock for $160, thus reaping a profit of $60.

Solution to "Another Puzzle From Tony's"

SINCE Tony decanted five times as much vinegar with the 3-quart measure as with the 2-quart measure, and drew only full measures, the least amount that he could have drawn with those two measures is 36 quarts. 36 quarts deducted from 126 quarts (31.5 gallons) leaves 90 quarts to be drawn off by the 5-quart measure. No other multiple of 36 deducted from 126 will leave a quantity divisible by 5, so we have to conclude that Tony drew 6 quarts with the 2-quart measure, 30 quarts with the 3-quart measure, and 90 quarts with the 5-quart measure.

Toy Electric Range

HERE is an ideal miniature range for little sister. It is 9 7/8 inches wide, 7¾ high, and 5 deep. It is finished in black baked enamel, dipped inside

and out to prevent rust. The top is in one piece. The stove has a heat element under both burner and oven, and a pan under the bottom to enclose the heat element. A tea kettle, pie pan and sauce pan of aluminum are included.

Dependable Dowel Joints

By Charles A. King

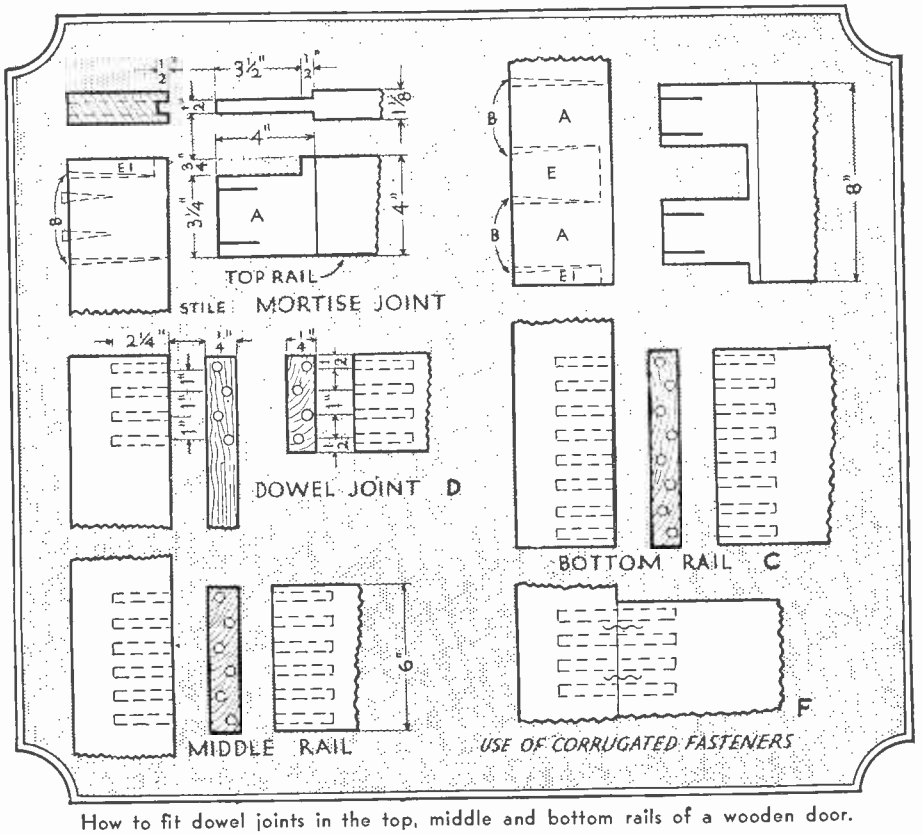
WE will grant that the mortise joint is favored by most draftsmen as the strongest for a certain range of construction in wood, but the writer maintains that its reliability is overestimated, for we cannot disregard the unavoidable and practically continuous shrinking and swelling of wood caused by periodic changes in atmospheric humidity and temperature which begin their weakening influence on the day the joint is made.

If the tenon A which is part of the rail or horizontal member of a door extends through the stile or vertical member as at B, its endwood is exposed to the weather and quickly absorbs or discharges moisture until it contains about the same percentage as the air. The stile shrinks or swells at right angles with its grain and the hold of the glue is broken by the changing relations of the fibers of the wood, until in time the glue is of comparatively little value in the strength of the door. This process is repeated with every change of moisture-content of the air and in long spells of very dry or wet weather the entire joint is similarly affected and correspondingly weakened. Whether outside doors, or doors in the interior of the house are exposed to summer dampness and the artificially heated and excessively dry air of winter are considered, the process continues, the results varying only in degree. When we realize that wood may shrink from 1/8" to 3/8" for each foot in width we can understand why cheaply made outside doors sometimes need considerable repairing, and why the strength of their joints records the passing of the seasons.

If a tenon is not more than four inches wide, we will say, probably the side wood of the mortise will be stiff enough to maintain contact with the tenons, but if wider, double tenons are usually made with strengtheners at E and another at E1 of the top and bottom rails to hold the sides of the mortises in contact with the tenon. Manifestly E1 is weak, for it is seldom more than one inch, usually about three-quarters of an inch long and may be easily split by the slamming of the door, by using too much force if the door sticks, or they may be cut away in fitting the door.

The dowel joint, the only substitute for the mortise and tenon joint has, in its poorest form, kept bad company so long that the entire type has acquired a reputation for inadequacy that is not deserved. In making a mortise and tenon joint a certain degree of thoroughness must be exercised, but a dowel joint seems so simple, so easy to make, that the craftsman is tempted to apply as little care as possible. This has resulted in gradually reducing the number of dowels in a joint, in making them too short, too loose, or too tight, to putting glue on the dowel instead of on it, and also in the hole, often using the cheapest glue and not enough of it. In fact the dowel joint is perfectly adapted to the needs of those manufacturers whose only ideal is to make furniture to sell, and to those craftsmen whose ideal of accomplishment is to "get it done," and the two form a large and congenial

(*Continued on page* 948)



How to fit dowel joints in the top, middle and bottom rails of a wooden door.

Tribulations of an Inventor

(*Continued from page* 895)

in one. I patented the suggestion and had the device built up. Steel was way up in price but that did not make any difference. I spent $800.00 trying to get this on the market, after which I realized that I did not have enough business experience to handle it right. Today, I would not even attempt it. Fourteen years later, the suggestion came out in a comic supplement. The joke cost me $800.00.

Flags, Collar Buttons, Travelling Kits,—What Next?

Then came a ray of sunshine, a flag that will never go down. I provided a small ball with a lead weight at the bottom. I immediately had a model built, and on the strength of that model, orders mounted to over 200,000 within a very short time. A $900.00 profit was cleared. The flag was made to sell for ten cents although it cost the jobber only five. Unfortunately, all of the orders could not be filled, only 125,000 of these were made and sold. The reason we had to close shop was because we were unable to buy any more of the tiny silk flags that were fitted to the top of the ball. All imports from Japan had been shut off. The lesson I learned here was: "Do not count your chickens before they are hatched." Of course, it was no one's fault but just one of the chances a man takes.

But what's the use of lying down on the job. Take out another patent, perhaps this one will succeed. Accordingly, I invented a new collar button to use for the back of the collar band. I was offered a thousand dollars, spot cash, if the papers were in good order. After the patent had been issued, I went out to make my sale, but my prospect refused to go through with the deal. He stated that the claims were not solid enough and I realized that they probably were not as thorough as they might have been. So I was out the cost of the patent and the school of experience taught me another lesson: "Look over specifications and claims carefully. Check up on your attorney."

A flier in the form of a front collar button was never protected. One cannot expect to get rich by designing a product and keeping it locked up in the desk drawer.

The World War instilled me with a new thought. A travelling kit was designed at the request of an official who handled army supplies. The idea was to make a compact box that would hold everything a man needs for his morning toilet. A mirror, tooth brush, tooth paste, razor, soap, shaving cream, shaving brush, a small bit of alum and styptic pencil, all in a compact case. By the time a patent had been granted on this suggestion, the war was over. I might interpose that this had nothing to do with stopping the war.

But I was not through with patenting. My next thought was one that might have fooled the wisest of business men. A package handle was developed that had the added feature of serving as a means for tying the package, and when untying there was no necessity for cutting the cord. This would save time in forming packages and make a neat bundle that could be easily carried anywhere. Much to my dismay, I found that the idea was destined to be a complete failure. The large stores that might have been interested, demonstrated to me that it would cost more to advertise this article and instruct people how to use it than the device was worth.

Working my way East during these years, I finally secured a position as a salesman for an Advertising Display House in New York. One of my prospects was in the market for a new display stand. I designed one illustrated on these pages, and without even taking trouble to apply for a patent on the suggestion, and on the mere strength of the pencil drawing alone, I landed an order for $6,000. Considering some of my failures along other lines, this I thought quite commendable. Delving into the subject of display advertising, I found that practically every subway card was printed in the same old way. One looked exactly like any other, three or four color printing jobs with slightly different designs here and there. I anticipated that if a subway card could be constructed that would be unique and attention-getting, it might meet with a fair sale. Accordingly, letters were cut out on the card and were backed by aluminum or silver foil to reflect light and make the card as good as an illuminated electric sign. The experiment proved successful. A few weeks after the first card was shown to a national advertiser, he sent in his order and has since given two re-orders. Many signs are today being made along the same lines.

The Eternal Inventor!

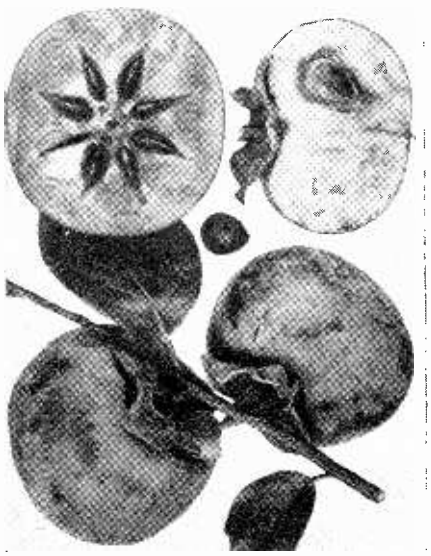
To say I have finished patenting would be a long way from the truth. Designing new inventions has grown to be a hobby with me. Some fellows collect postage stamps, some are song writers, others collect antiques. We all realize that if you patent the right invention at the proper time and handle it correctly, a profit will result. There is money in patents.

At present, I am furthering a candy box with a daisy game on top which will tell you whether a girl loves you or not, a night light with indirect lighting, and a party game that is meeting with considerable success. Exactly how successful any of these ideas will prove to be, must be left to the readers of SCIENCE AND INVENTION and other members of the public (who should be readers), to decide.

Introducing the Papaya, Loquat and Tangelo

(*Continued from page* 893)

In the land of palms and sunshine, where one finds cherries growing on bushes, gooseberries on trees, one is quite prepared to pick an enormous canteloupe from a tree. This is the papaya, tasting much like our popular canteloupe, though sweeter and richer and the flesh more tender. In ripening the flesh changes from white to a deep rich yellow and is from one to three inches thick. When cut in half, the surface of the cavity is found to be incrusted with small round gray-black seeds which look like sifted June peas. These seeds have a pleasant, peppery, nasturtium flavor and are a distinct addition to salads of any kind. The skin of this fruit is tender, thin and smooth, changing color, while ripening, from green to golden yellow. There is an increasing interest in the production of this fruit; refrigeration is rapidly solving the marketing problem. Its rich flavor has been found to be unimpaired after many weeks in storage. This "canteloupe tree of the tropics" is straight and branchless, with large deeply lobed leaves at the top which act as an umbrella to shade the fruit hanging in a cluster along the upper part of the trunk, the smaller ones grow near the top, the fruit is larger toward the base of the tree, the latter sometimes weighing thirty pounds.



The red-orange Japanese persimmon, which is much larger than our native variety.

Another new fruit is the Japanese loquat, which is about the size and shape of a seckel pear, with a smooth, thin skin and one or two seeds. It has a delicious sub-acid flavor between a plum and a cherry and is very juicy, which makes it desirable for jelly and preserves as well as being an interesting fresh fruit. The evergreen tree that bears this fruit in clusters grows in the Gulf States and California.

The pomegranate has long been an imported fruit procurable only in fruit stores where odd and unusual fruits were dealt in. It is now widely grown in our own southwestern states and the native fruit is appearing during the late summer months. It is near the apple in size. Encased in its leathery skin of red, orange yellow or purple is a slightly acid pulp which is eaten raw, or the juice is pressed from the fruit and the seeds may be made into a syrup for use in a beverage, as the flavor and color are so attractive.

The tangelo, a purely American fruit product.

Perhaps the tiny thorns that grow in the dark wart-like spots of the prickly pear will make many people hesitate to try this fruit, but they will be repaid if they do by the delicious orange-colored pulp they find beneath the vivid skin which shades from red to yellow and green. The housewife who likes new things will be glad to add the jelly made from it to the contents of her fruit closet.

The first time I picked up a green skinned orange and was told it was ready to eat I was doubtful about the salesman knowing what he was talking about. It proved delicious. This new variety of orange, thick as well as green skinned, is very juicy and is in the market in the late winter and early spring. Another new variety of orange is the result of crossing the orange and tangerine, and is known as the "Temple" orange. It has a thin, smooth skin the color of an ordinary orange and like it is firm in texture and juicy, but it tastes like a tangerine.

A unique fruit invention of Uncle Sam's is the tangelo, a combination of tangerine and pomelo, the latter meaning grapefruit. It is between the two fruits in size and though somewhat sweeter than the grapefruit, possesses much of its sprightly acid flavor. It can be peeled and pulled apart like the tangerine and has the most desirable quality of not squirting—so different from the grapefruit.

Who can predict how soon these fruits will be added to our daily bill-of-fare? Within the memory of many of us the grapefruit was an oddity, today it is a solid staple, procurable in even remote hamlets. It has made fortunes for those who saw its possibilities.

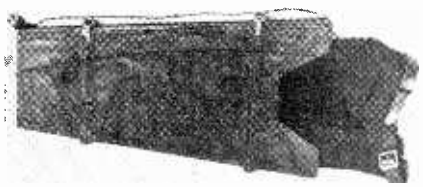
Scientific Aids to Your Comfort

(Continued from page 913)

at almost the same time! Or, if you prefer, separately—a double plugged cord permits you to shut off one of the units. The extremely attractive silver and black percolater holds six cups of coffee. In the rack beneath it, a slice of bread is toasted on both sides at once. When you remove the percolater, the heating element may be used as a stove for cooking eggs, bacon, or fruit.

Electric Press

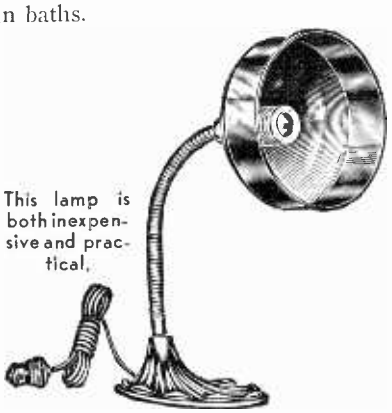
TO save the constant expense which is entailed in sending suits to the tailor for pressing, a very clever manufacturer has designed an electric trouser press. The device is both practical and economical. All you have to do is to insert your trousers between the leaves of the press, turn on the current



and wait the short time necessary for the wrinkles to be taken out of the article. It is quite convenient to know that whenever you deem it necessary, even though the tailor shop is closed, you can have your trousers pressed.

Infra-Red Rays at Your Command

SUNLIGHT contains a variety of rays. Health-giving, metabolism stimulating, pigment-producing radiations are included. The smoke and dust of cities, the atmospheric density of low altitudes, and the general uncertainty of sunshine all combine to make it almost impossible for the average person to derive the desired benefits from sun baths.

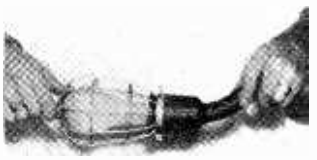


This lamp is both inexpensive and practical.

Infra-red rays, which form a good percentage of normal sunlight, can be produced cheaply and conveniently at home through the use of the pictured Infra-Red Lamp. Its goose-neck cable construction enables the user to focus the radiation on that part of the body which requires treatment.

Trouble-Shooting Made Easy

A NEW portable guard lamp is a late development. Practically troubleproof, it embodies no new devices. The desire to eliminate defects found in similar contrivances has dictated the necessity for numerous safety factors.



The rubber encased socket and handle are flexible.

The rubber incased cord has a moulded rubber plug and is led to the socket through a one-piece solid rubber handle. This handle is flared and rounded at the end in order to eliminate sharp bends in the wire.

Exteriorly the handle is shaped to provide a suitable grip. The interior supports a fibre disc. The wires are passed through holes in this disc and knotted. Strain transmitted by the cord acts upon the disc and knot alone; in no way are the socket connections affected. The electric bulb is protected by a ten wire, spot-welded cage, whose shape precludes rolling about. An aluminum reflector can be obtained which concentrates the light on the work and keeps the glare out of the user's eyes.

Triangular Leak-Proof Fountain Pen

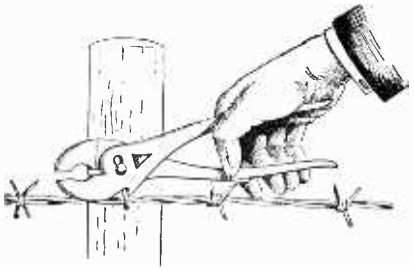
EVERY year manufacturers bring out new models in fountain pens. Usually these embody no distinct improvement or novel feature. But the latest pen is triangular in shape to fit the hand; this same feature prevents the pen's rolling off a desk or table. The point is adjustable to the angle at which you write. A single turn locks the cap securely in place, preventing the pen from becoming loose in the pocket. An air-tight pen chamber prohibits the possibility of leakage.

Pliers that Pull Nails

A PAIR of pliers is one of the tools most frequently used in the home and workshop. Sturdy construction and practical adaptation to work at hand is necessary. This pair of pliers is provided with an adjustment so that they can be used for jobs where the jaws must hold both wide as well as narrow objects. The efficient nail, cotter key and staple-pulling device located just back of the bolt should tend to make it popular. The appearance of the tool is greatly enhanced by the nickel-

All Devices Have Been Tested and Approved
Names and addresses of manufacturers

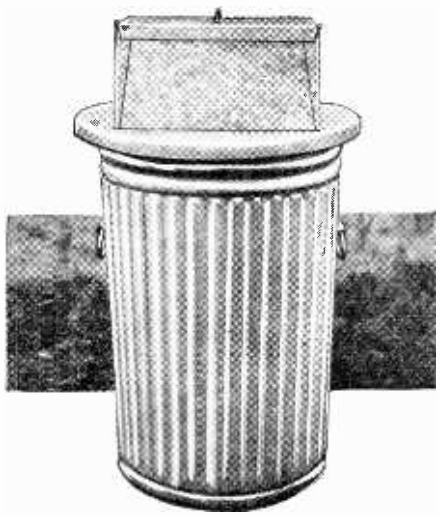
plating which covers it entirely and has the practical value of preventing the pliers from rusting.



Dustless Ashes

NOW that the winter is here in full force, those of us who have our own furnaces to attend are again confronted with the problem of how to do away with dust of the ashes that gets into our clothing and furniture.

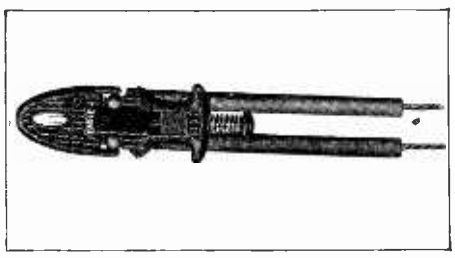
The ash can cover pictured above does the trick. Simply push the shovel containing the ashes through the swing door. As soon as you remove the shovel, the door automatically closes, preventing dust from escaping. The cover will fit all standard sized ash cans.



Current Test Light

VARIOUS complicated instruments have appeared on the market which serve as current testing devices. Neon glow lamps which are inexpensive are extremely practical for this purpose.

The one we have in mind is simplicity itself. It can be used for circuits whose potentials range from 110 volts to 550 volts and will approximately indicate the voltage by the degree of brilliance of the glow. It provides an absolute indication of the kind of current you are using, for only one electrode glows on DC and will also show which are the grounded and ungrounded wires in a circuit.



In Our Laboratory supplied upon request.

Dependable Dowel Joints

(*Continued from page* 943)

army. Thus it is easy for any one without the proper craftsman's conscience, to perpetuate the already bad reputation of this really excellent form of construction. The writer has seen two short dowels in a joint 6" wide.

However, we contend that *well-made* dowel joints used instead of the mortise and tenon joint in making ordinary doors, screen doors and panel work will need no apology, for they are abundantly justified by inherent merit and usage. For one and one-eighth-inch doors or less, three-eighths-inch dowels are ample and half-inch dowels will be about right for doors up to one and three-quarter-inch thickness. Each dowel should extend at least three-quarters the width of the stile into the stile to prevent the danger of splitting it by the slamming of the door; the dowel should extend into the end wood of the rail the same distance. Of course, the holes should be accurately centered and bored, and each dowel should enter its hole with an easy push fit; if too tight the dowel will be glue starved, if too loose it will not fit the hole, wood to wood; in neither case will the dowel hold with maximum efficiency. It is obvious that the dowels will be protected from atmospheric vagaries.

There should be one dowel for each inch of the width of the rail, hence their centers will be less than 1" apart on the axis of the rail. The dowels should be placed staggering, as shown, to give additional strength to resist the strain of slamming. Also the continuous line of the grain of the stile is less broken, which practically eliminates the danger of splitting it by a sudden wrench should the door stick in damp weather. The center lines of the two sets of dowels should be placed to allow about one-quarter inch between the outside of each line of dowels and the nearest surface of the door; in the case of a one and one-eighth-inch door the center lines should be one-quarter inch apart.

It is plain that the wood of the stile forms separate, wood to wood contact with each dowel and that no shrinking of either stile or rail can materially affect this contact. If the rails shrink, each dowel and the wood of both stile and rail will compress under the strain enough to allow the rail to move a reasonable distance either way without losing contact, for each dowel reacts separately from the others, instead of the variation affecting one piece, hence the dowels will hold the joint quite as well as a tenon. The weakness of El of the top and bottom rails of the mortise joint does not exist in dowel construction, for there is ample holding wood above the dowel. The joints of a screen door may be reinforced by corrugated fasteners or "dogs," for these light doors must stand harder usage than the heavier doors of the house.

And lastly, but not of least importance, if the dowel centers are marked carefully, if the holes are bored with reasonable accuracy, assuming, of course, that the joint between the rail and stile was well fitted to begin with, the amateur may be more certain of a well-made door than if he tried to make mortise and tenon joints.

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For the Home Machinist

(*Continued from page* 916)

job when the radius bar is exactly parallel to the lathe ways. It is not necessary to place the radius bar in line with the tool, as any location on the tool cross slide will serve to guide the tool correctly.

The turning of balls, such as are used in ball and socket connections, for conveying liquids or with oil tight ball and socket connections, in universal joints, is depicted in Fig. 5. This technique can be used with the small lathe without any special ball turning equipment.

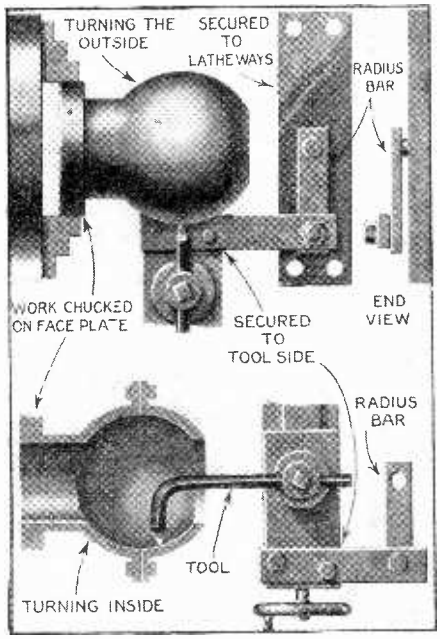


Fig. 5—Methods of turning the inside and outside balls in a lathe.

The set-ups are very similar to those employed for curved surfaces. A radius bar is made, in which pivoting holes are spaced a distance equal to the exact radius of the surface to be cut. A support is provided on the lathe ways, so that this end remains fixed with the lathe. From the tool cross-slide, an extension is provided to hold the opposite end of the radius bar. The tool is placed at the exact center of the larger diameter of the ball, when the radius bar is transverse to the lathe ways. From a study of the two illustrations, it will be clear how both the inside and outside of the ball is turned.

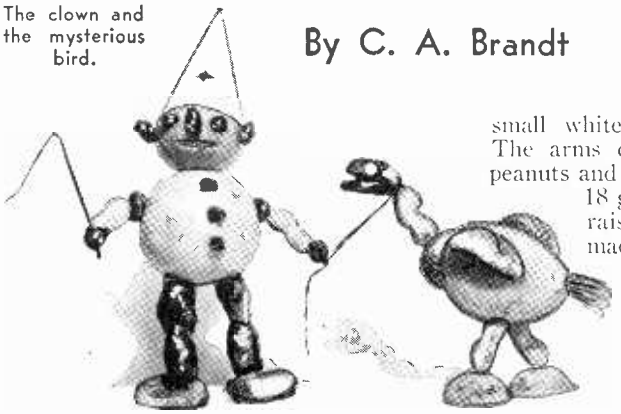
Germany's Radio Giant

(*Continued from page* 907)

established before the outbreak of the war. The United States Government ultimately had to confiscate Sayville to put an end to a secret cipher correspondence which constituted a breach of American neutrality. This service was conducted very precariously and Koenigswusterhausen was frequently called upon to assist Nauen in establishing or maintaining contact, for those were the pioneer days of long distance radio communication.

Bring Your Fruit Bowl to Life

By C. A. Brandt



The clown and the mysterious bird.

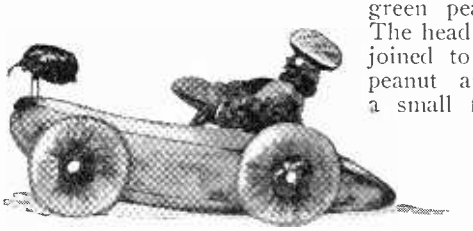
A PRETTILY and attractively arranged table with shining silver and sparkling glass is the finest contribution any hostess can make to the enjoyment of her guests. The use of flowers as an additional decoration is universal; equally so is a tastfully arranged fruit bowl, but since there exists the eternal search for novelties even in table decorations I suggest that the fruit bowl be brought to life by making comically attractive and clever figures or manikins out of fruits, nuts, etc. These manikins are not only easily made, but they are decorative, amusing and edible.

Tools and materials required: small hammer, small hand drill, (if hazel or Brazil or other hard nuts are used) wooden applicators or toothpicks pliable 18 gauge and 12 gauge copper wire, flat headed thin wire nails about 2 or 2½ inches long, black headed pins, a small knife and wire cutting pliers.

This weird monster is made out of a banana, raisins, peanuts, and a date.

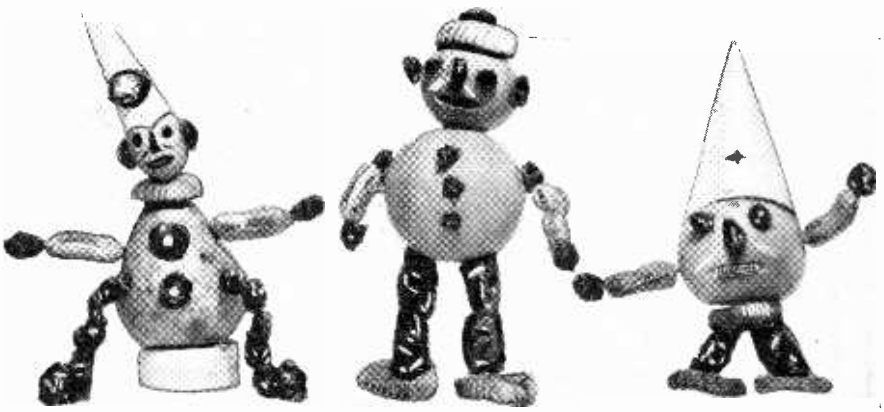
The Clown and The Mysterious Bird, Fig. 1. The clown consists of a small apple as a head with raisins for eyes, a prune for a nose, shell almonds as ears and small white beans or rice as teeth. The arms can either be made from peanuts and raisins mounted on pliable 18 gauge copper wire or from raisins alone. The legs are made from dates (use ordinary rather hard dates) the body is a small orange with raisins as buttons. The feet are made from figs or Brazil nuts. Two wooden toothpicks will hold head and body together and provide support for the legs.

The mysterious bird shown in Fig. 1 consists of a hard pear as a body. The head is a prune or date, shaped and cut to fit its purpose and the eyes are small green peas. The head is joined to a peanut and a small fig which serves as the neck, by a piece of pliable copper wire and stuck at a suitable angle into the pear which serves as a body. The legs consist of peanuts joined to walnut shells or Brazil nuts by means of wooden applicators or heavy copper wire. The tail of the bird can be made from pieces of an old whiskbroom or by depriving a feather duster of a few feathers.



The latest rocket car, which shot right out of the fruit and nut bowl during the holidays. This machine features a banana and figs.

The body of the racing car shown in Fig. 2 is a banana. The wheels are figs with large raisins as hubs. The driver is made as follows: make the head from a prune pressed into semblance of a head, small white beans serving as eyes, and fasten to a cut and fitted section of a small banana by means of two toothpicks. The arms can be made from dates, and a cap can be made from (*Continued on page* 955)



The Tasty Family, made of fruits and nuts.

Taking Care of Your Car

(*Continued from page* 911)

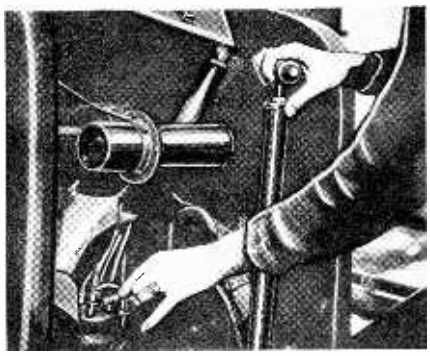
engine oil at the front end of the engine is another important consideration. It causes slipping and ruins the belt on cars which have a belt drive for the generator and fan. The covers, over the turning gears and the forward end of the crankshaft, can often be removed so that new gaskets and a felt ring may be fitted to correct this troublesome condition. Other hints for oiling the engine are noted in the center illustration.

Misaligned wheels, loose springs and a wobbly steering gear result from hard driving. Nothing racks the chassis more than ice and snow lumped in gutters, ruts and holes in the travel lanes of winter roads. It is true that misaligned wheels are not easily detected by the driver on his own car. However, they are very noticeable in another car that is running in front of yours. The front and rear wheels do not run in the same track. The rear wheels shift toward the lower side of the road.

Once or twice during the winter your car should be sent to the garage and the various parts to which we call attention in the illustrations should be examined. The practice of tightening up and adjusting parts as instructed should be adopted. Through the use of these measures misfortunes such as broken springs can be averted.

Tire Pump Dries Wet Wires

SOMETIMES after a heavy rain the motor in the auto refuses to run. Usually the cause is water dripping through the top of the hood and splashing on the spark plug wires, generator, distributor, or coil. The remedy for drying these wet parts is simple when the tire pump is brought into use, as the dampness can be quickly blown away with its aid. The force of air from the pump will reach every inaccessible place around the wet wire connections. After a few vigorous strokes the coil, distributor, and generator, will be as dry as before the shower.—*Ray J. Marran.*



Heavy thunder storms which occur suddenly, too often stall even the most smooth running car. Here is a way to dry out your ignition system quickly and expediently, if you are unfortunate enough to be caught in a downpour.

Escaping Neptune's Clutches

(*Continued from page* 881)

"How tall is the tank?" asked Wallington.

"One hundred and thirty feet, including the observation tower at the top," was the response. "The tank measures eighteen feet across and the water is one hundred feet deep. The observation tower and this sub-compartment account for the additional thirty feet."

"You asked the 'why' of the pressure test," Momsen said turning to Wallington.

"Submarines operate under water by means of oxygen tanks. We not only breathe the oxygen but also use it to equalize to some extent the pressure on the outside of the sub," he went on.

"In an emergency the men are instructed to get to one of the end compartments, which this represents. Then we flood it by means of a sea valve," indicating a rod somewhat like a hand brake on a street car, though with a much smaller wheel.

Preparing for the Descent

"The air pressure likewise is increased until it is more than the water pressure outside. This 'pops' the hatch cover and almost immediately water rushes in here like a small cataract. Don't worry, though," Momsen laughed as everyone started, instinctively.

"This skirt-like bell," he said, walking over to it, "protects you. When the water reaches the bottom of it, it can go no higher. You will see the skirt comes well down below my shoulders, about to the armpits," Momsen finished.

Hicks and Wallington hurriedly stepped forward and reassured themselves that the skirt came below their shoulders.

"As long as you stand erect your head and shoulders are out of water," Momsen explained.

"Next a rope with a big buoy attached is let out of the hatch and floats up to the surface. At intervals on the rope there are wooden blocks and rings. I'll explain their significance when you go through the first time," he finished.

By late afternoon the visiting engineers had practically completed their technical set-up. A microphone position had been established in the sub-compartment by the simple experiment of clipping the electric light wires which went inside through a stuffing box. The microphone was hung by wire so it would be above the water line on the skirt. Its waterproof lead was sufficiently long to permit Hicks, who was selected for this position, to stand at the door to describe the men entering before following them.

While the engineers worked, Lieutenant Ives explained the activities at the top of the tank in the observation tower and gave preliminary instructions with the "lung."

This device is in appearance something like an over-sized hot water bottle. It has a soft rubber mouthpiece which fits between the teeth and over the lips. A nose clip also is attached and there is a valve on the mouthpiece. Inside the bag there is a container for soda lime. Two tubes lead into the mouthpiece. One supplies the oxygen to it. After taking a breath the "lunger" blows, very much as he would a trumpet. This forces his exhaled breath, now contaminated with carbon dioxide, back into the "lung" but through the second tube which passes into the soda lime container. This absorbs the carbon dioxide, leaving the oxygen, thus permitting the contents of the "lung" to be breathed over again and again. A lanyard and several clips permit one to hang the "lung" around the neck, resting it on the chest. Two clips and a web strap hold the "lung" in place. It is necessary to wear it lightly and not pressed against the body as this would expel the oxygen.

First instruction involves standing on ladders at the top of the tank and ducking the head under until the man becomes accustomed to the novelty of breathing under water and entirely in and out through the mouth. The first sensation is one of absolutely no confidence in the "lung." Pride will not permit one to come up too quickly, however, and, finally, no longer able to hold your breath, you take a gasp and, to your surprise, you find that breathing is natural and easy.

After this the staff was taken down to the eighteen-foot lock. This is the first actual "escape."

Water rushes in and the sensation is somewhat panicky when it creeps up, inch by inch, first over the feet, up the legs to the knees. By this time the pressure is at about ten pounds, and the air is warm and makes the water seem so. It reaches the armpits and the hatch-cover "pops." More water rushes in and it is difficult to keep on one's feet. The door is pushed open and a queer, greenish light comes down from the surface, eighteen feet up. A buoy is sent up. One ring is on the lead ten feet from the surface.

Ready? Go!

Ives attaches an oxygen hose and fills the "lung."

"Now, put the mouthpiece against the teeth," he says.

"Be sure the nose clip is tight; water must not seep in. Open your valve, duck down a bit, a little more. Breathing all right—easy? Remember, stop at the ring and breathe deeply ten times. That will equalize your pressure.

"Ready to try it?"

Another nod—your teeth would chatter but for the soft rubber mouthpiece which you bite hard. Your knees tremble but no one notices; the water conceals them. Everyone else is watching curiously. They are to follow you.

"All right," Ives says. "Step out and down. Steady, hold on to the rope, but

In the February Issue of AMAZING STORIES

TELEVISION HILL (A Serial in Two Parts), Part I, by George McLociard. With the coming of the new inventions recently completed in the matter of practical television, interest in the subject has taken a new impetus. But this is not merely a television story. This is one of the most thrilling, exciting scientific fiction stories it has been our good fortune to offer in "our magazine." We must let this story talk for itself.

THE MAN WHO ANNEXED THE MOON, by Bob Olsen. We don't hear from Mr. Olsen often, but that is obviously because he will offer a story really worth while or he won't send us any. The Moon has been written about a great deal, but that does not take away one bit from the unusualness of this tale, for this author is without a doubt an excellent writer of scientific fiction with plenty of imagination and special and general knowledge.

THE PURPLE PLAGUE, by Russell Hays. Despite our late "war to end war" there is much thought given to possible warfare of the future. Chemists have now become an established entity in the scheme of things. How practicable the ideas suggested by this author might prove remains to be seen, but he has certainly written an instructive piece of fiction of absorbing interest.

BEES FROM BORNEO, by Will H. Gray. The work of the apiarist is important, for the bee is one of the wonders of the world. The very limitations that control them are most interesting, for there are many variations among them, and the queen bee is one of the miracles of the insect world. The author of "The Tide-Projectile Transportation Company, Ltd.," gives us here an ingenious story of unusual interest.

THE EXTERMINATOR, by A. Hyatt Verrill. This clever short short-story is so definitely different in scope and treatment from any of the other works published by our well-known author, that we give it without introduction of any kind. We prefer to let our readers get the surprise.

Other Scientific fiction.

duck your head so you won't foul. Take your time—that is most important, al——"

You hear no more. Your head is now under water. Breathing comes easily, but nervously you gulp. Now your body is clear of the eighteen-foot lock. Your body has a tendency to push upward. You cling to the rope, wrapping your knees around it. Watch it! Nearly squeezed the "lung" against you. That won't do. All the oxygen will be lost. Golly! Water in your mouth and still below the ring! Mustn't go up. Navy darned decent to permit only four civilians to go through. Mustn't make 'em regret it. But can't hold breath any longer, can't let go. Gosh, got to—— Oh boy, "lung" still has oxygen. Your mouth's tired and you relax and water seeps in around the mouth-piece. Sap! Mustn't lose your head. What'll you do at a hundred feet?

One, Two, Three, Four

The ring! Now, ten full, deep breaths. One, two—three (or is it four?) Better count on your fingers. Must be ten full breaths. Gosh, neck's tired, mouth's tired, seven-no, mustn't cheat, that's six, seven—eight—nine—ten! Now up, slowly, take it easy, that's what Ives said. Nearly up, someone's got your hair! Top of head's above water!

"Fine, close your mouthpiece. How are you?" It's Momsen, sitting on the wooden ledge. You shake your head, blink your eyes and try to grin. "Swell," you manage to gasp and it's over.

Up beside Momsen on the ledge. Just below there's Hicks. Almost, not quite—there he is.

"All right?" queries Momsen again.

Hick's eyes smile. The mouthpiece is off. "Great" he says. Wallington is just behind him and a minute later "Tony" Hutson is up.

Next morning the staff went through the fifty-foot lock. It is just the same excepting there are two more stops, at thirty-feet from the surface for ten breaths, at twenty-feet for twenty breaths and at ten feet for thirty breaths.

Microphone positions in addition to the one in the sub compartment were established on the ledge at the top and in the diving bell, also at the top, which operates like an electric elevator. It permits observation and instruction under water.

Wallington and Ives were to go down in it and meet Momsen half way up in his ascent from the sub compartment. On one rehearsal time slipped up on us all, and at four-thirty the power house turned off the electricity, not realizing the "tank" was still in use.

It left Wallington and Ives twenty-five feet below the surface in the diving bell with no "lungs."

Through the earphones, those above and below heard startled exclamation.

"What's wrong?" demanded Wallington into his microphone. Hicks and Momsen in the submarine compartment below heard it and Campbell, Wilson, Hutson and myself at the top.

"Steady—just a moment," we said. Then——

"Power's off, we're sending over to the power house," we told them.

"That's a half mile away," Ives said into the microphone from the diving bell.

Wallington was heard by all again.

"How far is it to that ladder, Lieutenant?"

"About fifteen feet," Ives responded.

"Never mind the power house, Skeets, we'll be seeing you," came from Wallington below.

"Are they alright?" anxiously queried Hicks into his mike from the submarine compartment.

"Sure," was Momsen's response beside him but heard by those at the top through the feed-back headphone system.

The sky was dark and it was reflected on the water. None could see from the top but a ripple came up, another and then Wallington's head was up and he took one big gasp for air and grinned. Ives appeared a second later. He didn't bother to take a breath. These officers already have grown a bit contemptuous of depths and often come up from the fifty-foot lock without a "lung." To the rest present, however, Momsen excluded, it was a thrilling and tense moment.

The next afternoon the program went off according to schedule and was heard by millions of listeners from coast to coast.

Hicks and Momsen talked from the outside of the submarine compartment. Captain Brown paid a tribute to the men engaged in the training work. Momsen, Hicks and four sailors entered the compartment. It was flooded; Momsen's instructions to the men were heard and Hick's discription of their escape went on the air. At the top, Wallington and Ives talked to the audience and queried Hicks and Momsen, asking pertinent questions for the benefit of listeners-in.

After the men had reached the surface, Momsen announced that he was coming up. Wallington and Ives went down in the diving bell and as he came up, pulled Momsen into it with them. Then, for a few minutes, the three chatted from the bell some forty feet under water and their voices were heard across the country. Finally Momsen slipped out and continued his ascent while Wallington and Ives returned to the surface in the bell.

Tapping a Thirty-six Million Year Old Factory

(*Continued from page 879*)

Natural and artificial gas may yet be the home-heating fuel; at 6 cents a gallon, stove oil, with 19,000 heat or "British thermal units" per pound is equivalent in heating value to average coal at $10.25 per ton and 10,000 b.t.u. per pound. It must be converted into gas before it will burn.

There are over 1,000 by-products from crude oil, from alcohol solvents for lacquers, soaps, etc., to liquefied gases for illumination and metal cutting; white distillates, naphthas and kerosene; waxes, greases, medicinal mineral oils; road oils, roofing and paving asphalts; special products for bricquetting, explosive and rubber making—even for chewing gum and candy.

The finding of oil by study of surface rock, strata, etc., and drilling hundreds or thousands of feet deep, has been rightly termed "one of the great achievements of the human brain." Upon oil and gas depends our great industrial and machine age.

No doubt when oil pools are no longer to be found, even many miles deep, man will have found a new source of power, or will know how to obtain cheap oil from shales.

This map shows the oil-producing regions of the U. S. on a comparison basis.

Degree of shading indicates relative amount of oil to be found in areas darkened on this map.

IMPORTANT

TO NEWSSTAND READERS

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Your Fruit Bowl

(*Continued from page* 950)

a walnut shell. The steering wheel is made from a fig.

The dragon illustrated in figure 3 is made from a banana. The legs, six long peanuts, are fastened by wire nails flanked by small long pins to keep them securely in place. The head is made as follows: insert two small white beans into a fig or prune to make eyes. Two small dots made with india ink represent the pupils. The antennae are two small raisins fastened on very thin wire. Then sharpen one of the wooden applicators and drive it carefully lengthwise through a peanut. Be careful that the wooden applicator does not penetrate the chest of the dragon. The auxiliary and the tail legs are made from 18 gauge pliable copper wire on which small seedless raisins are strung. In order to hold these auxiliary legs and tail in place it is necessary to allow a sufficient length of wire for insertion into the banana. The weirdness of the dragon can be enhanced still further by painting spots and stripes on the banana.

Figure 4. The "Tasty" family consisting of a clown, an old man, and a dunce. The head of the clown is made from a walnut with the features painted on with india ink. The rest of this figure and the other two are self-explanatory.

You will find it a fact that your own ingenuity is your best guide when making these fruit figures. New ideas will come almost automatically.

The Oracle

(*Continued from page* 920)

in his contention that two three-volt flashlight lamps connected in series to a six-volt storage battery will not burn out more quickly than if connected to a six-volt flashlight battery if the internal resistances of both batteries are the same.

According to formula the amperage or current flow in any circuit is directly proportional to the electromotive force or voltage and inversely proportional to the resistance. In this case the voltage is equal to six, the resistance of the lamp is a constant. Therefore the current drain will always be the same.

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Thawing Frozen Water Pipes

By David Henry Brown

THE cold weather which we always welcome because it forms ice on our favorite skating pond, frequently freezes sub-surface water pipes at the same time. If the overlying soil is frozen, it is often a very difficult job to get at the section of the pipe where the freeze-up has occurred.

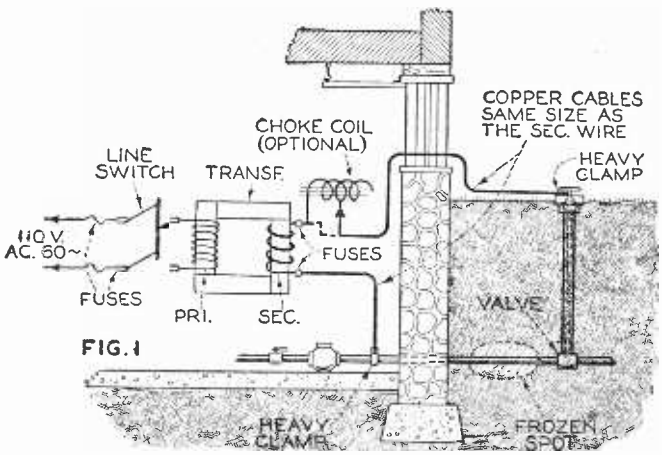


FIG. 1

The method of connecting the transformer to obtain the heating effect which will melt the ice in the pipe. The use of the choke coil is optional.

By utilizing a low voltage electric current of fairly high amperage, a strong heat will be produced in the pipe, when the secondary terminals of the transformer are connected to the water pipe. This is shown in figure No. 1. It is best to place suitable fuses in the primary and secondary circuits to protect the transformer; an additional protection is afforded by connecting a choke coil in series with the secondary circuit as the diagram shows.

The heating effect set up is equal to the square of the current in amperes multiplied by the electrical resistance. It therefore follows that as long as we have sufficient current pressure—about 20 volts—to overcome the electrical resistance of the pipe and fittings, the larger the current delivered by the secondary of the transformer, the greater will be the amount of heat set up.

Care should be exercised to see that at least one shut-off valve is located between the water main in the street and the valve in the basement or cellar. This is particularly important where lead pipe is found in the service main entering the house, as it has happened that when a heavy ice-melting current was passed through a lead service pipe, the lead melted and the cellar was flooded before the water could be shut off. Specifications are given here for two sizes of pipe-thawing transformers, a 1 k.w. transformer for thawing small pipes, and a 2 k.w. transformer for thawing larger water pipes, from 2 inches in diameter and up.

The data for constructing the 1 k.w. transformer is as follows: Sheet iron is used for the core, 15″ long by 8¼″ wide over all. Each leg of the core has a cross-section area of 2×2 inches. The weight of the core is 41 lbs.

The primary winding comprises 4 layers, each 10″ long, of No. 10 B. & S. gauge D.C.C. magnet wire. There are 344 turns, with taps brought out at the end of the 3rd and 4th layers. These taps permit adjusting the secondary voltage. The full-load primary current when the transformer is connected to 110 volts, 60 cycles A.C., is 9.6 amperes. The primary winding requires about 11½ lbs. magnet wire.

The secondary winding, which is to be wound on one of the longer legs of the core (the primary winding having been wound on the other long leg of the core) is (*Continued on page 959*)

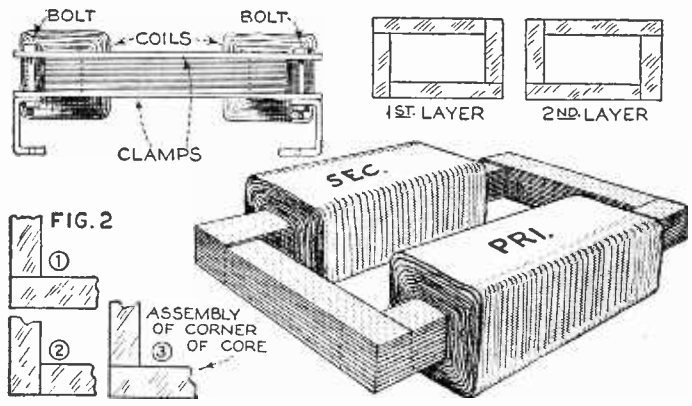


FIG. 2

Constructional details for a pipe-thawing transformer.

INDEX TO ADVERTISERS

(While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.)

Thawing Frozen Water Pipes

(*Continued from page 957*)

designed to supply about 52 amperes at 18.3 volts. The secondary coil contains 58 turns of No. 2 B. & S. gauge D.C.C. magnet wire; this size wire is rather difficult to wind and instead one may use 4 No. 8 wires, connecting these in parallel so as to provide the same current-carrying capacity as the No. 2 wire possesses.

In constructing the transformer windings each of the longer core legs should be insulated by winding 5 layers of oiled linen or some other impregnated cloth around them; it is best also to wind a layer of this insulating cloth between each layer of the coil.

The diagram in figure No. 2 shows how the successive layers of the sheet iron coil are built up, staggering joints on the successive corners. After the windings and the cores have been assembled the core should be clamped together tightly by bolts and brass strips.

Two k.w. transformer data:—The sheet iron core measures 17½×8¾ inches overall, each leg of the core measuring 2¼×2¼ inches in cross-section. The core requires about 56 lbs. of transformer iron.

The primary winding consists of 244 turns of No. 8 D.C.C. magnet wire (or two No. 11 wires may be wound on side by side, and connected in parallel). The primary coil is wound in three layers, each 12 inches long, but the insulation over the iron core should extend at least ½ inch on either end. The full-load primary current at 110 volts, 60 cycles, is 18.2 amperes. About 14 lbs. of magnet wire is required for the primary coil.

The secondary coil consists of 41 turns of No. 0 D.C.C. magnet wire, or instead, the constructor may wind on two No. 3 or four No. 6 wires, side by side, and connect the terminals in parallel, so as to provide the same cross-section or carrying capacity as the No. 0 wire. On such large size wire it is best to use triple cotton insulation. This secondary coil is designed for 18.3 volts and a current of approximately 100 amperes. Be sure to use leads to the pipe of the even greater carrying capacity than that of the secondary wire on the transformer, i. e., No. 2 for the 1 k.w. and No. 0 for the 2 k.w., or a size larger.

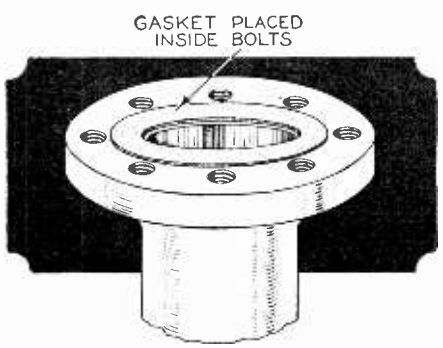
Wrinkles

(*Continued from page 917*)

Renewing Blown-Out Gaskets

ONE of the most disagreeable jobs about a power plant is renewing old gaskets when they blow out.

The most common error in making a gasket is that of cutting it the full size of the flange and cutting holes in it for the bolts. The part outside the



bolt circle will in no way prevent leakage, but might otherwise cause it.

If the gasket is cut to fit just inside the bolts it will be much easier to put in place. When the bolts are drawn up, a much better and tighter joint will be made.—*R. C. Demary.*

A Bottle Opener

A BOTTLE opener is one of those handy things which we always require and never have. An easy way of insuring our ability to open crown-capped bottles is to make a device such as follows:

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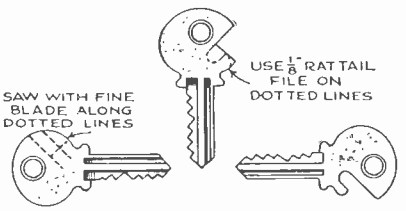
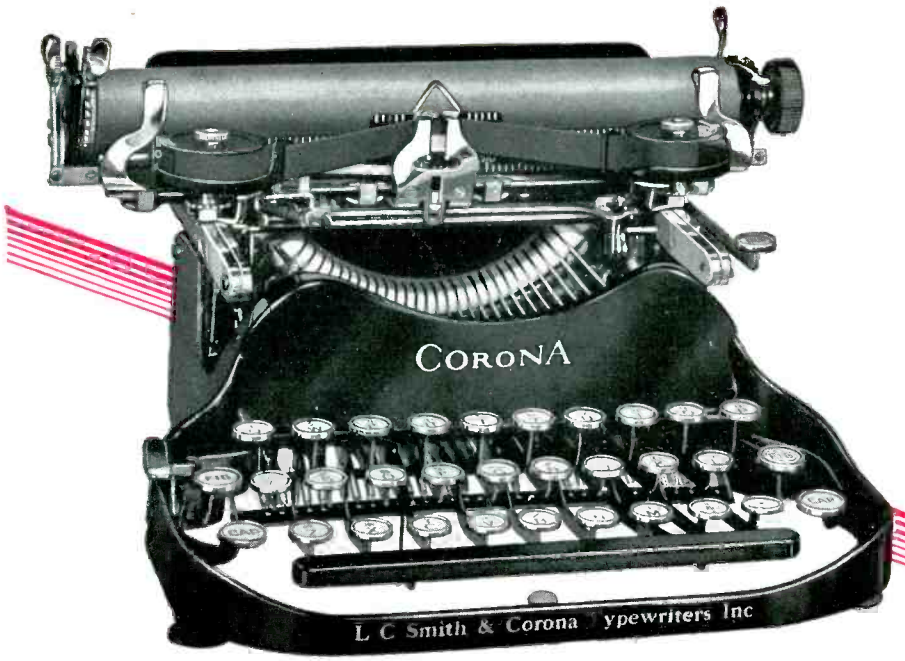


should be used and a rat-tail file would very nicely round off the uneven edges. This bottle opener is a miniature of the large and cumbersome devices which can be found in any beverage shop.—*Lieut. Buckley Barrett.*

Painting Window Frames

WE all like to have our window frames painted, because they present such a clean, neat appearance that the whole house takes on a more orderly aspect. Sadly enough, when the average householder attempts to brighten up his woodwork he very often puts as much paint on the window pane as he does on the frame. A practical way of preventing this all-too-common trouble is to coat the glass with soap; any ordinary laundry soap will do. After the frame has been painted, the window can be washed and when the soap is dissolved it will carry away with it the paint which was on top of it.—*L. Linneville.*



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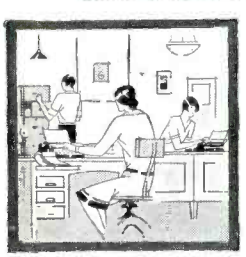

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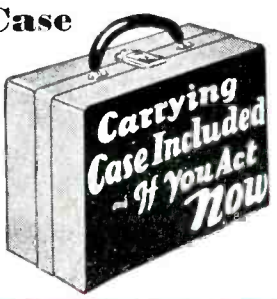


Leatheroid carrying case, oiler, instructions free on this offer. Send no money—just the coupon. Without delay or red tape we will send you the Corona. Try it 10 days. If you decide to keep it, send us only $2—then $3 a month until our special price of $39.90 is paid. Now is the time to buy. Mail coupon today!

Save Money—*Use This Coupon*

Smith Typewriter Sales Corp.
(Corona Division)
469 E. Ohio St., Chicago, Dept. 1202

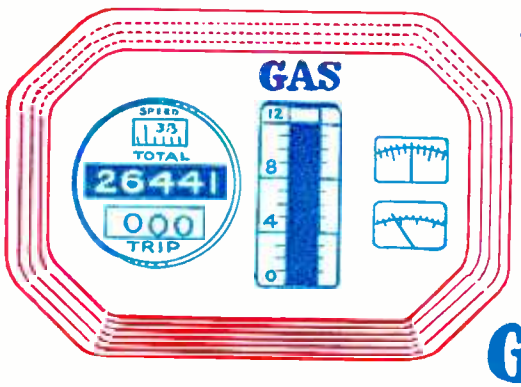
Ship me the Corona, F. O. B. Chicago. On arrival I'll deposit $2 with express agent. If I keep machine I'll send you $3 a month until the $37.90 balance of $39.90 price is paid, the title to remain with you until then. I am to have 10 days to try the typewriter. If I decide not to keep it, I will repack and return to express agent and get my money back. You are to give your standard guarantee.

Name _____

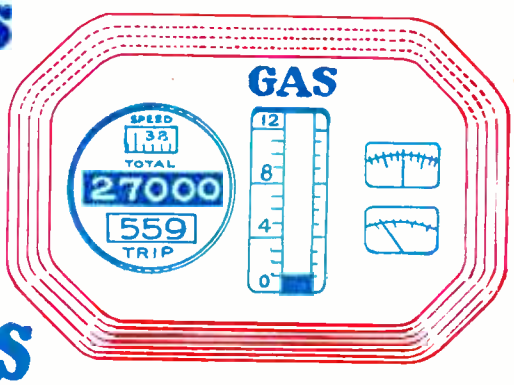
Address _____

Employed by _____

Over the Mountains from Los Angeles



559 Miles on 11 Gallons of GAS



Think of it! FIVE HUNDRED FIFTY-NINE MILES over rough mountainous country burning only ELEVEN GALLONS OF GASOLINE. Imagine more than FIFTY MILES to the GALLON. This is what the WHIRLWIND CARBURETING DEVICE does for D. R. Gilbert, enough of a saving on just one trip to more than pay the cost of the Whirlwind.

THE WHIRLWIND SAVES MOTORISTS MILLIONS OF DOLLARS YEARLY

Whirlwind users, reporting the results of their tests, are amazed at the results they are getting. Letters keep streaming into the office telling of mileages all the way from 22 to 59 miles on a gallon, resulting in a saving of from 25 to 50% in gas bills alone.

Mark H. Estes writes: "I was making 17 miles to the gallon on my Pontiac Coupe. Today, with the Whirlwind, I am making 35 5/10 miles to the gallon. Am I glad I put it on? I'll say so!"

P. P. Goerzen writes: "I made an actual test both with and without a Whirlwind, getting 13½ miles without and 34 6/10 miles with the Whirlwind, or a gain of 21 miles to the gallon. The longer the Whirlwind is in use on the machine, the better the engine runs, has more pep and quicker starting. It makes a new engine out of an old one, and starts at the touch of the starter button."

R. J. Tulp: "The Whirlwind increased the mileage on our Ford truck from 12 to 26 miles to gallon and 25% in speed. We placed another on a Willy's Knight, and increased from 12 to 17 miles per gallon.

Arthur Grant: "I have an Oakland touring car that has been giving me 15 miles to the gallon average, but I can see a great difference with the Whirlwind, as it climbs the big hills on high and gives me better than 23 miles to the gallon of gas, which is better than 50% saving in gas."

W. A. Scott: "I had my Whirlwind for three years. Winter and summer it gives the same perfect service, instant starting, smoother running, and what I saved in gasoline these last few years has brought other luxuries which I could not have afforded previously."

Car owners all over the world are saving money every day with the Whirlwind, besides having better operating motors. Think what this means on your own car. Figure up your savings—enough for a radio—a bank account—added pleasures. Why let the Oil Companies profit by your waste. Find out about this amazing little device that will pay for itself every few weeks in gas saving alone.

FITS ALL CARS

In just a few minutes the Whirlwind can be installed on any make of car, truck, or tractor. It's actually less work than changing your oil, or putting water in the battery. No drilling, tapping or changes of any kind necessary. It is guaranteed to work perfectly on any make of car, truck or tractor, large or small, new model or old model. The more you drive the more you will save.

GUARANTEE

No matter what kind of a car you have—no matter how big a gas eater it is—the Whirlwind will save you money. We absolutely guarantee that the Whirlwind will more than save its cost in gasoline alone within thirty days, or the trial will cost you nothing. We invite you to test it at our risk and expense. You are to be the sole judge.

SALESMEN AND DISTRIBUTORS WANTED

To Make Up to $100.00 a Week and More

Whirlwind men are making big profits supplying this fast-selling device that car owners cannot afford to be without. Good territory is still open. Free sample offer to workers. Full particulars sent on request. Just check the coupon.

WHIRLWIND MANUFACTURING CO.
999-436-A Third Street Milwaukee, Wisc.

FREE OFFER COUPON

WHIRLWIND MANUFACTURING CO.
999-436-A Third Street, Milwaukee, Wisc.

Gentlemen: You may send me full particulars of your Whirlwind Carbureting device and tell me how I can get one free. This does not obligate me in any way whatever.

Name .....

Address .....

City .....

County ..... State .....

☐ Check here if you are interested in full or part time salesmen position.