

My Boys Shoot Down Zeros

POPULAR MECHANICS



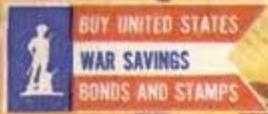
MAGAZINE

SO YOU CAN UNDERSTAND IT

REG. U.S. TRADE MARK GREAT BRITAIN

REG. U.S. PAT. OFF.

MARCH
25 CENTS
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SEE PAGE 27



"Take it easy, Prince; we'll give you a run in London tonight!"

It's a short, short way to Tipperary as the Ferry Command flies today. It will be even shorter tomorrow.

For the hearts and hands now building planes to destroy our enemies will be turned to the creation of a new and better world.

If you could only sit down and talk to the men in the aviation division of B. F. Goodrich, your imagination would be stirred by the miracles which are going to take place after this war.

They'd be able to tell you about the weather five miles up and the fight they've been waging to tame it. They could tell you hair-raising stories of what ice did to planes before B. F. Goodrich De-Icers were developed.

They could tell you of a type of brake (called the B. F. Goodrich Expander Tube) which does wonders stopping the lightning-fast fighter planes we're building today, and they'd add, "We think your plane-of-

tomorrow will have this new kind of smooth-stopping brake."

They could show you tires used on bombers, like the Flying Fortress, that are taller than you are and can absorb the 30-ton shock of landing one of these giants. You'd recognize the name of these tires from your own driving experience, because it's "Silvertown."

These are only a few of more than 80 natural and synthetic rubber products which B. F. Goodrich is turning out to hasten the day of victory. They'll be here *after* victory, too . . . so the airliner you hop for Europe will be that much more comfortable—that much safer.



Here are some giant American cargo planes that are supplied with B. F. Goodrich equipment!



DOUGLAS B-19

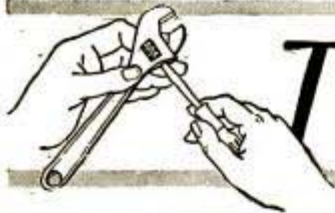


MARTIN MARS

Skyway or Highway

B.F. Goodrich

FIRST IN RUBBER



TOOL NOTES

Maintenance
and Repair
Suggestions to
Prolong Tool Life

No. 5 THE USE AND CARE OF CRESCENT COLD CHISELS AND PUNCHES

Crescent Chisels and Punches are forged from a high quality tool steel with cutting edges or points specially hardened and tempered. Heads are purposely left softer than the balance of the tool as a safety precaution to avoid chipping under hammer blows.

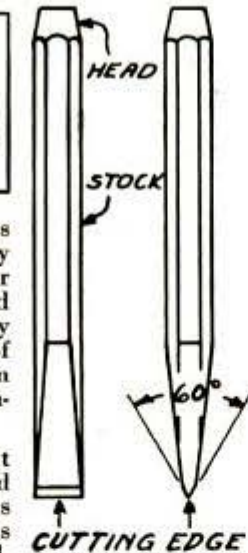
A few simple but important rules govern the use of cold chisels. First of all, cold chisels are designed to cut only metals softer than the tool itself. Hardened steel such as drill rod, hacksaw blades, etc., cannot be cut with a chisel. Use a chisel large enough for the job at hand. Use the center of the blade rather than just one point or corner. Always use a heavy hammer. Too light a hammer tends to burr the chisel head and does not sufficiently transmit the force of the hammer blow to the cutting edge.

Burrs are dangerous. Grind 'em off

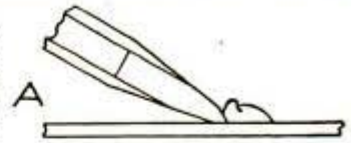


Crescent Cold Chisels are ground for average use so that the angle between the two bevel surfaces is 60°. Although a sharper point may be used for soft materials, it is recommended that this angle be maintained in re-grinding. Don't overheat the point in re-grinding or the tool will lose its temper.

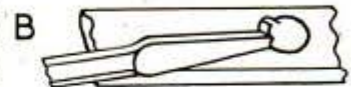
When shearing with a cold chisel the vertical angle at which the tool is held should be such that one bevel of the cutting-edge is parallel to the shearing plane. Sketch below illustrates a method of shearing light metal held in a vise so that the shearing line lines up with top of vise jaw. Note the slight horizontal angle at which the chisel is held . . . the point of the chisel is nearer to you than the head.



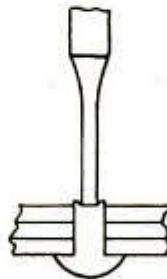
Ordinary cutting with a cold chisel involves the use of an anvil or solid metal backplate. Lay the piece to be cut on the anvil and, with chisel held perpendicular to the work, strike light hammer blows at first. When an initial groove has been started hard blows with a heavy hammer should follow. Usually the piece is cut part way through from both sides and finally parted by bending back and forth at the cut.



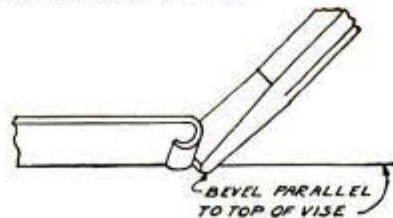
Two methods of cutting off rivet heads:
A — with flat cold chisel
B — with narrow cape chisel



Regarding Punches, when driving out rivets, pins, etc., use a size that almost fills the hole. A punch with too small a point may upset the end of a soft pin or rivet and make it seize. If a punch wedges itself in a hole, don't attempt to loosen it by tapping sideways. You may bend or break the punch or force the hole out-of-round. Drive it backwards with another punch, or hammer back on the pin or rivet being removed.



In re-grinding punches, observe the same precaution to prevent overheating as mentioned for chisels above. Both Chisels and Punches are made in various designs or patterns for different uses. Always select the proper type for the job at hand. Hardware dealers can advise you on this subject.



CRESCENT TOOLS

Give Wings to Work

CRESCENT TOOL COMPANY, JAMESTOWN, N. Y.



\$1,000 FOR YOUR IDEAS In the Big Marlin Gun Contest!

Now here's a chance for you hunters and target shooting fans, to *cash in* on your knowledge of guns! Marlin—always on the lookout for new ideas to improve sporting firearms—wants to hear from you. Sportsmen and gun dealers are cordially invited to join Marlin's big Gun Contest—with \$1,000 in cash prizes to shoot at. And remember, many a good idea is simple and easy to describe. Your chance is as good as the next fellow's to win a prize. It's easy to get in the contest—read the details below and send your entry in today! Contest ends July 1, 1943.

Jot down your ideas for improving any current model Marlin Gun. Follow the simple contest rules and send your entry in. If you wish, you may suggest new features, not at present in the line. A free catalog is yours for the asking, to review the features of Marlin Guns.

PRIZES IN THE BIG MARLIN CONTEST

The first prize is \$500.00 in cash; second prize \$100; third prize \$50.00; fourteen additional prizes of \$25.00 cash each. Seventeen prizes in all! (Marlin suggests the purchase of U.S. Savings Bonds with the prize money.)

The Marlin Firearms plant is now 100% on war production.



Marlin's Over & Under Shotgun, in 12, 16 and 20 gauges and .410 bore, is hammerless, cocks on opening, has sturdy one-piece frame.



All Marlin rifles—lever action, clip and tubular magazine and .22 automatic, feature deep-cut, accurate, "Ballard" rifling.



Marlin lever action rifles, in calibers .22, .30-.30 and .32 spec., have the solid-top, case-hardened receiver, with safe side ejection.

JUDGING

Three famous gun editors—Bob Nichols of Field & Stream, Jack O'Connor of Outdoor Life, Maj. Chas. Askins of Sports Afield—will select the winning entries. All ideas for which prizes are given become the property of The Marlin Firearms Company and none will be returned. Prizes awarded for the seventeen ideas which are most valuable and practical, in the opinion of the judges. Duplicate prizes awarded in the event of a tie. WINNERS will be determined and prizes announced as soon as possible.

CONTEST RULES

The Marlin Gun Contest is open to all sportsmen and dealers in guns, with the exception of Marlin employees. Written suggestions must not exceed 300 words, the shorter the better. No limit to number of entries which may be submitted. Write name and address clearly on each suggestion. Mail entries to Dept. C, The Marlin Firearms Co., 17 E. 42nd St., New York City.

Entries must be received on or before July 1, 1943.

Win cash with your ideas! Enter the Marlin Contest today.

Popular Mechanics Magazine

Registered in U. S. Patent Office and Canada

H. H. WINDSOR, Founder

H. H. WINDSOR, Jr., Editor and Publisher

March, 1943

Vol. 79, No. 3

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Set 'Er Down in Your Back Yard

SAY what you will, the airplane is a very helpless machine when it comes to landing and taking off. Superb in speed and cargo capacity, it is quite dependent on long, smooth runways. What you and I want is a machine that will climb vertically from between the cherry trees and wash line in the back yard and float gently down to the curb at the corner grocery or the parking lot on the office roof. Igor Sikorsky has been cultivating the idea for 35 years, and now it's here. An April article states confidently that your next car may be a helicopter.

The Navy's Fighting "Sea Bees"

UNSUNG heroes of the war are the Navy's "Sea Bees," the fighting Construction Battalions that are in there building new bases before the smoke has cleared from the battle that drove the Japs or Germans out. Their weapons are the tommygun, wrench and hammer. An article next month tells how the Sea Bees take over as fast as the Marines mop up.

Next Month

RIGHT now the Coast Guard is whetting its ax for the annual spring job of breaking the ice. The ax is a fleet of tough little ships that will ram open a channel for you through armor-plate ice four feet thick. If it doesn't give, the boat will climb right on top and lean on it. The main idea is to smash through to the Soo and get the ore ships back to work early. Ensign Waring G. Smith, author of "Running the Ice Blockade" in the April issue, says the ice-breaking records of 1942 should be smashed again this year.

Backyard Egg Crop

WHAT? No roast beef? Well, it's too bad we can't have everything, but there's a war on and an army to feed. So why not grow your own meat? Not beef, perhaps, but certainly you can produce in a four-by-twelve foot pen all the poultry you need to keep the family in meat and eggs. "A Backyard Flock Will Solve Your Meat Problem," says an article next month. It's full of advice on operating your "egg factory."

It's Raining Soldiers

JUST a few months ago there wasn't a glider in the U. S. Army. Today hundreds of glider pilots are ready to set our airborne Rangers down in the Nazi front yard; hundreds more are training. Paratroopers, soldiers in transports and gliders make up the powerful air-borne divisions that spearhead our attacks. Their story is featured in April.

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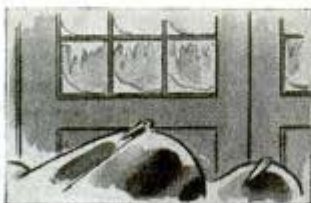
NEW CAR? PERHAPS BY 1945



You'll likely have new tires long before you have a new car.

... SO CARE FOR THE CAR YOU HAVE NOW!

Your present car stands idle for longer periods than formerly. Starts are fewer and colder. This is more perilous to vital parts than normal driving would be.



PUT THE ENGINE OF YOUR CAR INTO THE GLOVED HANDS OF PYROILO PROTECTION



Used by millions, Pyroil has the unique ability to keep cars running "silky smooth"; to avert the damage that acids, corrosion, carbon, gum and sludge can cause; to reduce wear

and thereby make your car last longer.

This is because Pyroil gives your car an *added lubricity* factor, above and beyond that obtained from the regular lubricant you use.

Three ounces of Pyroil poured in the gasoline tank—in addition to a few ounces in the crankcase—is a sufficient amount for 250 miles of driving.

Be sure to get some today at your service station. Use it, always.

Manufactured and Guaranteed by Pyroil Company, W. V. Kidder, Founder, 53 Pyroil Bldg., La Crosse, Wisconsin.



ADD MERELY OUNCES TO GAS TANK & CRANK CASE

BUY MORE AND MORE WAR BONDS

DISTRIBUTORS: CHECK AND MAIL COUPON FOR FRANCHISE FACTS.

INSTRUCTION COUPON—HOW TO CARE FOR YOUR CAR, NOW

PYROIL COMPANY
Pyroil Bldg., LaCrosse, Wisconsin

I'd like to know more about the protection Pyroil can give my car now that it remains idle much of the time. Please send details.

Send details of your Plan for Distributors

Name

Address

City State

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Where no name and address appear directly under an item, the product is not believed by us to be commercially available

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AVIATION offers you unlimited opportunities to serve your country and assures you a bright and successful peacetime future!

Prepare now! Study aviation! Ask your local airport authorities about getting mechanical training. When peacetime comes, see your Piper Dealer and take flight instruction. You can learn to fly with as little as 8 hours of dual instruction in the famous Piper Cub Trainer, whether you're 16 or 60!

Send Today for Your
"HOW TO FLY" Booklet!

Prepared by a certified flight instructor. Clearly explains basic flight principles. Send 10c for booklet and Piper catalog to cover postage-handling.



TEACHERS (Grades 7-12). Write for new, helpful Teacher's Kit of Junior Aviation Instruction Material. Send \$1 bill or check.

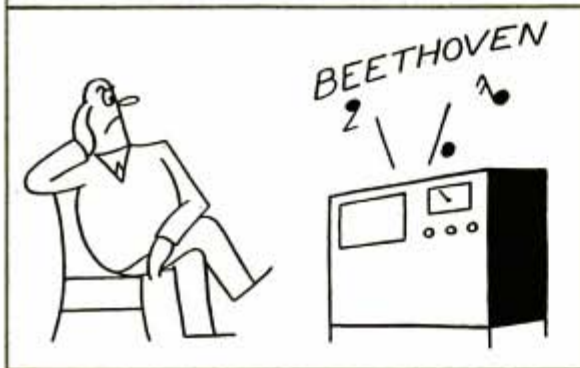


PIPER

AIRCRAFT CORPORATION

Dept. PM33 ★ Lock Haven, Penna.

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WHITE COLLAR or OVERALLS—



Which will YOU wear after the war?

HUNDREDS of thousands of white collar workers have put on war overalls for the duration. Millions of both white collar and overall workers have put on uniforms. Hosts of home women are patriotically taking jobs.

After the war, millions will be coming back from army, navy and air force to civilian jobs; great war materials factories will be re-converting to civilian production; old peace-time functions of business will be springing up—where will you fit in the situation?

If you are wise, you will look ahead and prepare. You will not wait on chance. You will analyze the probable conditions in peace employment, decide where your likes and aptitudes fit best, and get ready. You will decide whether your best opportunities lie in production or office or store. You will determine whether you wish to work for someone else or develop a business of your own. You will train now to be above the average and, therefore, surer to get the opportunity you want after the armistice.

Nor will you wait very long. Nobody knows when this war will end or how soon this problem will hit you in the face.

We Can Help You Decide

If you have some question either about postwar opportunities or about your own fitness for some particular one, probably we can help you. In our 34 years, over one million adults have enrolled for our training, we have built training courses for many

major fields of commerce and industry, and we have gathered a wealth of information about job opportunities and requirements. That information is at your service.

We Can Help You Prepare

And when you have decided what field of work offers most to you for a life career, we can help you prepare for it—quickly, economically, thoroughly, in your spare time and without any interference with your present work—if it is in the list below. A 48-page booklet on the field of your choice, discussing the field and our training for it, has been prepared to help answer your questions. The coupon below or your letter will bring it to you, without cost or obligation.

Do not delay. Whether the war lasts six months or three years, now is the time to make sure your preparation for postwar success shall not be “too little and too late.”

La Salle Extension University A Correspondence Institution

DEPT. 364-R

CHICAGO

I want to pick my career for after the war and get ready for it now. Send me your free booklet on the field I have checked below and full information about your training in that field.

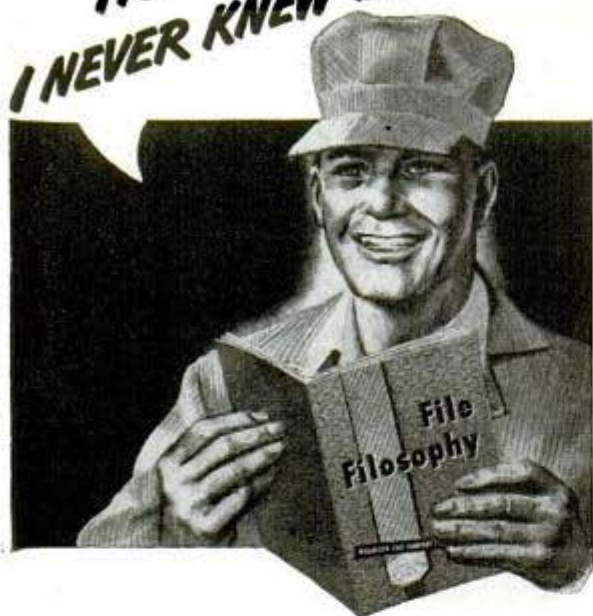
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|---|--|
| <input type="checkbox"/> Foremanship | <input type="checkbox"/> Industrial Management |
| <input type="checkbox"/> Bookkeeping | <input type="checkbox"/> Accounting |
| <input type="checkbox"/> Business Law | <input type="checkbox"/> Law: LL.B. Degree |
| <input type="checkbox"/> Executive Management | <input type="checkbox"/> Traffic Management |
| <input type="checkbox"/> Salesmanship | <input type="checkbox"/> Business Correspondence |
| <input type="checkbox"/> Business English | <input type="checkbox"/> Stenotypy |

Name.....Age.....

Present Job.....

Address.....

**"IT'S GOT THINGS
I NEVER KNEW BEFORE!"**



"DON'T anybody ever tell me a file is just a flat, round, half-round or triangular length of hard steel with a roughened surface!

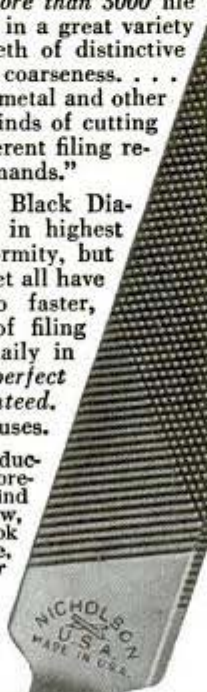
"This book says there are *more than 3000* file kinds, cuts and sizes. . . . Files in a great variety of designs. . . . Files with teeth of distinctive shapes, angles and degrees of coarseness. . . . Files for today's many types of metal and other materials; for sharpening all kinds of cutting implements; for the many different filing results specialized production demands."

Right! Each Nicholson or Black Diamond File is made, not only in highest quality and with utmost uniformity, but for a particular kind of job. Yet all have one common purpose: to do faster, better work on the millions of filing operations which take place daily in America's industries. *Twelve perfect files in every dozen — guaranteed.* At mill-supply and hardware houses.

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NICHOLSON

**FILES FOR EVERY
PURPOSE**

**NICHOLSON
U.S.A.
MADE IN U.S.A.**

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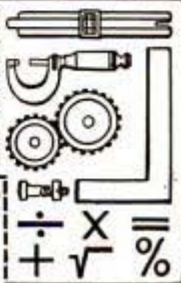
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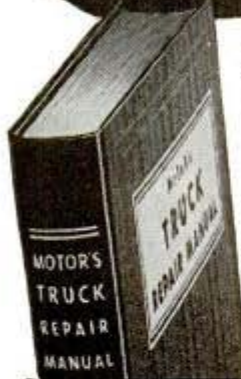
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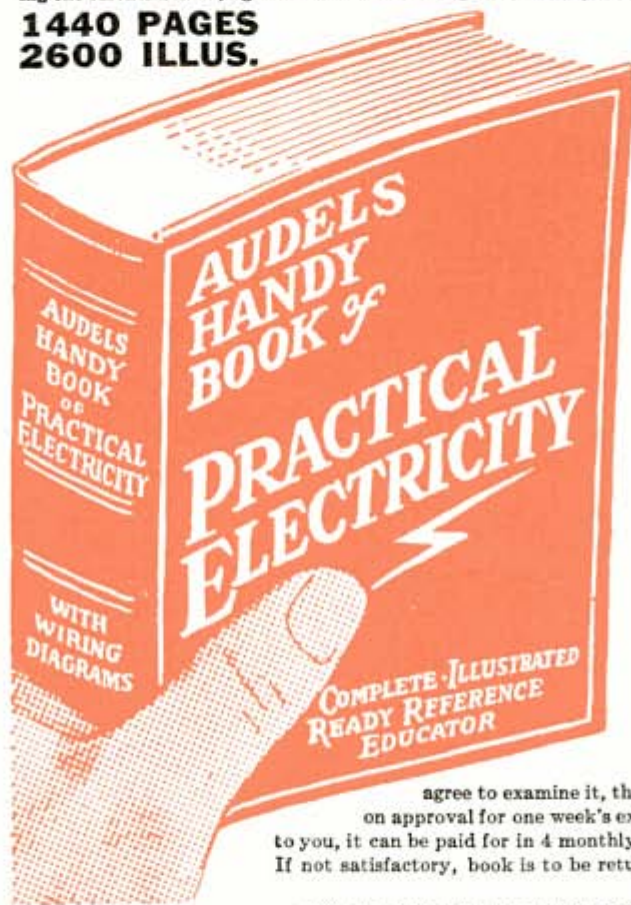
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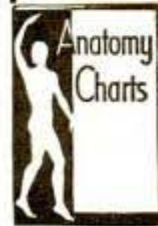
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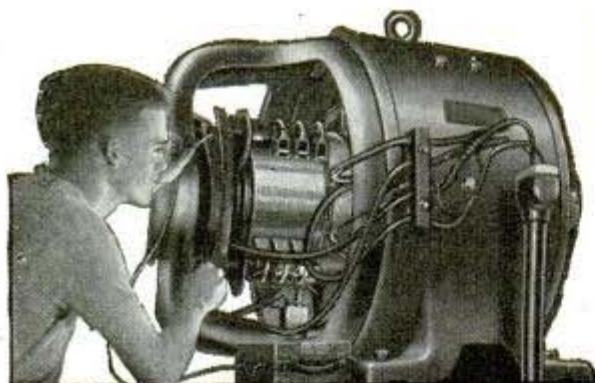
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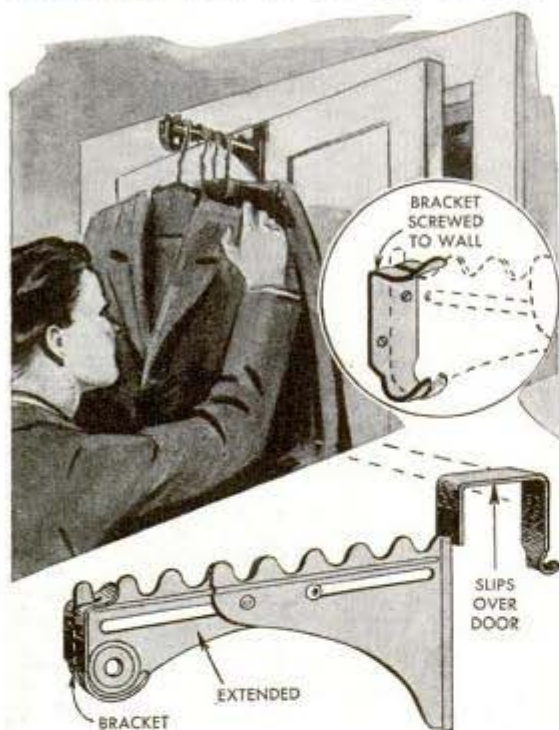
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m/1089



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Snap Fastener for Metal, Wood Is Self-Attaching *m/1058*

Snap fasteners, formerly used only on fabric, now are made with a self-attaching push-pin base that also permits their use on metal or wood parts. For joining wood pieces, such as a cabinet door and shelf,



Adjustable Strainer Tip for Teapot Fits Over Broken Spout

m/1173

To assure the crystal clearness of poured tea, a handy tip for the teapot spout has a built-in strainer that keeps the leaves from flowing out with the liquid. Adjustable to fit various shapes and sizes of spouts, the strainer can be used to conceal the broken end of the spout on a teapot made of crockery. It cannot rust and, according to the manufacturer, it will not become clogged nor drip.



the snap sections are eased into the wood like thumb tacks. They are attached to metal by inserting the base pin through a small hole in the metal and into the snap section which is specially constructed to hold the pin in a tight grip. For fabric, the pins are made in several lengths for varying thicknesses of material.

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SEND Your favorite negatives and dime for sample photo Valentine and sample photo Easter card. Roll developed 8 prints and two enlargements 25c. Young Photo Service, 405-V, Albany, N. Y.

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16 SPARKLING Lifetone prints, 2 beautiful Hollywood enlargements, free Leatherette frame and photo wallet only 25c. Free photo album with first order. Lifetone Studios Dept. A-339, Des Moines, Iowa.

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FREE Water and our concentrates, makes flavors, lotions, shampoos, 72 products, labels, bottles furnished. Qualco, E-20030 Russell, Detroit.

SCHOOL Seniors—Sell graduation name cards. America's largest, fastest-selling, low-priced display. 35% commission. Free cards. Universal Engraving & Printing, Box 745-PM, Pittsburgh, Penna.

AGENTS—300% Profit selling gold leaf letters; stores and offices. Free samples. Metallic Letter Co., 438-B North Clark, Chicago.

USED Men's shoes 14¢, hats 12¢, pants 28¢, dresses 10¢, winter coats 50¢, fall coats 35¢. Bargain catalog free. Portnoy, 566-V Roosevelt, Chicago.

AGENTS: Stamping names on pocket-key protectors. Sample check with your name, address, 25¢. Stamping outfits. Emblem checks, check-fobs, name plates. Hart Mfg. Co., 303 DeGraw St., Brooklyn, N. Y.

DO You want agents for your proposition? Your ad in this space will place your message before hundreds of men seeking fast-selling products. My folder "How to Secure Agents," is filled with proof. I'll gladly send you a copy free. P. W. Johnson, Manager Classified Advertising, Popular Mechanics Magazine, 200 E. Ontario St., Chicago.

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PERSONAL Stationery—200 6x7 bond letterheads, 100 6¼ envelopes, three or four lines printed, \$1.00 prepaid. Shirk, Printer, Lebanon, Penna.

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500 8½x11 BOND Letterheads and 500 6¼ White Wave envelopes to match printed to your copy \$2.75. Jack's Printing Service, Box 5450, Metropolitan Station, Los Angeles, California.

FIRST Quality printing—Reasonable. Samples. Treaster Printing Service, Milroy, Pennsylvania.

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USED Presses, type, supplies. Lists 3c. Turnbaugh Service, Loxysville, Penna.

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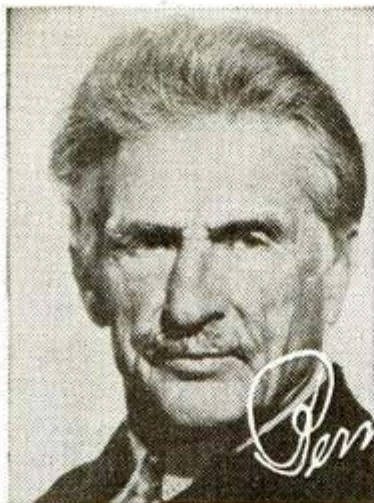
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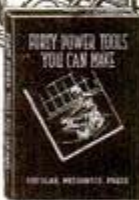


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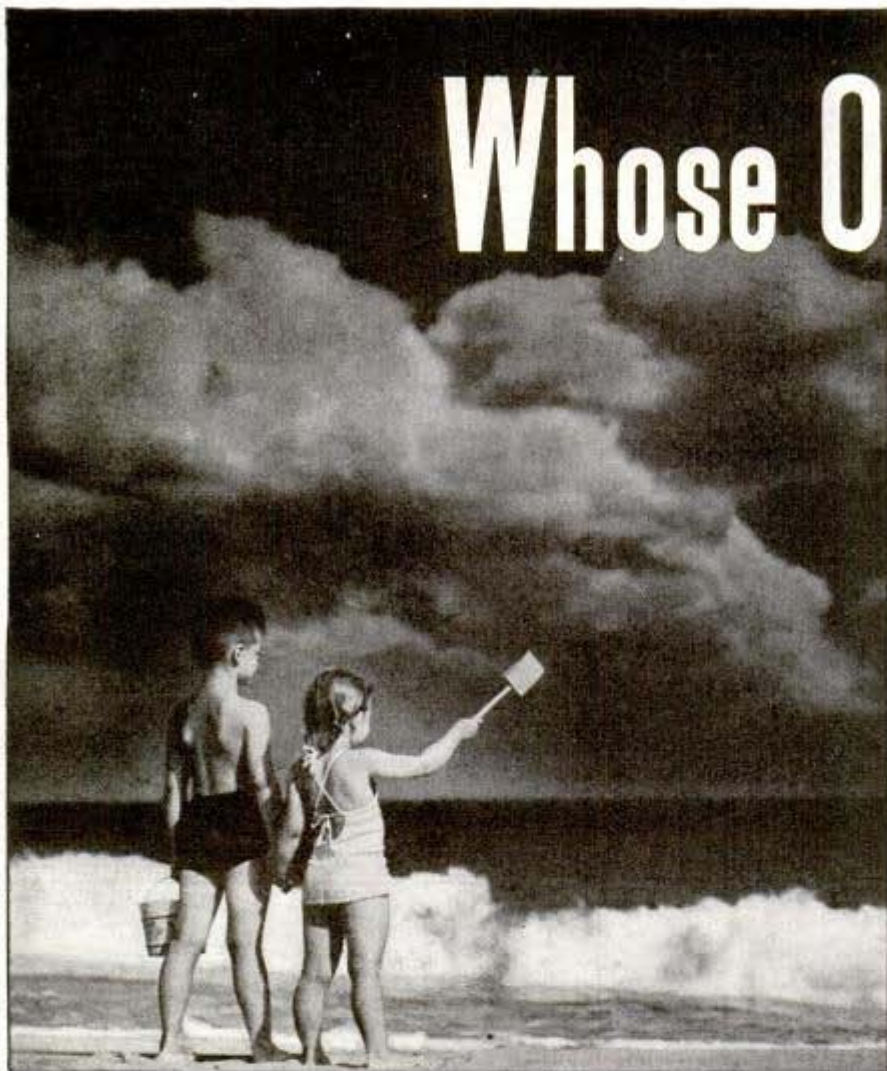
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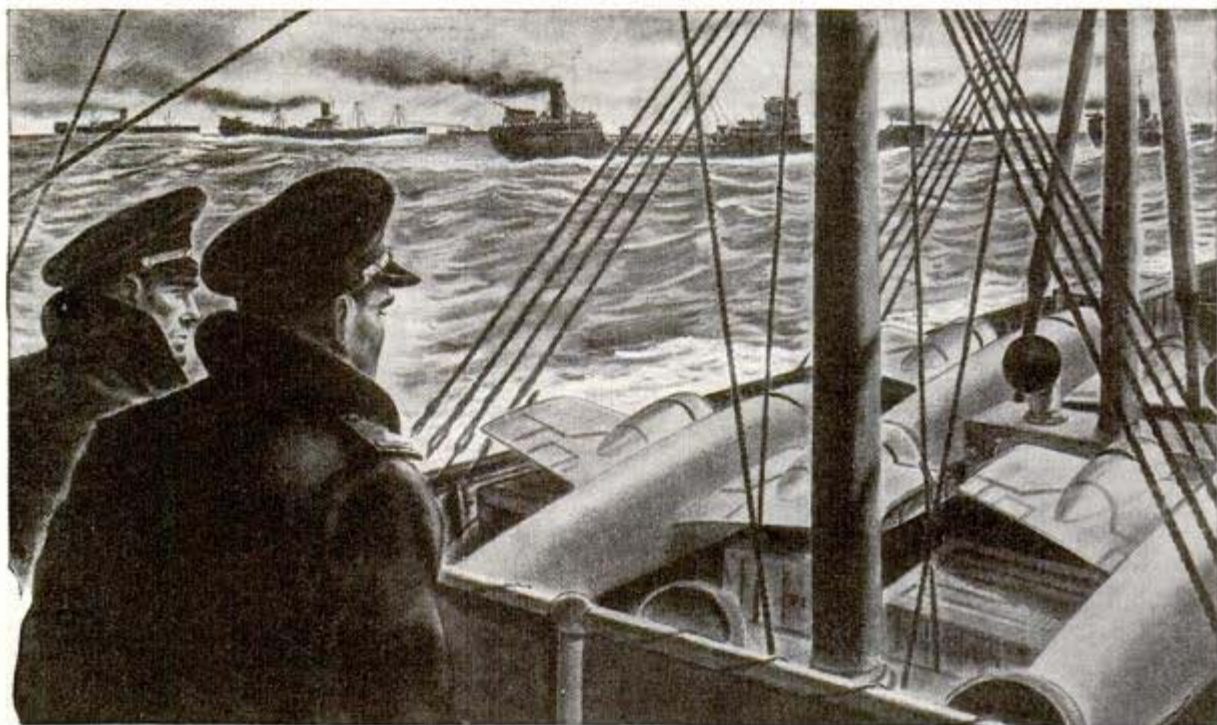
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Vol. 79

MARCH, 1943

No. 3



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It is a struggle between men of high technological skill in America and the foremost scientists of the Axis, both striving to apply the newest discoveries of science, chiefly in the field of mathematics, physics and chemistry, to development of new implements of war.

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Designers and engineers built into the M-4 "General Sherman" tank, in foreground of top picture, many fighting advantages over the M-3 (background). Below, laying out new Westinghouse Merchant Marine Works

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Auto*



Fuselage sections of a Boeing Flying Fortress are assembled

auspices of the American Society of Mechanical Engineers to describe over the air some of the activities of the engineer at war. They revealed, for example, that the United States, in its first year of war had developed the best tank in the world.

What made it best was American engineering skill which combined 25,000 separate parts into a masterpiece of functional design, an engine of war against which no tank of comparative size can combat on equal terms. Each of these 25,000 parts had to operate in harmony. Tools had to be created to produce every part. Men had to be trained to produce them, to operate, service and repair them. Back of all these was engineering brains. What looks to the public eye like a clumsy, lumbering vehicle is a delicately balanced, intricate machine as finely put together as a watch. A 30-ton type like the M-4 "General Sherman" can outspeed, outshoot and outlast any-

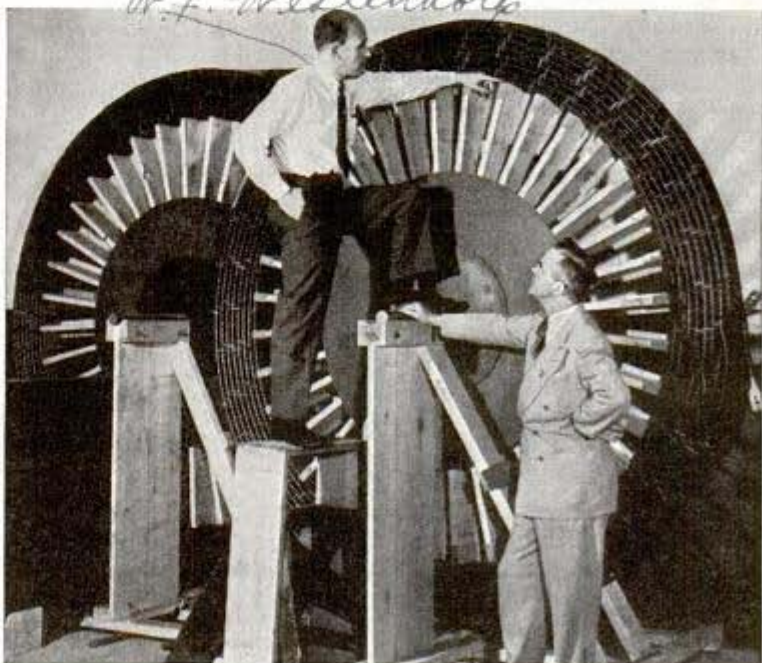
thing the Axis has ever put on the field. It is called the M-4 because it is the fourth standardization of design in medium tanks, each better than the last and each a huge engineering job, requiring 175 to 250 pounds of blueprints alone.

Another striking triumph of engineering is the American aircraft engine, such as the 14-cylinder Wright Cyclone. Improvement after improvement has been added until this engine—a variation of which is used in our tanks—contains nearly 9,000 parts, many of them machined to dimensional tolerances of two to three ten-thousandths of an inch, or one-tenth the thickness of a hair.

Since this precision work required much time, engineering brains went to work to simplify production. What they accomplish is demonstrated in one operation, the finishing of cylinder heads. Transforming a rough forging into a cylinder head required boring, drilling, reaming, threading and many other operations. Thirty-five operators were needed on the production line for this single process.

Then came an automatic unit 165 feet long which performed almost every operation like a machine with engineering brains

Two General Electric men study coils for induction electron accelerator



W. F. Westendorp
Dr. C. Chaverton

of its own and at the same time carried the parts from one machine tool to another without the pulling of a lever. Ten operators now turn out cylinder heads five times faster than 35 on the old assembly line.

A major engineering victory for America was the changeover from cast to forged cylinder heads, without scrapping the old machinery. Forging the heads permitted addition of two cooling fins to the inch, dispersed heat much faster, permitted greater power output and on a ship like the Boeing Flying Fortress added 500 horsepower without putting on an ounce of weight. The range of some bombers was increased 1,000 miles by this single feat. In this war of long-distance transportation, the grow-



Hooded shot blaster in Westinghouse plant fires metal shot from nozzle to clean motor and other castings *6. Page*

construction of all warships has been faulty. The result of this engineering is a military secret, but—as in the case of the American tank—when Uncle Sam's new fortresses of the sea get into action, no warship in the world will be able to withstand their power.

A complete shift in naval construction tactics is being brought about. Eventually

Left, a giant power press assembled for a Pacific coast shipbuilding company. Below, huge steel gear rings at Westinghouse marine works will cut reduction gears that harness steam turbine power to ship propellers. Gears are machined accurately as a watch



ing of seven tiny cooling fins where only five grew before is a vital improvement.

No group has been under greater pressure than the naval engineers. Each shift in battle tactics puts up new problems and results in hours of overwork, acres of blueprints. Not only has experience changed strategists' ideas of what a modern warship should be, but experiments in the naval laboratories have actually proved underwater





Dr. Sanford A. Moss of General Electric, who pioneered in developing the airplane supercharger for high-altitude flight, demonstrates the impeller

this is likely to eliminate almost entirely the sight of a gallant, new vessel sliding down the greased launching ways. Instead there will be a great saving of time and money and labor by building warships in graving docks. A graving dock is cut out of the earth near a deep waterway and protected from the water by dikes and cofferdams. The side walls and floors are usually reinforced concrete and the entrance is sealed with a watertight gate.

As a dry dock, the graving dock permits a huge warship to be floated in, after which the gates are closed and the water is

pumped out, leaving the ship high and dry on a cradle for repairs.

Now, say the engineers, if a warship is built on a level keel, millions of dollars of expense, millions of hours of engineering and labor will be saved, for heretofore all planning and construction were carried on at an angle made necessary by the sliding method of launching, a condition which the ship never meets during its life of service. The stresses of a launching down the slide are eliminated from calculations and a ship is built on a horizontal plane and float-

ed out of the graving dock when completed.

One common denominator spells success or failure of our tanks, planes and ships. This is petroleum and the products derived from "black gold." Here again our engineers have scored technological victories for the United Nations. Petroleum not only drives our combat units, but engineers are making crude oil give up its plentiful and cheap hydrocarbons, the building blocks of organic chemistry, to produce synthetic rubber, the ingredients of TNT, smokeless powder, plastics, glycerin and hundreds of other products. 100-octane gasoline, which

Mobile substation built by General Electric will help maintain electric service in emergencies of war or peace



gives the aviation engine its efficiency, is being produced at 15 cents a gallon today where it was put out only in laboratory quantities costing \$10 a gallon less than a decade ago. Most of this advance has been accomplished since the war began. Whether or not the Axis powers capture oil fields, engineering genius has given the United Nations three-fourths of the cracking facilities which make possible 100-octane gasoline.

Back of the engineering brains of our armed forces are the engineers in the great industrial organizations. Westinghouse engineers, for example, have evolved an X-ray tube which will produce an X-ray picture in a millionth of a second through an inch of steel armor plate, facilitating the inspection of metal parts for war machines. From the same laboratories has come an electronic tube which serves as a production watchdog to help reduce spoilage of parts for airplanes, tanks, guns and other machines. It functions as an automatic dew-point recorder, preventing rust of machine parts.

A new Westinghouse tool, requiring 8,000 man-hours for assembly, is a 120-inch gear hobber which cuts teeth in a huge marine reduction gear, used in propulsion equipment for naval and marine vessels. It cuts teeth accurate to three ten-thousandths of an inch. The extraction of tin from low-grade American ores has been facilitated by a machine which uses an "electrical spray" which will remove as little as one percent tin from ore. Another Westinghouse engineering process converts steel chips from machining operations into "briquettes" which makes it easier to melt them into alloys used in the manufacture of war implements. A Westinghouse electric eye device measures grain sizes as small as 1/25,000 of an inch in one-thirtieth of the time ordinarily required, speeding the production of small gears, bearings and other parts from powdered metals.

General Electric Company engineers have developed a 100,000,000-volt X-ray machine, a device so powerful it is housed in a concrete structure with walls three feet thick. Its main part is an electromagnet weighing 125 tons, made of 100,000 pieces of silicon steel. Its purpose is the examination of thick metal objects. The company also has a new portable million-volt X-ray machine, weighing only 1,500

(Continued to page 182)

MARCH, 1943

Acme Newspictures
467-8 av. N.Y.C.
British "Scarecrow" Sniper
Drills for Street Fighting
m 1138



Camouflaged member of home guard ready for action

Snipers of the British home guard, trained in the art of street fighting, wear camouflaged clothing that makes them resemble scarecrows. They stroll behind the fighting lines and seek vantage points from which to pick off enemy troops who may come within range.

Million-Pound Planes Foreseen Built of Plastics and Glass

Airplanes weighing as much as one and one-third million pounds are deemed possible by H. D. Hoekstra of the Civil Aeronautics Administration, who believes that one of the main limiting factors at present is the development of large-enough power plants. Although aluminum alloy may not lose its leadership as a structural material, Mr. Hoekstra cites research now under way in glass and plastics that might result in a product which could take its place, particularly if the glass fibers can be combined into a usable material with plastics as a bonding agent. Stainless steel also is a contender, and may always be essential at points involving corrosive effects and where spot welding would reduce weight.

Ref: Washington Post

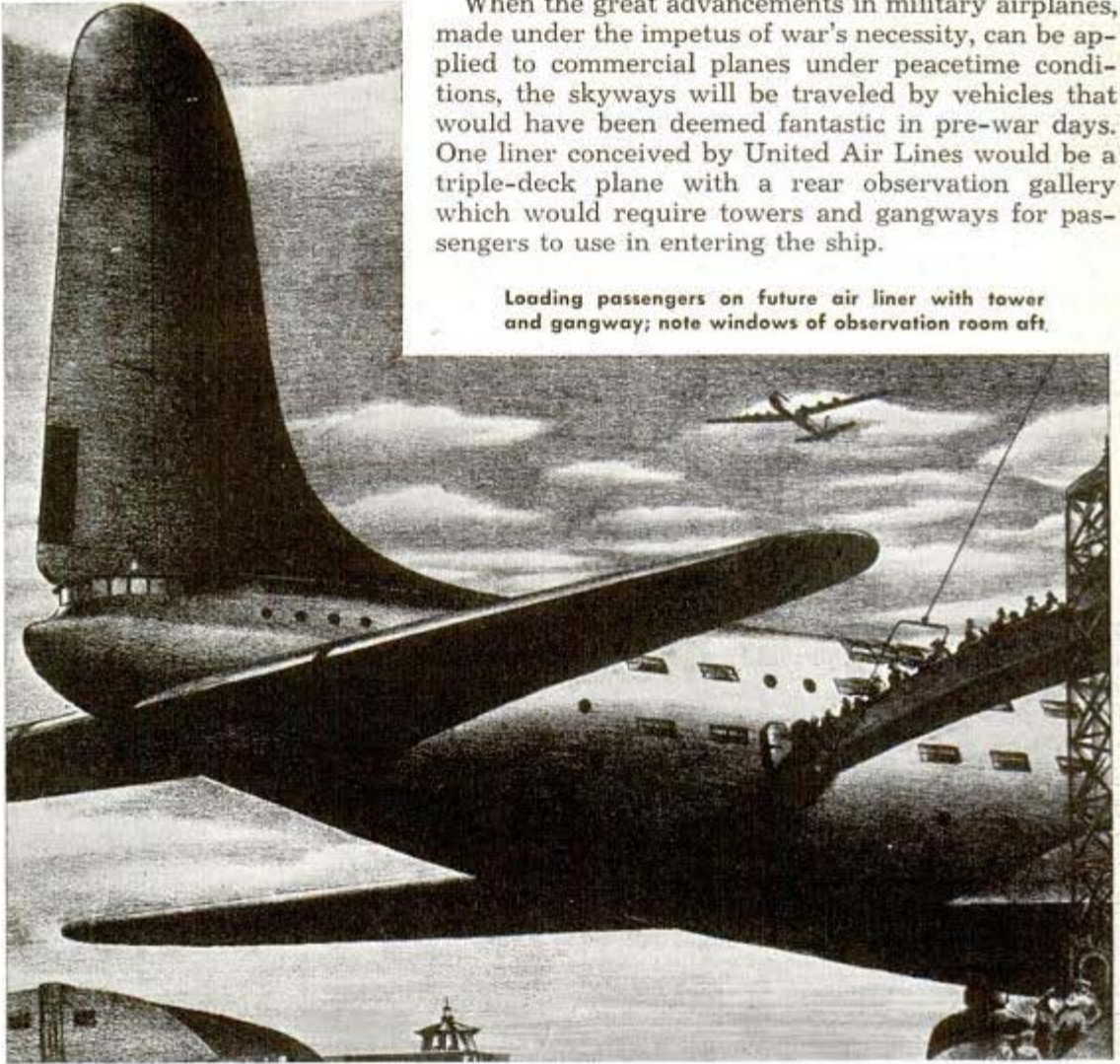
*Int'l News & Photos
326 W Madison, Chgo*

Triple-Deck Plane to Have Observation Room

M 1119

When the great advancements in military airplanes, made under the impetus of war's necessity, can be applied to commercial planes under peacetime conditions, the skyways will be traveled by vehicles that would have been deemed fantastic in pre-war days. One liner conceived by United Air Lines would be a triple-deck plane with a rear observation gallery which would require towers and gangways for passengers to use in entering the ship.

Loading passengers on future air liner with tower and gangway; note windows of observation room aft.



Two-Family Trailer-Type Home Set Up in Half an Hour

M 1102

The problem of housing workers in the nation's war plants is finding a solution in many ways. The latest answer is a port-

able duplex home that can be erected and occupied by two families in half an hour. It is a modified, expansible trailer coach type house, which is set up on blocks, its sides being lowered to form two apartments. The homes are in use near the Willow Run bomber plant.



Any magician would be proud of this trick—transforming what appeared to be a big moving van into duplex house for war workers in 30 minutes

ⓂTons of ore can now be recovered from pillars left in mines by a new method of determining rock pressures based on "listening" to subaudible sounds in the rock.

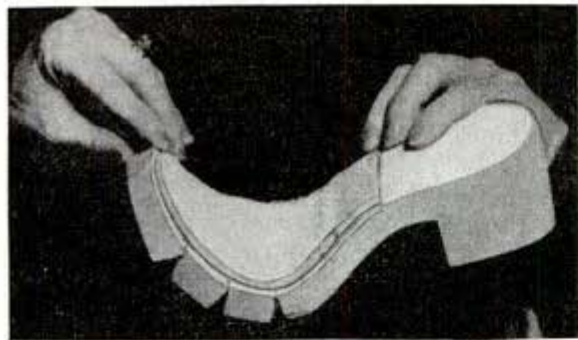
6 *Palace Travel Coach Corp
Flint, Mich.*

POPULAR MECHANICS

*Int'l News & Photos
1115 N. Dearborn St. Chgo*

*Elliott E. Simpson
 d. 7th Dressage Co. nyc
 29 W. 34 St. nyc
 m 1084*

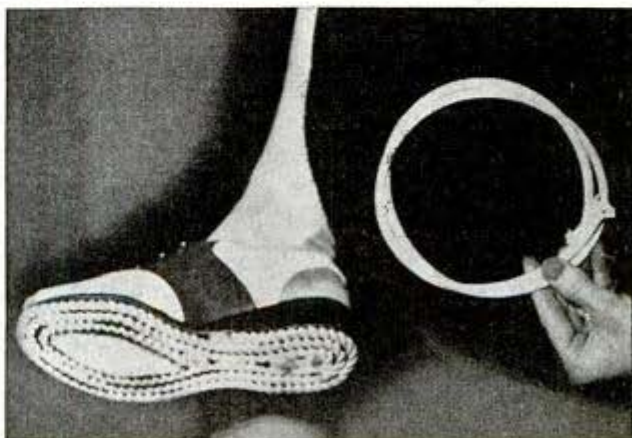
Shoes Made of Glass, Plastic, Wood and Lace



You may be walking on shoe leather and rubber heels now, but it won't be long unless the war ends soon and these materials are released for nonmilitary uses. For months inventors have been developing substitutes. One is the wooden shoe sole, above, built in four sections and attached to flexible, durable cloth by waterproof binder. Another wooden sole, shown at right, is bound to the fabric in sections like rollers to give the necessary flexibility



Spun glass, making up the shoe-tread at left, has withstood endurance tests successfully. The glass is prepared in the form of cards, shown in the foreground, and these are wound around and around—upon a new machine designed for the purpose—until they take the shape of a sole to fit a certain type shoe. Plastic binder applied to the finished sole keeps it in shape



Even a lacelike braid has been found to give good service, and such a sole is illustrated at the left. Above, twisted cord like that shown gives a ruglike appearance; a plastic plate is inserted under the ball of the foot where the wear is greatest. Cotton is the basic material for this sole, and all are treated with waterproofing and plastic adhesives. Machines formerly weaving rugs now are turning out shoes of this type. For use as uppers, hundreds of nonstrategic fabrics are available

The ARMY'S GIANT "FIVE-BY-FIVE"

m 11 99



In the spacious office of Secretary of War Stimson, up-to-the-minute war maps slide out from ingenious alcove

Mr Whittaker

FEW buildings acquire a legendary status before completion. Among them, perhaps foremost, is the giant Pentagon Building—the War Department's new home in Virginia across the Potomac from Washington.

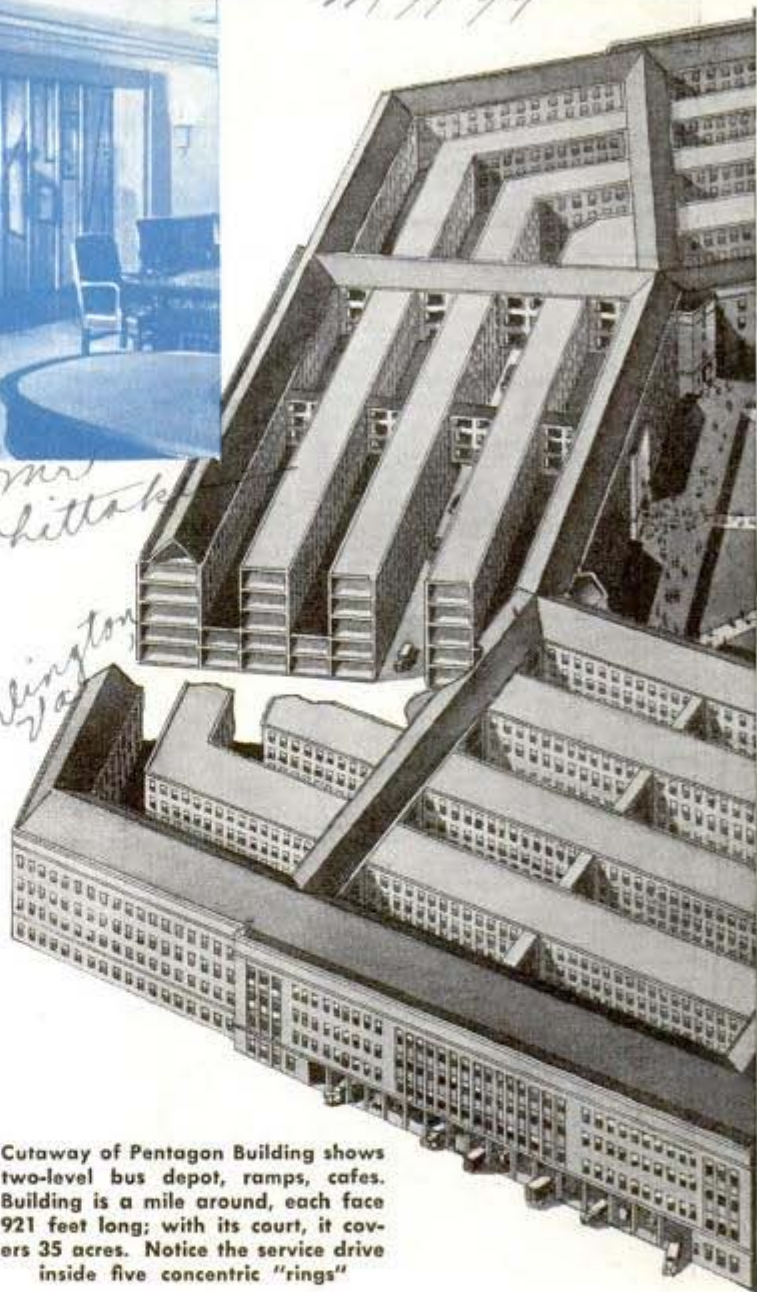
Arlington, Va

From the day the first spadeful of earth was turned, Sept. 11, 1941, the Pentagon has been a "legendary" proposition. The speed of its construction and the vastness of the project, largest office building in the world, captured the imagination of the public.

In the early construction days there was the story of a newly hired worker who spent three weeks wandering over the 400-acre site looking for his foreman. The most widespread "legend" is that of the Western Union messenger who got lost in the building and three days later came out a lieutenant colonel.

Another story, and this one is true, concerns a captain in the Signal Corps whose duties take him to the far corners of the Pentagon's five floors. One day he strapped a pedometer to his leg after betting a lieutenant that he actually walked more than 10 miles a day. The captain won the bet; the pedometer registered 16 miles at the end of the day.

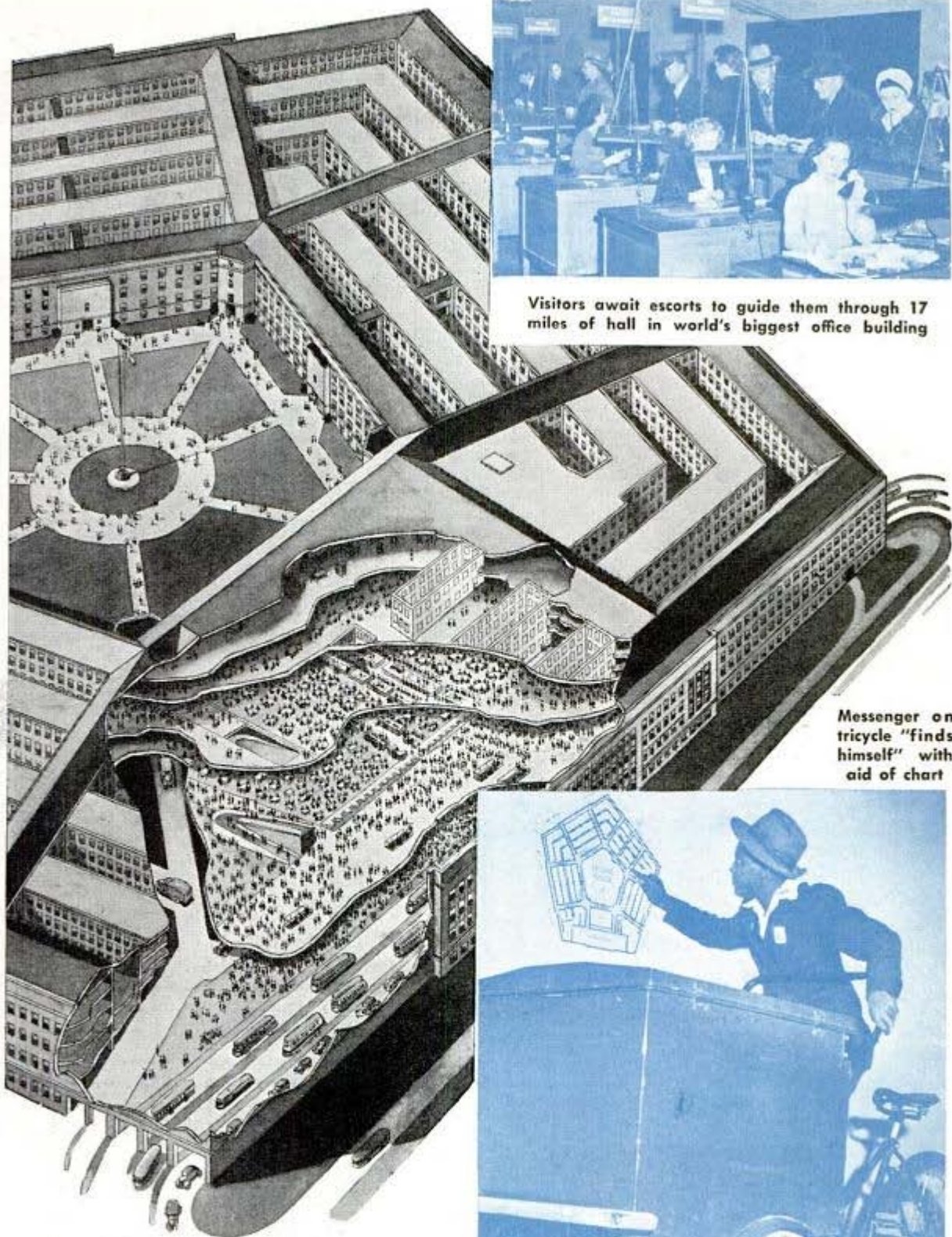
The Pentagon is so big—each of its five



Cutaway of Pentagon Building shows two-level bus depot, ramps, cafes. Building is a mile around, each face 921 feet long; with its court, it covers 35 acres. Notice the service drive inside five concentric "rings"

sides is 921 feet long—that it is impossible to see the entire structure except from the hills of Arlington or from an airplane. One glance at two-fifths of the building, which is the most you can see from any approach, and you would vouch for the story of the Signal Corps captain.

David J. Witmer, chief architect for the War Department, says the National Capitol would fit neatly into any one section of the Pentagon. In other words, you could set five replicas of the Capitol on the Pen-



Visitors await escorts to guide them through 17 miles of hall in world's biggest office building

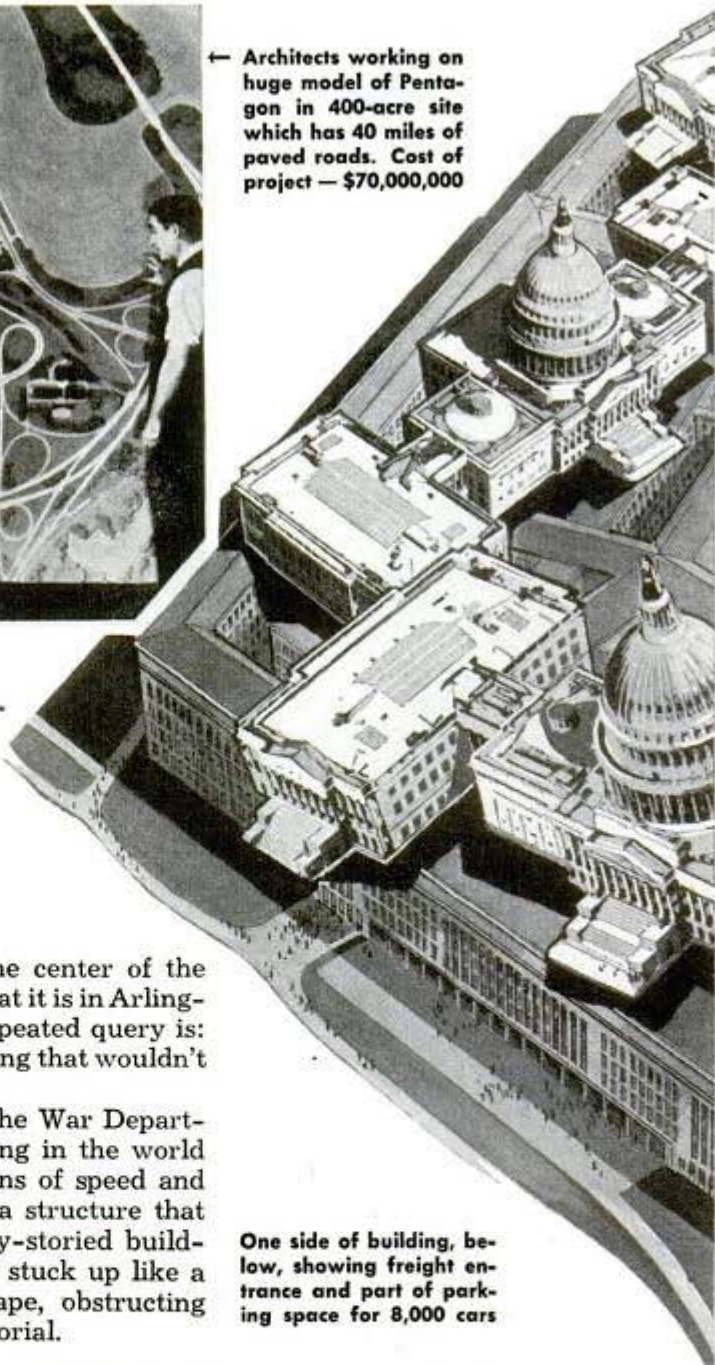
Messenger on tricycle "finds himself" with aid of chart



tagon site. Three football fields could be laid out in the center courtyard and the outer corridor would make a racetrack a mile long. The building has a total of 17 miles of corridors. The great Pyramid of Cheops could be set within the Pentagon



← Architects working on huge model of Pentagon in 400-acre site which has 40 miles of paved roads. Cost of project — \$70,000,000



One side of building, below, showing freight entrance and part of parking space for 8,000 cars

with a couple hundred feet to spare.

Mr. Witmer, who with G. Edwin Bergstrom planned the building, says there are many misconceptions about the Pentagon. One of the first questions visitors ask is:

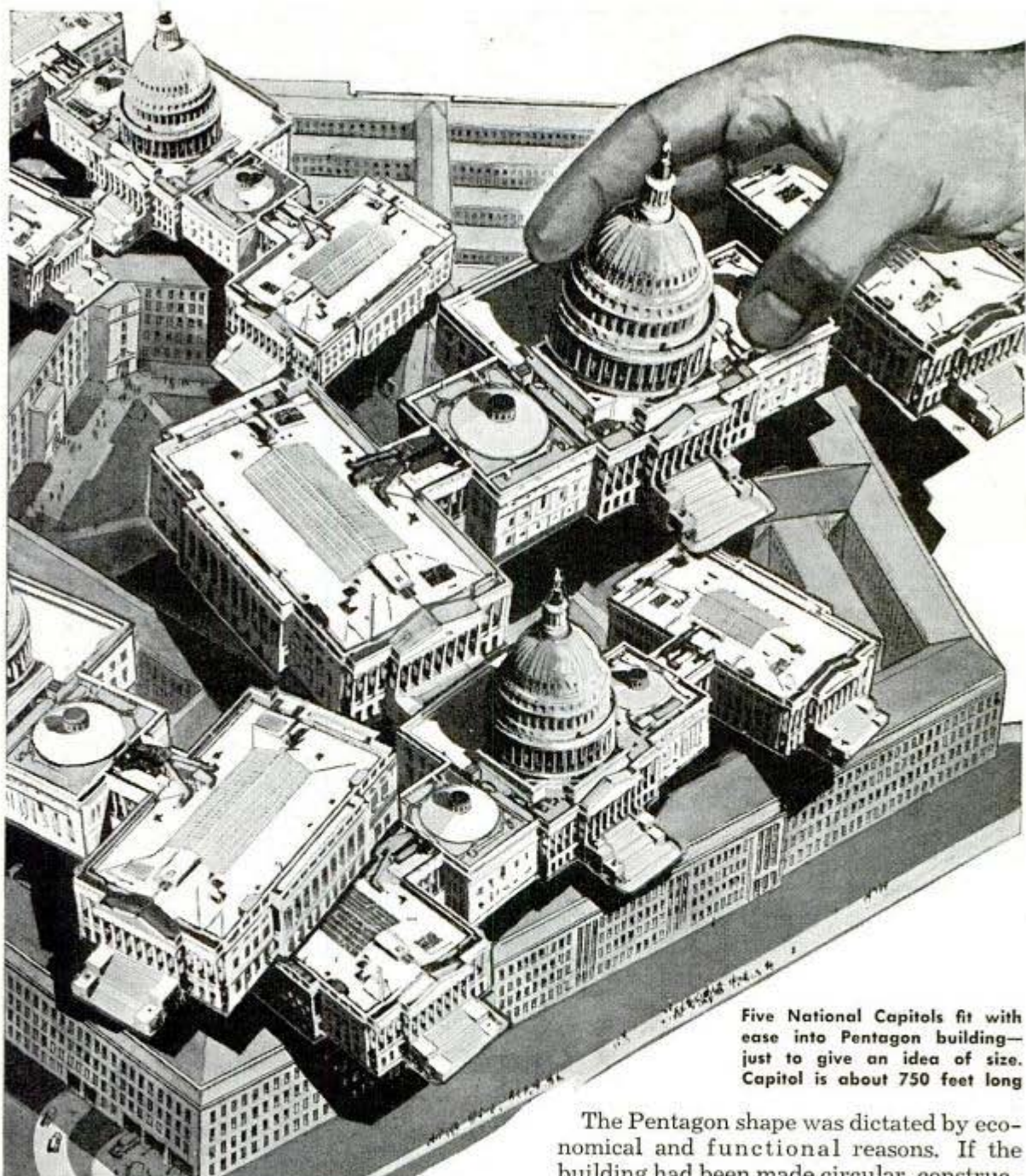
“Why did the War Department build its offices away out here in Virginia?”

Mr. Witmer explains that the Pentagon is less than two miles from the center of the District of Columbia despite the fact that it is in Arlington County, Virginia. Another oft-repeated query is:

“Why didn't you build a taller building that wouldn't take up so much ground?”

There are several answers. First, the War Department needed the largest office building in the world and wanted it in a hurry. For reasons of speed and economy it was desirable to put up a structure that would not require elevators. A many-storied building on the Pentagon site would have stuck up like a monstrosity on the Potomac landscape, obstructing views of and from the National Memorial.





Five National Capitols fit with ease into Pentagon building—just to give an idea of size. Capitol is about 750 feet long



The Pentagon shape was dictated by economical and functional reasons. If the building had been made circular, construction would have been more costly. The pentagon shape permitted rectangular construction of the sections. Incidentally, the five sections were built clockwise in a record-breaking 14 months under the general supervision of Lt. Col. Clarence Renshaw, Corps of Engineers, and J. Paul Hauck, project manager.

The architects ruled out plans for one long building because offices in the far ends would have been nearly a mile apart. As it is, no two offices are more than half a mile apart on the same floor.



Central tube station is heart of five-mile network of tubes
Two-block long concourse in bus station with doors to ramps



The Pentagon and inner court cover about 35 acres. The architects insist it's only a myth that every stranger is lost 10 minutes after he enters. They credit the wide circulation of this "legend" to the fact that many employees were lost when the first thousands moved in during May, 1942. But at that time, the building was still eight months from completion and it was impossible to place permanent directional markers.

The numbering system of the offices affords an understanding of the floor plans. To begin with, you must get a general picture of the Pentagon as a five-sided, five-story structure enclosing five con-

Pentagon switchboard—the world's largest private unit would serve city of 125,000

centric "rings" of connected buildings. Ten "radial" corridors, like spokes of a wheel, lead to the outside walls from the center court.

Five "ring" corridors spread out from the center, increasing in length toward the perimeter. The inner, or main ring, is numbered A and the others, B, C, D and E, respectively. Branching from the rings are "bays." The number of an office must reveal floor, corridor, ring and bay. Thus, office 2E257 means second floor, E ring, second corridor and bay 57.

Three concentric light courts extend from roof to third floor and a fourth "court" is a 40-foot-wide service roadway which circles through the building between third and fourth rings. These ring courts are not to be confused with the five-acre central court around which the Pentagon is built. Despite the modern design, the inner courts when viewed from the roof give an effect of some medieval fortress or castle.

The service roadway within the building provides access for delivery trucks or fire protective equipment. Loading platforms along this road are convenient to kitchens, freight elevators, post office and storage rooms.

Walls of the five floors are painted different colors so that one may ascertain location with ease. The ground floor is brown (the earth), the second floor green (grass),



the third, fourth and fifth are officially and respectively, red, white and blue. The designers, however, softened the white to gray to relieve glare.

Doors in the concourse which open on ramps leading to various floors are painted in five colors. The green doors open on a ramp leading to the second floor; the red doors guide workers to the third floor ramp.

The Pentagon's two-level bus station, similar in size to the Pennsylvania Station in New York, is designed to handle 30,000 persons in one hour. There is a 680-foot concourse on the upper floor from which stairways descend to loading points on the ground level. There are three lanes of traffic, two for buses, one for taxis. During the rush hours a bus will pass through the terminal on the average of every 8 seconds.

Traffic moves in and out of the grounds on a specially built highway system. Forty miles of 24-foot paved roads approaching the building connect with three main highways outside the grounds. Twenty-one bridges provide grade separations at all crossings on the "reservation" and no stop lights break the flow of traffic. The highway system was worked out by the War Department in co-operation with the Public Roads Administration.

In grading the approaches and landscaping the site, some 5,000,000 cubic yards of earth were moved. That is one record that will probably stand for all time. Preparation of the grounds included removing a slum area and abandoned brick yard, taking over the old Hoover Airport and part of the Arlington Experimental Farm, and creating a lagoon of several acres. Eventually, fountains and gardens will add to the beauty of the site, but it will be several years before the landscaping is complete.

When it comes to superlatives the Pentagon is unsurpassed. It is the largest air-conditioned building on earth. It has the greatest floor space of any office structure—4,000,000 square feet. Its switchboard is the largest private one in use and would suffice for a city of 125,000. In its cafeterias, dining rooms and lunch counters some 7,000 persons can be fed simultaneously. It has a hospital complete with surgery.

The building rests on 40,000 concrete piles, one for every worker in the Pentagon. If these piles were placed end to end they would extend 200 miles. The Pentagon has its own power and disposal plants.

(Continued to page 182)

Don: Allen Warren Elliott
70 Park av, nyc.

Infrared Lamp Dries Sketch To Save Second Inking



Applying lamp to ink lines drawn over pencil sketch

Use of an infrared lamp for drying freshly inked drawings at the patent department of Westinghouse Lamp Division is speeding the work of draftsmen and in many instances saves valuable production time. Pencil marks on drawings are always erased after they have been traced over with ink, and in the past this would produce gray lines which meant that the drawings had to be inked a second time. The necessity for this re-inking now is eliminated by turning a 250-watt R-40 reflector drying lamp on the drawing for a minute, which takes out the moisture.

Sponge Rubber Substitute Found In Laboratory Accident

From the foam of a kettle boiling over in a Chicago laboratory, two experimenters obtained a substitute for sponge rubber that can be made from waste farm products. This discovery was accidental, since according to officials of Bauer & Black they were seeking a rubber substitute to be used in adhesive tape. In the pot was a mixture of a special resin, acids from vegetable oils and other chemicals. Tests of the foam showed that at normal temperatures it is not so flexible or compressible as natural rubber, nor has it as great tensile strength, but it is said to be useful as lining for tanks, airplane cockpits, helmets, in seat cushions, and as de-icers for plane wings and stuffing for hospital mattresses.

*Kungsholmen, Ontario
& Rue de la Chicago*

STRINGLESS PUPPETS PUT ON GRAND OPERA



GRAND opera, with stringless puppets instead of real singers strutting about a miniature stage, is the culmination of a lifelong hobby of Fredrik Chramer, Chicago restaurant owner. The 13-inch puppets, the scenery, the theater with 95 fixed seats, the stage and the production reflect many years of painstaking work and research. Unlike marionettes controlled from above by strings, these tiny figures, clad in costumes copied from those worn by Metropolitan and LaScala artists, respond to the deft manipulation of wires passing downward through slots in the stage floor that form "tracks" for the cast. Four girls, maneuvering the puppets from beneath the stage, wear headphones to keep in touch with Mr. Chramer, who directs each presentation. Orchestral music and the voices of many famous artists come from disk recordings. Remarkable for beauty and com-

Mr. Thoren
Typical of other puppets, Flora of La Traviata, above, is controlled by looped wires and rods. A disk at the feet enables puppet to stand erect

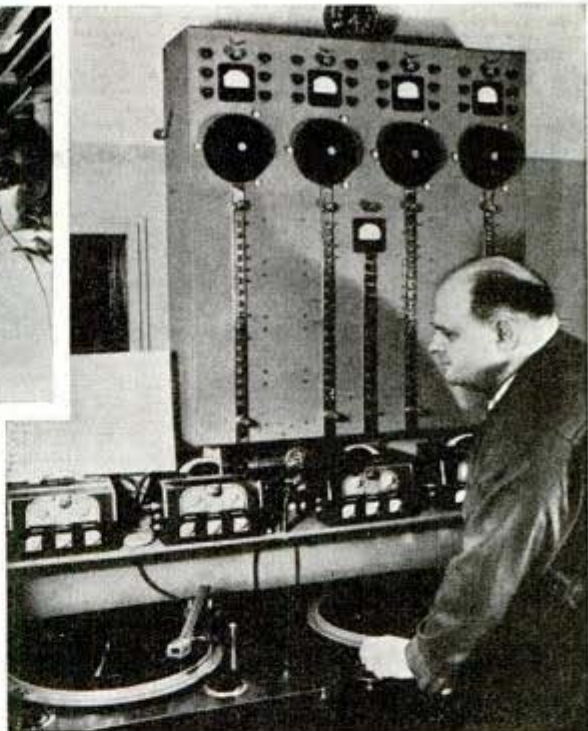
Below, left, a corner in the workshop where scenery and properties are built by expert workmen. Right, looking through stage wings. Rows of overhead lights may be raised and lowered. More than 1,000 lights are used, some being operated from backstage, others from the control room





Girls beneath stage see that puppets do not miss cues and give them action appropriate to music

pleteness, the scenery and properties are constructed in Mr. Chramer's own workshop. Since an operatic performance calls for little more than slight gestures, the puppets' actions are limited to simple arm, leg and head movements, yet they can kneel, sit, shake hands, embrace and even carry small articles. For his repertoire of 14 operas, Mr. Chramer uses about 300 puppets, 48 being the largest number for any single performance.

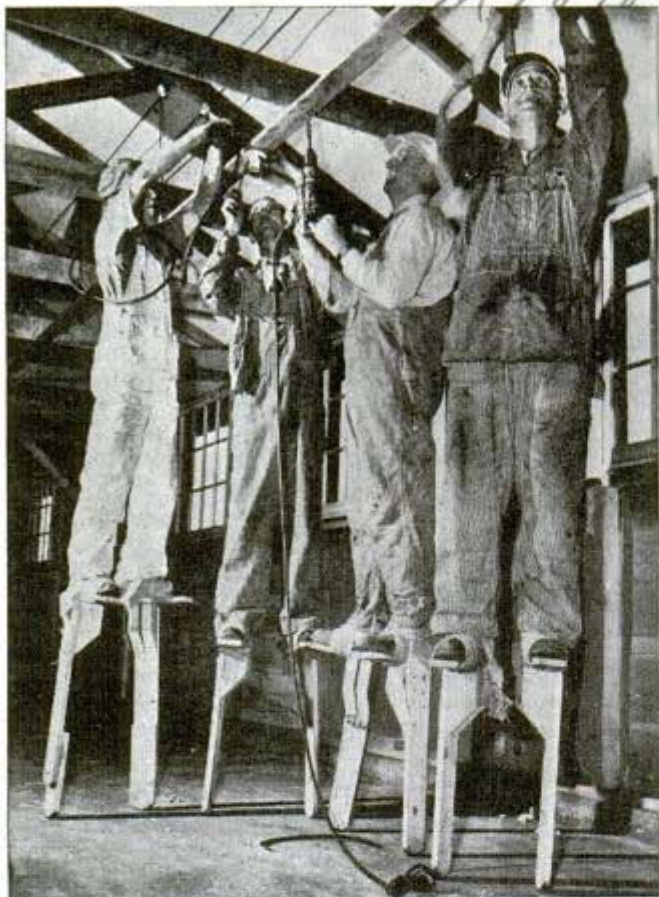


In control room Mr. Chramer runs disks, operates most of stage lights by bank of switches. Below, scene from *La Traviata*; note tiny candelabra, puppet orchestra with leader "Tosca." Stage is 12 feet wide, eight feet high



*Press Assn. Inc.
50 Rockefeller Plaza, N.Y.C.*

Electricians on Stilts Save Trips Up and Down Ladder



Making ceiling installations on stilts saves time and climb

Taking up the suggestion of a bystander, electricians at work wiring barracks and mess halls at Ft. Lewis, Wash., mounted stilts so they could reach the ceiling to make overhead installations. This innovation, it was estimated, saved each man more than a half-mile a day of climbing up and down stepladders.

Radio Meter Held by Buoy Broadcasts Tide Action

Velocity and direction of ocean currents can be broadcast continuously by the Peters-Roberts radio current meter, developed by the U.S. Coast and Geodetic Survey. Housed in a streamline case so it will align itself automatically with the current, the meter unit is suspended to a depth of about 15 feet from a special buoy that remains steady regardless of strong

Ref:

16 *Washington, D.C.*

currents. The impeller, resembling a small ship propeller, is soldered to a cone-shaped body equipped with a magnetic driving element instead of a mechanical one to prevent leakage. This magnetic drive actuates a contact mechanism in the submerged case which, in turn, keys the radio signals on a transmitter housed within the buoy. Included in the setup is a compass mechanism having two sets of contact points and a revolving contactor.

Semihollow Balsa Life Raft Floats With Bullet Holes

Bullet holes alone could not sink a balsa-wood life raft of semihollow construction in tests conducted by the manufacturer. After 60 rounds of .38 caliber bullets passed through its bulkheads, the raft sustained 640 pounds with a freeboard of five inches. Balsa rafts are made in sizes that will support from 15 to 25 persons clinging at the sides. A special waterproof covering protects the balsa wood, and if pierced by bullets the holes swell shut, preventing the absorption of water. Life floats have lines all around the sides which shipwrecked persons use to keep themselves afloat. Some have suspended platforms upon which several can stand.



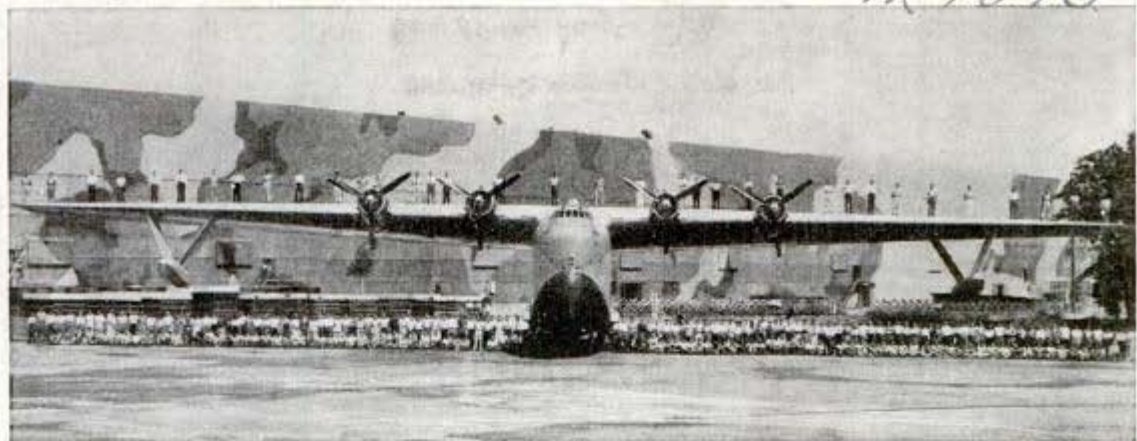
New raft floats high supporting many men. Left, note basket arrangement of bottom

POPULAR MECHANICS
*Winner Mfg. Co. Inc.
Trenton, N.J.*

*The Glenn L. Martin Co.
Baltimore, Md.*

Flying Boat "Mars" Becomes Largest Freighter

m 1095



Grouped beneath and above wings are workers who helped build navy plane now converted into freighter

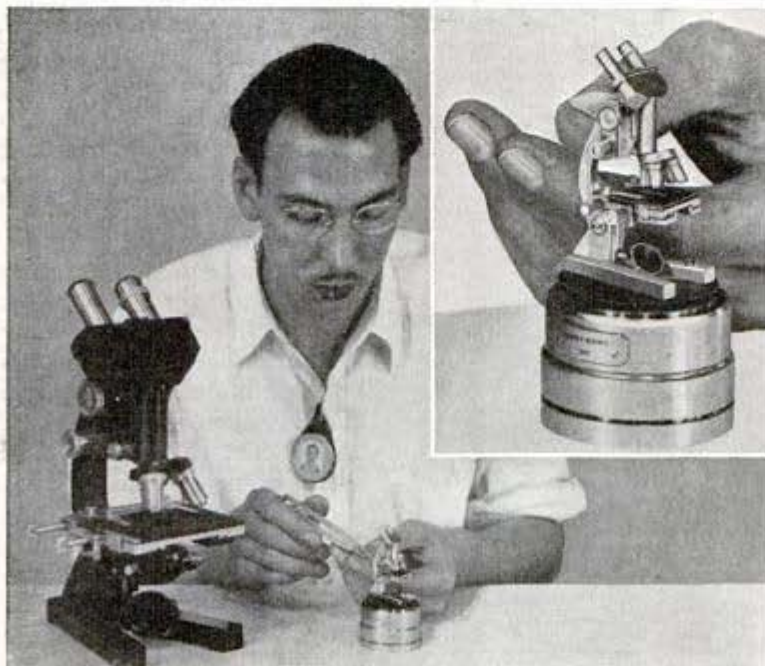
Tiny by comparison with the gigantic proportions of the 70-ton navy flying boat they helped to build, 250 members of the "experimental" crew posed recently with the mighty Martin Mars—the biggest plane of this type. Spaced an average of nearly

six feet apart, 35 men stood along the top of the 200-foot wingspan, while 215 other persons posed beneath the wing. The huge "water bird" has undergone conversion into an air cargo carrier, in which capacity it is said to be the world's largest.

Little Brother of Big Microscope Is $2\frac{3}{4}$ Inches in Height

Almost microscopic in size itself, a tiny microscope that actually works has been built in his home workshop by Joseph P. Kleiber, an employee of Bausch and Lomb, Rochester, N. Y., who spent a year of his spare time at the task. A watchmaker's

lathe, taps and dies were used in constructing the instrument, which is only $2\frac{3}{4}$ inches high, with a specimen stage $\frac{3}{4}$ inch square that can be racked in and out like a research model. It has coarse and fine focusing adjustment and also adjusts for inter-



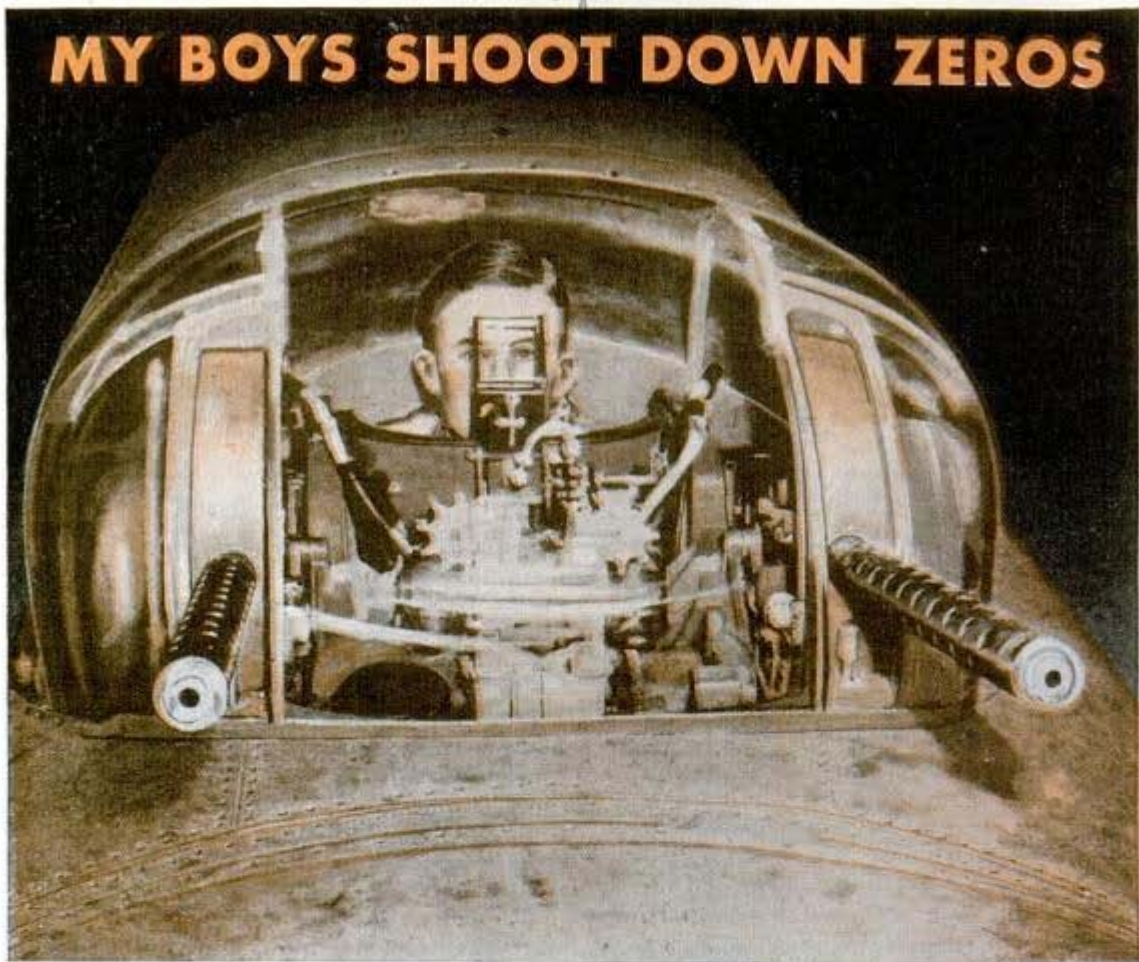
Tiny microscope beside full-scale model to left; closeup view in inset

pupillary distance. Making his task more difficult, Kleiber selected a binocular type microscope, fitting it with a revolving nosepiece carrying multiple objectives. Hardest to make were some of the tiny screws, and all it lacks now is a substage condenser to control light from the mirror. A glass cover for the instrument was made from a pill display bottle.

It is estimated that 2,000,000,000 pounds of household fats have been thrown away annually, and it takes only a pound to produce enough glycerin to fire four anti-aircraft shells.

Acme Newspictures, Inc.
461-8 av. nyc.

MY BOYS SHOOT DOWN ZEROS



Jap Zero pilots don't care for this view of a Martin B-26 top gunner
Air Corps men learn to recognize Allied and enemy planes from models



m 1000
By

Lt. Willis S. Brown, Jr.

Army Air Corps, Stockton Field, Calif.

As told to RODERICK M. GRANT

SO YOU think the Jap Zero can outclimb and outfly and outmaneuver any American plane? Well, you're about right.

But that's not the whole story. Did you ever hear a Yankee back from Midway or the Solomons or Australia grumble about his plane and wish he could trade it in on a Zero? I haven't. And some of my students have shot down Zeros.

Yes, the Jap fighter can fly. It has a tremendous engine in a bantamweight body. It has huge wings for its weight. It can get there plenty fast. But it can't al-

ways get home again, for any American plane can outgun it, and that is rather important in a shooting war. We have some planes with as many as 10 machine guns which can pour out 200 bullets per second. Add it up for yourself. Three of these Americans flying in a "V" can ladle out 2,400 slugs in a concerted four-second burst.

There are some other nice things about our ships. They are armored, fighters and bombers alike. The Japs are, for the most part, unprotected. Aces of the first World War talk fondly of the "crates" they flew. The Zero is a crate; flimsy wood, plastic and fabric. Maybe it's hard to catch when it's running away, but any time it's in gun range you can make it look like a punchboard.

Here's a funny thing about the Japs. They don't carry parachutes. The boys from the land of silk and umbrellas aren't supposed to bail out. It's not honorable in a Nip to land safely and be taken prisoner; besides, a parachute would be that much extra weight in a plane. So when you hit 'em, they go down, and it's no happy landing.

That's not the way we were brought up.



What the well-dressed American pilot wears at high altitudes. Notice emergency oxygen mask below chin

One-hundred-pound practice bombs are used at a training "college" to tone up muscles in calisthenics





The instructor goes over maps with his team of pilots before takeoff

Our fliers get a sporting chance to float down if they're disabled. Every man who climbs into a plane gets a parachute for a going-away present. In fact, the U. S. Army insists on a chute for every passenger and crewman in an army plane. That's even safer than the civil air lines, which provide no parachutes whatever for the millions of travelers they carry.

and stay beneath the overcast. Thunder clouds are poison in a beautiful disguise. You're likely to run into a 100-mile-an-hour downdraft around the edge of the cloud and a 100-mile-an-hour updraft inside it, with terrific turbulence. Something like that tore the wings off this man's plane.

Our safety record here is rather remarkable in view of the fogs that sometimes blanket the field with unpredictable suddenness. We have had as many as 20 students caught by fog at one time, and brought them all down without incident. Students are taught to follow the radio beam to the cone of silence marking the beam center, make the right-angle turns, measure off distance and altitude and set the plane's angle of glide to meet the invisible

This is the "greenhouse" of the B-19, the mightiest warplane in the world. Our bombers have the biggest guns and heaviest armor



runway exactly. With an altimeter accurate and sensitive to 20 feet, it's not so difficult. In the densest of soup you can always see the ground from 10 or 20 feet up.

Incidentally, much of the credit for our safety record goes to the ground crews who keep our planes in perfect condition. They're all enlisted men who have of-

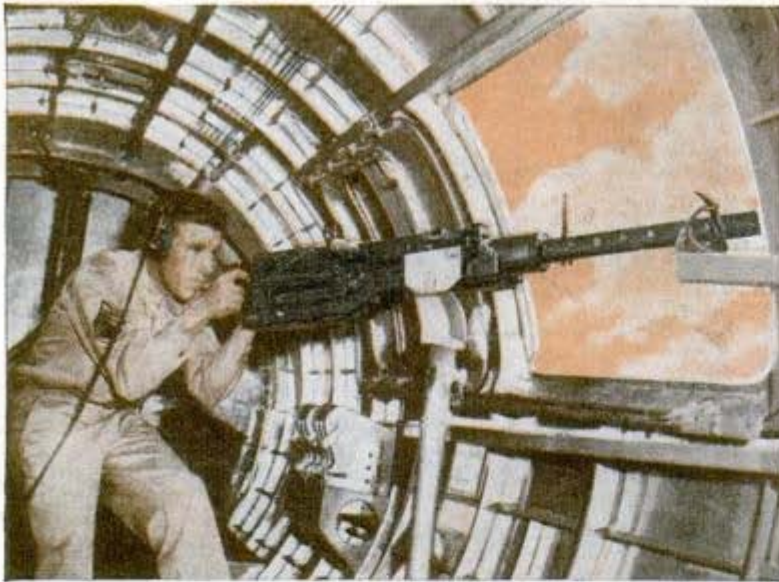


At upper right, the bombardier's nest in the nose of a four-engine bomber. He also has a 50-caliber machine gun to man when not busy planting "eggs." At left, above, a preflight and gunnery trainer. Below, Air Corps students study model of a gyroscope

fered their services and talents in a job that isn't always glamorous, but is just as important as that of the cadet. For the pilot depends on his ground crew for a smoothly operating ship. They are the boys who don overalls at the crack of dawn to tune up our planes for another day's

flight training or for a scrap with the enemy. They're working with grease and oil late at night on their essential part of the big job of making the U. S. Air Corps supreme in the world. And, every one a skilled craftsman, they get a thrill in watching the plane they've groomed take off with a graceful lift—and a load of TNT for Dusseldorf. We've a swell crew of mechanics here, and we need more like them.





These 50-caliber machine guns are poison to Zeros and Focke-Wulf fighters

Precision is the main dish in this advanced school—precision in flying and navigating. Yankee fliers today are taught to fight as a team and to bomb as a team, and teamwork necessitates the utmost precision. Dogfights of the 1918 brand are taboo. They may happen, but they are not planned that way. By operating in groups, the fighters multiply their fire power; they are schooled never to break off into single combat. Like a perfectly trained symphony orchestra following the conductor's baton, the wing men of the fighter team train for the dangerous game of follow the leader,

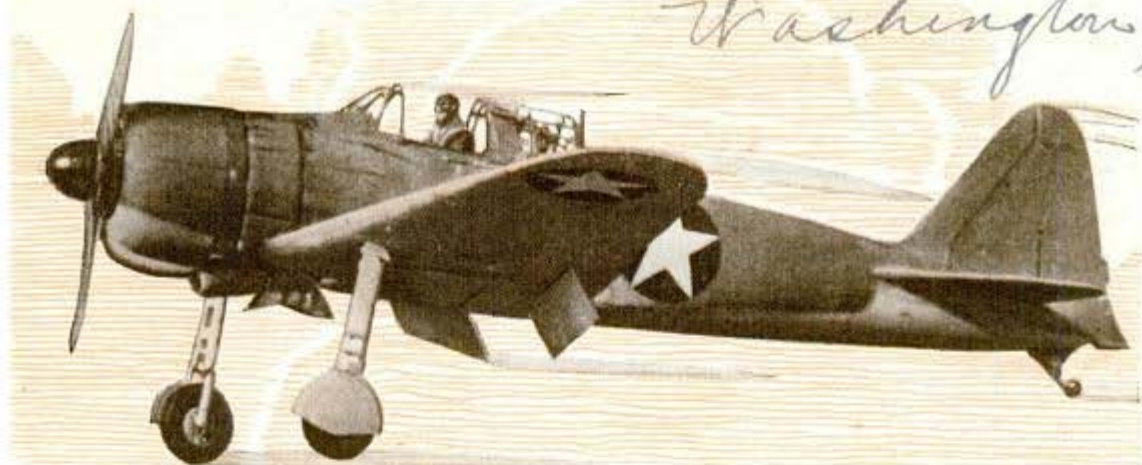
we don't use the strings. They were just stage "props."

Here's how the team works. Three Airacobras or Warhawks or Thunderbolts line up on the runway. The leader of the "V" element gives the signal and they are off together. From that second until they pull up at the home base hangar at the end of the tour of duty, neither wing man takes his eyes off the leader. They climb, bank, dive, zoom as a unit. In the air, the two wing men take a position with their wing tips three feet to the side, three feet back, three feet above the leader's.

Using models to represent a task force, an instructor demonstrates methods of attacking an enemy fleet



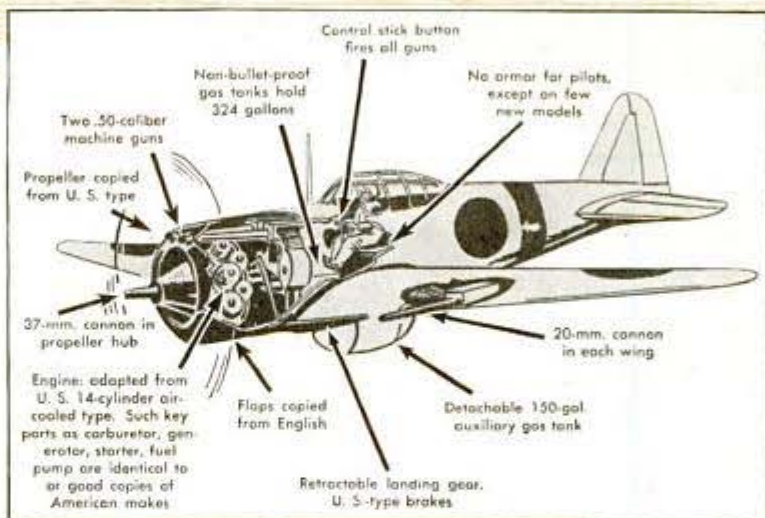
Lt. Comdr. J. R. Sander
Washington, D.C.



Three thousand feet below, the leader sights a squadron of Japanese. Without a sign to his teammates, he leads them into a power dive. He may radio the order to fire. More likely no word will be spoken. When the wing men see the flash of his guns, they press the triggers on their own sticks and spray the target. They may not even see it. Thus their fire power is trebled.

One burst, and they pull away. There is no climbing back for another round, if these are Zeros they are fighting. They have lost the advantage of altitude and the speed of the plunge. One deadly burst from above, and the team is on its way rejoicing.

The Chennault system works. You may remember that the Flying Tigers shot down something like 34 Jap ships for every P-40 lost. It's the system we teach here and at all fighter and bomber schools where formation flying is a part of the curriculum. At first the instructor leads the element with hand or head signals. Thumb pointed left or right means a turn. Head tilted forward, increase speed. Head tilted back, decrease speed, and so on. The student's eye, focused unwaveringly on the leader's opposite wing, takes in the signals and observes any change in aspect of the flaps, and after many hours of flight together the trio is welded into a unit, the wing men responding as if the leader's brain transmitted its commands by a sin-



Top, a captured Jap Zero (detailed in the drawing) is tested by a U. S. Air Corps pilot. Below, the navigator of a big bomber plotting the course to target





Parachute training is a "must" for all airmen. Here a cadet is learning the technique of guiding his parachute by manipulating the shroudlines

gle nerve to the fingertips controlling three planes.

You've driven down the boulevard with your eyes glued to the fender of the car ahead. It's something like that, but in the sky there's a third dimension to think about and the pace may be 100 to 400 miles an hour instead of a wartime 35 on the boulevard. Yet it becomes automatic, even the landing of a pursuit ship at 100 miles an hour with your attention on the other fellow's

It's every student's ambition to pilot a big bomber like the B-19, the biggest thing with wings



wing and landing gear instead of the ground that is fast coming up to meet you. That's teamwork, polished to the point that you're reading the signals in the quarterback's mind as fast as he thinks them. Lately our fighters have evolved a two-plane combat team that has proved a good combination.

We have a plane for every purpose. There has been criticism of the inability of the Airacobra, for example, to fight much above 15,000 feet. It was never intended to. It was designed primarily for ground strafing. We have high-altitude fighters. We have interceptors, notably the Lockheed P-38—the English call it the Lightning—which can climb a mile a minute and operates very effectively at high altitudes. We have one attack plane that is the toughest bird of its kind. It has four fixed guns firing forward; it can strafe the enemy as it swoops down, and as it climbs away from the attack a belly gun sprays backward against the ground.

No plane can excel at everything. The Flying Fortress comes as near to it, I believe, as any. Some of my students are piloting Boeing B-17's over the Pacific, and they tell me the Japs won't go near a Fortress any more. A few early encounters evoked a deep respect for the big forts in those sons of the erstwhile Rising Sun who got away. The Flying Fortress just isn't vulnerable.

Acme Newspictures, Inc
461-8 av nyc.

Cadets Learn to Abandon Ship On Waterfront Platform

m 1071



Cadets leaping over the side of "doomed ship" and scrambling down ropes

At a west coast port, cadets in the Maritime Service Basic Training School use a lofty platform at the water's edge for rehearsing "Abandon ship!" The platform has upper and lower decks and is equipped with nets and ropes. It only takes the cadets a few seconds to get into the water at the signal, "Over the side." During the drill they are fully dressed and wear lifesaving jackets.

Robot "Remembers" Flash-Image Until Camera Clicks

m 1134

In studying unpredictable flashes and surges in electrical equipment, it is a great help to have photographs of them, but they vanish before it is possible to click the camera shutter. However, the problem has been solved in General Electric's laboratory by the development of an electronic

robot that retains the image of a flash for $\frac{1}{25}$ second, long enough to permit the opening of an automatic camera lens. It consists of a cathode ray tube having a thin coating of a fluorescent material on which a small beam of electrons continuously paints a picture of what is happening. When a flash occurs, this memory oscillograph holds the image while a thyatron tube trips the camera for a $\frac{1}{50}$ -second exposure.

Lever Locks Blade Of Hack Saw In Position

m 1065

Hack saw blades are replaced or repositioned in a jiffy with a cam-action lever-lock that eliminates loose studs and threaded tension devices. Pushing down on the lever attached to the spring steel frame locks the blade into position under high tension. This tension results in straighter cuts and fewer broken blades. The saw is adjusted for 8-, 10- or 12-inch blades. The blade can be faced in any of four directions by placing it over fixed pins on the side and bottom of the frame. Straight or pistol grip handles are available.



Pushing down on lever to lock blade into position

Schenectady, N.Y.

POPULAR MECHANICS
Clemson Bros. Inc
Middletown, N.Y.

*London Electrotape Agency
134 Fleet St. London England*
Speedy Cable Layer "Shoots" Line to Roadside

77 1153

Keeping up with the fast tempo of modern warfare, the British Royal Corps of Signals uses new track vehicle for laying cables



Laying cables behind the front lines at the rate of 20 miles an hour is the feat of the British Royal Corps of Signals with the track-driven cable layer shown above. The machine, manned by a crew of five, is equipped with a "gun" which projects the cable to one side, clear of the roadway used by advancing vehicles. Three big drums mounted on the front of the layer carry

mile lengths of line. The machine is followed by a "building crew" that erects the cable on light poles or buries it. The artist's drawing, which is based on official information, shows a crew laying cable on the desert to link command headquarters with a forward air base. Cable communication is vital in offensive operations as an alternative to radio.

The LONGEST ROAD in the

mem 1 from Don Blaissman, Coordinator of Inter-American affairs, 4 x 4 truck in page.



Gas station "traffic cop" is a road map and clock of Argentine Automobile Club

m 1055

By Edwin W. James

Chief of the Inter-American Regional Office
United States Public Roads Administration

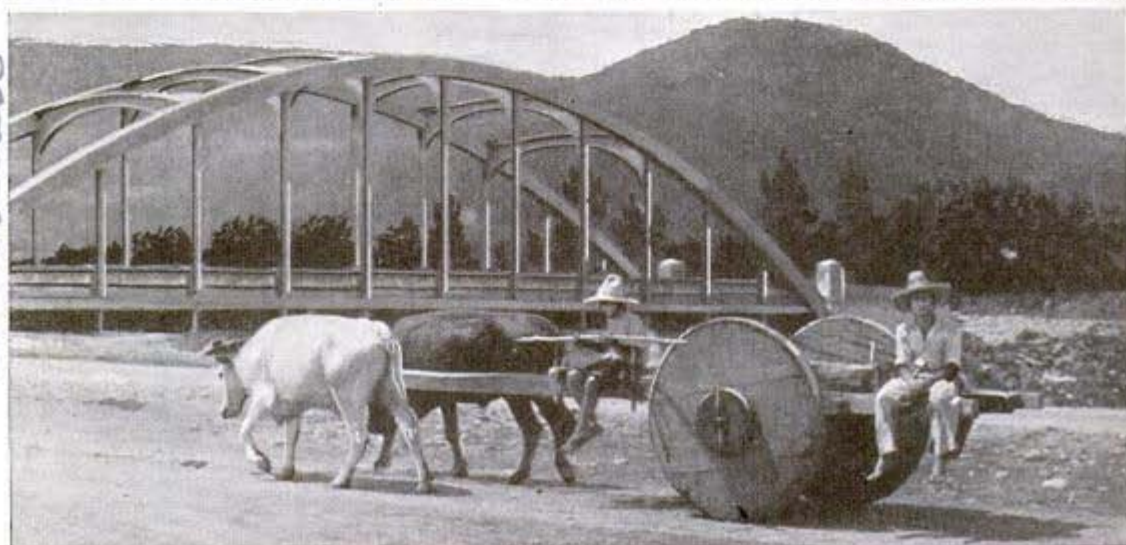


AS THE PLANE FLIES, Buenos Aires is about a third of the way around the world from Fairbanks, Alaska. Between them, almost completed, lies the longest road in the world.

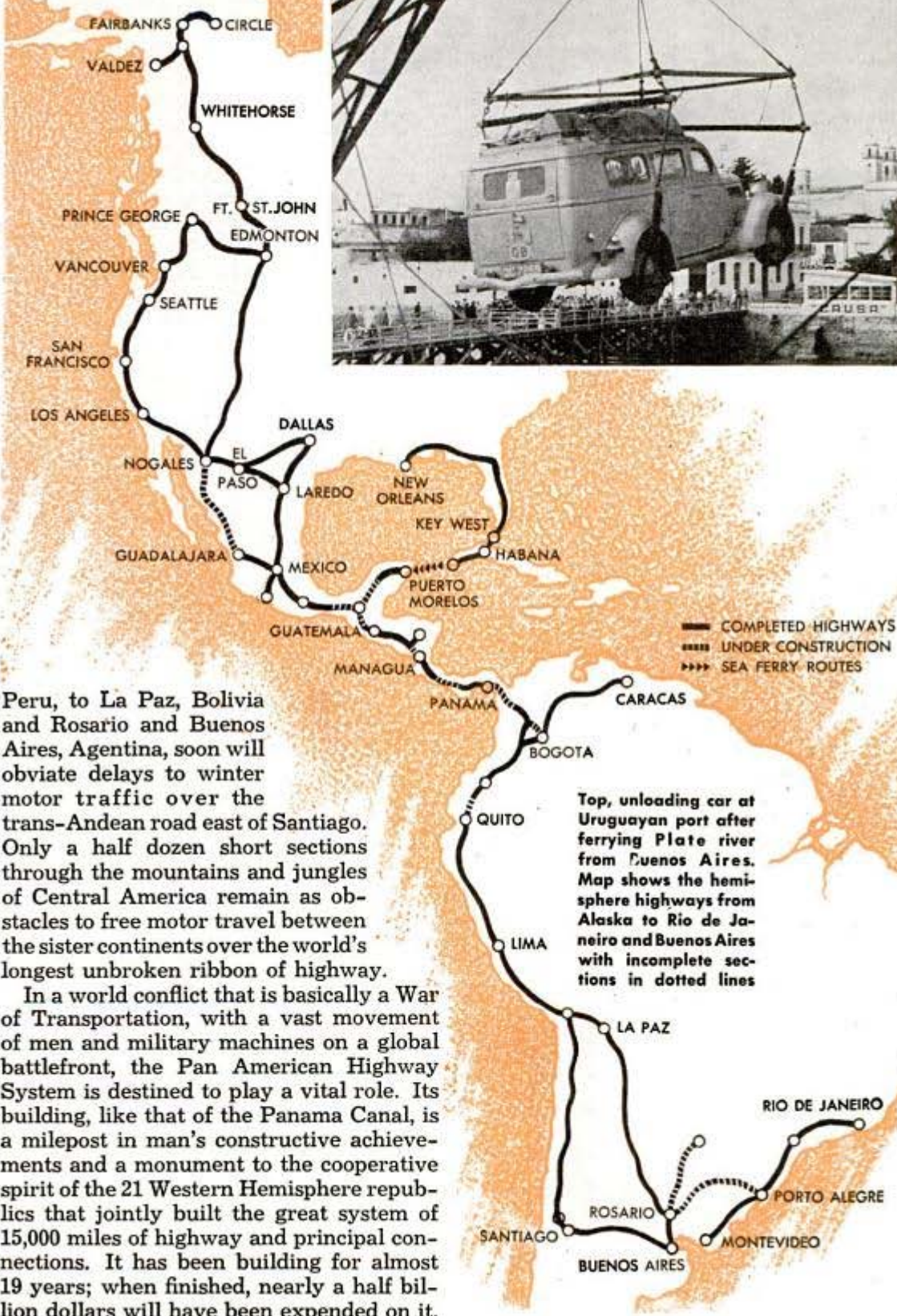
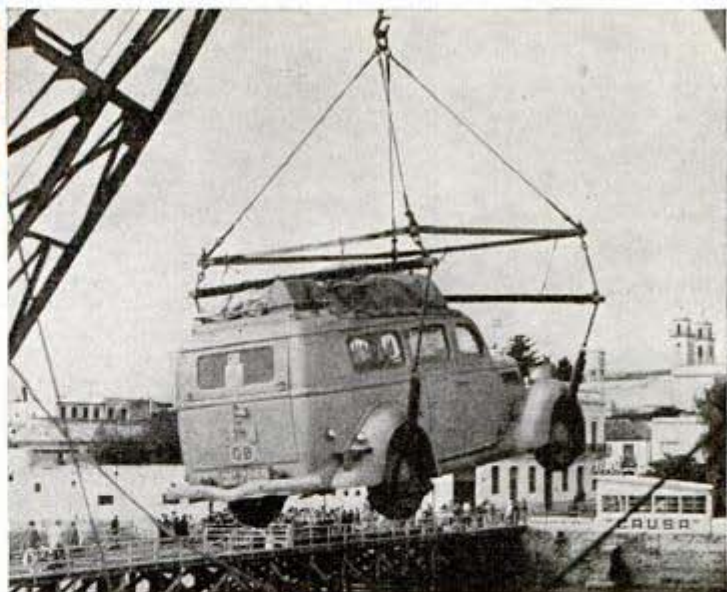
Bulldozers crashing through the underbrush from north and south met in the Yukon wilderness in November and U. S. Army trucks were soon rolling over a new 1,632-mile pioneer road connecting Alaska and Canada with the United States.

From Fairbanks to a point in southern Mexico the road is now uninterrupted. From Buenos Aires, Argentina, across the Andes to Santiago, Chile, and north through Lima the highway is in use, and an all-year alternative route from Lima,

Left, tamping Guatemalan section of Pan American highway. A million Indians must work two weeks a year on national highways. Below, an oxcart meets a modern bridge in Nicaragua



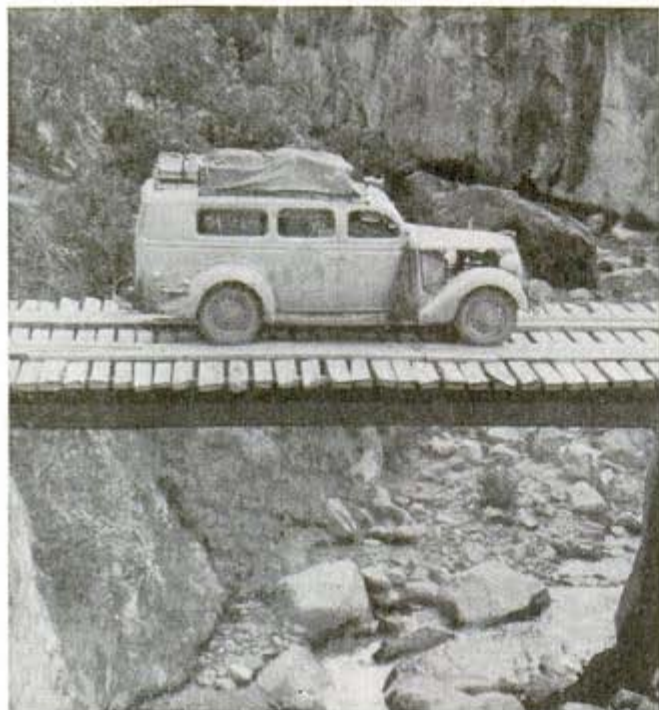
WORLD



Peru, to La Paz, Bolivia and Rosario and Buenos Aires, Argentina, soon will obviate delays to winter motor traffic over the trans-Andean road east of Santiago. Only a half dozen short sections through the mountains and jungles of Central America remain as obstacles to free motor travel between the sister continents over the world's longest unbroken ribbon of highway.

In a world conflict that is basically a War of Transportation, with a vast movement of men and military machines on a global battlefield, the Pan American Highway System is destined to play a vital role. Its building, like that of the Panama Canal, is a milepost in man's constructive achievements and a monument to the cooperative spirit of the 21 Western Hemisphere republics that jointly built the great system of 15,000 miles of highway and principal connections. It has been building for almost 19 years; when finished, nearly a half billion dollars will have been expended on it.

Top, unloading car at Uruguayan port after ferrying Plate river from Buenos Aires. Map shows the hemisphere highways from Alaska to Rio de Janeiro and Buenos Aires with incomplete sections in dotted lines



Crossing a narrow bridge over a spectacular gorge in the Andes

Right now the question is—can the Pan American Highway provide a major war-time contribution by bringing strategic materials from the other American republics to the United States?

It can, under certain conditions. Our government has granted loans and appropriations totaling between 85 and 95 million dollars to push the highway through Central and South America. A 675-mile pioneer road is being rushed from the Mexico-Guatemala border to the Panama Canal, to be linked by June with the Mexican railway system to our border.

The wisdom of an international highway system as a part of our war program was dramatically exemplified by China's Burma Road. Scooped out in ten months by back-breaking hand labor of more than 100,000 men, women and children, this highway functioned for almost five years, pouring life blood into the armies of China.

Observers who have

A motorist follows a detour around a washed-out bridge on the road over the Peruvian Andes



compared the Burma Road with finished sections of the Pan American Highway rate the Burma Road a back-country, grade-D highway. Yet in 1941 the Burma Road carried 20,000 tons of vital supplies every month to the fighting Chinese. Despite lack of fuel, machinery and equipment, lack of organization, technical difficulties, inadequate surfacing and the unremitting rain of Jap bombs, this artery functioned until Burma was conquered. Chinese humorists' favorite jibe was that a Jap bomb cost \$1,000; the hole it made in the road cost eight cents to repair. Today the Chinese are feverishly building another highway to connect Chungking with India.

Ships are the principal means of moving freight between the Americas. Since Pearl Harbor, ship sinkings in the "Battle of the Atlantic" have totaled over 545.

Shipping distance from Buenos Aires to New York over the 24-day peacetime route is 5,871 nautical miles. By utilizing alternative water and land routes we may reduce our exposure to submarine attack.

Except for about 2,000 miles of continuous surfaced road in Mexico, the 3,500 miles of the North American section of the highway (called the Inter-American Highway north of the Panama-Colombia border) is still under construction. Sections are completed, but not continuously connected.

Parts of southern Panama and northern Colombia are still only semi-explored.

The South American section between La Guaira, Venezuela, and Rio de Janeiro, Brazil, is about 8,200 miles long—325 miles longer by the Santiago route than via La Paz. Reports indicate the highway is about 98 percent completed. The principal bottleneck is a 290-mile stretch in Ecuador, which could be built in about five months if funds, equipment, labor and supplies are provided. This gap can be detoured by a water jump of 175 miles from Talara, Peru, to Guayaquil, Ecuador, or 90 miles from Puerto Bolivar to Guayaquil.

Truck transportation over the Pan American Highway is expected to be important in future trade among the other American repub-



In western Venezuela the highway (above) snakes its way in abrupt ascents to the cloudwrapped "panamo" on top of the Andes at La Negra pass. A wrecked car is mounted on a monumental base (left) to warn speeders at a Peruvian crossroads



A fleet of ten Caterpillar tractors pulling scrapers is making the cut at right on the highway to Panama in Costa Rica

lics. There are plans afoot to solve local shipping problems by using truck convoys from southern to northern Peru, about 1,000 miles.

There are about 10,000 Diesel vehicles in the Western Hemisphere, half of them in the other Americas. About 100,000 gasoline trucks were reported frozen in our dealers' hands—a large stock pile from which motor vehicles could be diverted for trucking vital materials from South America. There is a moderate supply of trucks on that continent.

(Continued to page 176)



20-Foot Leap Trains U.S. Rangers For "Commando" Raid



Ranger leaping from top of rail barrier with his gun in hand

United States Rangers, who distinguished themselves in the raid on Dieppe, keep in top physical condition by training with British Commandos on obstacle courses. Scaling a 20-foot rail barrier with full fighting equipment and then jumping off is one exercise. The Ranger knows how to land without breaking bones—unless they happen to belong to the enemy.

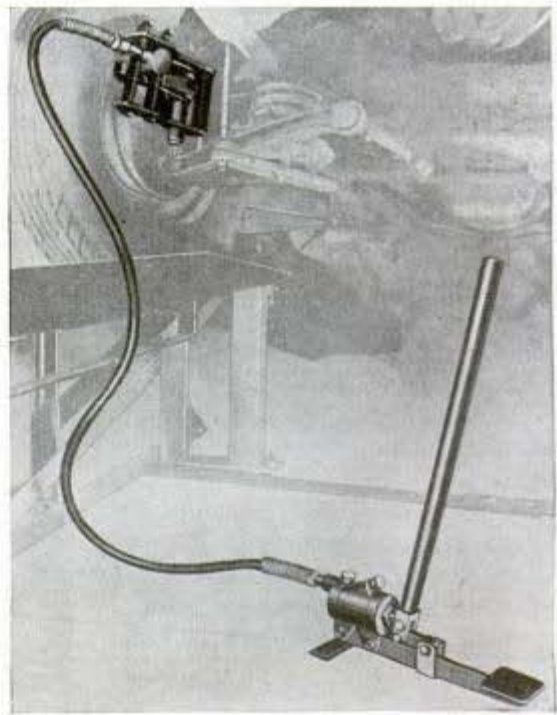
Clam Demonstrates Its Ability To Keep Its Mouth Shut

Steady pulling for five days with weights ranging from about two pounds to more than eight pounds failed to make oysters and clams open their shells in tests conducted by Prof. A. M. Reese of West Virginia University. He was trying to learn particularly how a starfish induces the mollusks to open their shells so it may devour them, but this problem remained unsolved. Some of the shells were opened slightly after five days, others not at all. One oyster, after a three-pound pull for

48 hours, was subjected to a sudden increased pull, but resisted until the tension reached 22 pounds, yielding only when its shell-closing muscle was torn apart. To apply the weights, small notches were cut in the shells into which small hooks were inserted. Weights on lines passing over pulleys applied the tension, while the shellfish were kept alive in a salt solution similar to sea water. It was pointed out, however, that in their natural environment, oysters and clams might not react in exactly the same way.

One-Man Tool for Wheel Saves Removing Parts

Knee action wheel faults are repaired without removing parts from the car with a handy tool that can be operated by one person. The tool, powered by a hydraulic ram, corrects faults that would result in abnormal wear on tires. It is applied with three-point contact and adjusts from 3 to 7 inches to correct camber. It also can be used to straighten steering arms and spindles.



Repairing knee action with the new hydraulic tool

Margantown, W. Va. Bee-Line Co. Danenport Lowe

Cafe Keeps Patrons' Sugar Like Shaving Mugs

Sugar problems of the diners in one restaurant have been solved by the proprietor, who installed a rack behind the counter where each patron may store a sugar bowl of his own. If the customer wishes more than one spoonful in his coffee or tea, the first one is on the house and all the extras come from his niche in the "sugar vault."

Stored like soap mugs in an old-time barber shop, sugar dispensers belonging to patrons provide that extra spoon in the coffee. An odd assortment, the containers include atomizers, oil cans and bean pots

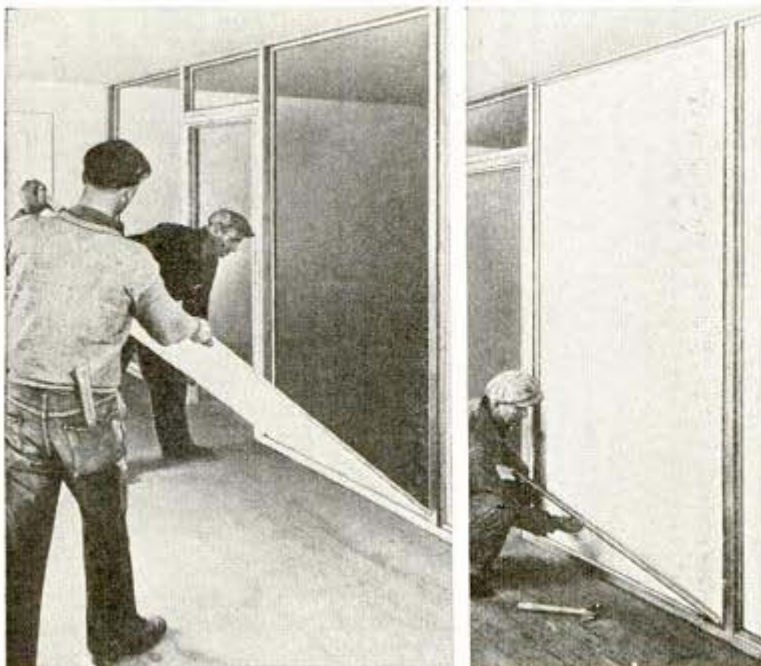


Ref: N. Andrews, Philadelphia, Pa.

Demountable Partition Panels Conserve Wood and Nails

Solid partition walls can be erected speedily and easily with gypsum core wall-board supplied in panels six to 10 feet long

and four feet wide. These panels are set within a framework of two-by-fours spaced four feet apart, using wood molding to mount the panels in place. Panels so installed may be dismantled intact simply by ripping out the moldings. Fewer nails are required for this type of installation than where wallboard is mounted on studs spaced with 16-inch centers, and the wider framework also saves considerable wood. The molding nails may be driven without puncturing the panels.



Two views at left show workmen setting panel in frame of two-by-fours, and placing quarter-round molding which holds the panel all around

MARCH, 1943

National Gypsum Co 33 Buffalo, N. Y.

Popanga Calif.



SHARP SHOOTING with "HAND IRONS"

Ref:
Top, Ralph Miller, California gunsmith, uses high-speed ammunition in a revolver that has been fitted with a telescopic sight for long range shooting. Below, Sergt. R. J. Nowka, crack shot of the Los Angeles police force, fires simultaneously at two targets

new for St. Div. L.A. Police Dept Los Angeles Cal



REVOLVER shooting looks easy, when you watch a crack shot knock the ashes from a friend's cigarette, or with two guns simultaneously hit two small targets held at arm's length apart by someone in front of him.

But have you ever tried to hit a small target with a revolver yourself? If you have, you've observed that the sights wobble all over the place. You get more misses than hits; and no wonder, for a handgun is the most difficult of all guns to use. You need a lot of practice to become a good shot, but here are a couple of tips that will improve your shooting almost at once.

In the first place, you may hold the gun improperly. The average person pokes his finger across the trigger and rests the rear of the gun against the big joint of his



Facing away from targets on police range, marksmen turn at a signal, fire at each target as they rush in

thumb. That's all wrong. It puts the barrel at an angle with your forearm, tending to spoil the aim. The recoil may slam the gun into the base of your thumb, tearing off some skin.

The right way is to place the rear of the gun against the soft flesh between thumb and forefinger. This lines the barrel up straight with the forearm. Your thumb now lies parallel with the barrel and the ball of the forefinger rests on the trigger. Always hold the gun this way. Be sure the grip or stock is held vertically instead of cocked to one side.

Steady sight alignment is necessary before you can run up good scores. The se-



Don't try this on the boulevard—it's a trick for experts. Aiming a revolver by looking in a mirror

At left, Miller's high-speed .22 caliber revolver bullet is shown in center, compared with a .38 caliber revolver bullet at left and a .45 caliber, right





Gunsmith Miller overhauling various types of revolvers in his shop

cret is practice. The more you aim at the target, the steadier you become. Dry snapping, or simulating fire with an unloaded gun, is good practice and won't hurt a modern revolver.

A good shot never pulls the trigger but always squeezes it. When you pull the trigger you pull the barrel to one side, spoiling the shot. A slow squeeze doesn't deflect the barrel. Even this isn't enough. There is a "follow through" in aiming and squeezing that makes the difference between good and poor shooting. A steady aim during the trigger squeeze is simply preliminary; the aim must also be steady during the time the bullet is traveling through the barrel, after the gun has

been fired. Sergeant R. J. Nowka, former national pistol champion and a member of the crack Los Angeles police pistol team, explains that a good shooter deliberately "holds through" and continues to sight and squeeze after the shot has gone. This helps to prevent the marksman from unconsciously flinching at anticipation of the concussion.

In exhibition, Sergeant Nowka can perform such stunts as shooting the ash from a cigarette held in a man's mouth 20 or 25 feet away, then shooting the coal of fire from the end of the cigarette, and finally cutting the cigarette in half. Cutting a playing card held edgewise at the same distance is another stunt; hitting clay pigeons thrown into the air, or putting shots

guns that are fired simultaneously are other examples of fine exhibition shooting. These are not trick shots. No such shooting as this should be attempted by an average shot while using another person to hold the targets. The slightest deviation in aim might cause a death. Not even the best



Properly held, rear of gun fits into soft flesh between forefinger and thumb; thumb is parallel to barrel. Notice thumb in improper hold at right, with trigger finger extending too far

shots will fire at a target held above a person's head because a slight variation in powder charge may cause the bullet to drop more than it should.

Plenty of practice, plus coaching, is what it takes to become a fine pistol shot. Revolver shells are hard to buy these days but most revolver clubs reload their own shells. An automatic reloading machine built for the Los Angeles Police Department range loads 2,000 revolver shells per hour. Target shooting is safer and more convenient on a regular range than out in the open country. The first requisite for a practice range is a thick backstop, such as a hill. The whole area should be posted with warning signs and the range itself fenced in. A combination range for both revolvers and rifles should have targets at 25 yards, 50 yards, 100 yards, and on up to 500 yards or more if room is available. The shooting area should be in front of the range, on level ground, with enough room to provide six feet of space per man. Standard targets may be obtained at sporting goods stores.

Sergeant Nowka, former national pistol champion, cuts cigarette in two with a bullet. Below, gun case for four hand guns, tools, ammunition



A revolver or any sort of handgun is a compromise weapon at best. Its chief asset is portability. It is a difficult weapon to aim and even a slight breeze will throw a crack shot off his mark. Because it is held by the hand below the barrel, the recoil of the gun throws the muzzle upward. In fact, the tall front sight of a handgun is built up purposely to compensate for the distance that the muzzle lifts upward during the time the bullet is traveling through the barrel. The barrel is actually aimed way below the target.

Most handguns are effective for only 50 yards, about the range of a shotgun. The bullets of heavy revolvers are big, slow-speed slugs that have muzzle velocities under 1,000 feet per second. Ralph Waldo Miller of Topanga, Calif., is

(Continued to page 175)

Dr. Jos. N. Burkhardt Public Relations
Office Chgo Quartermaster Depot

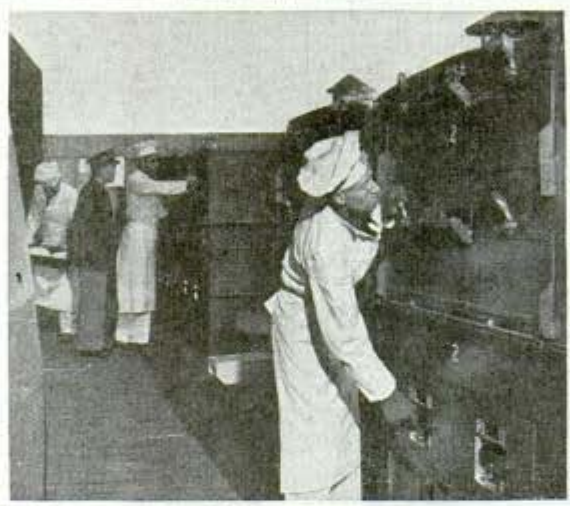
Doughboys Join "Bread Line" at Baking School

71910

1819 & Peabody Rd, Chicago



Reading the temperature of bread dough, above, is just one of the fine points of baking given soldier students at the Army Training School for Advanced Baking Instructors in Chicago. Co-operating with the Army in developing expert bread bakers is the civilian staff of the American Institute of Baking. Center, watching over Army ovens



The "weighing in" process, above, is accompanied with more temperature tests. Below, students on the "campus" learn how to bake good bread with field equipment, rain or shine, hot or cold. The dough is mixed and weighed in tents and baked in ovens fired with either coal, wood or oil. Men who complete the five-week course are experts

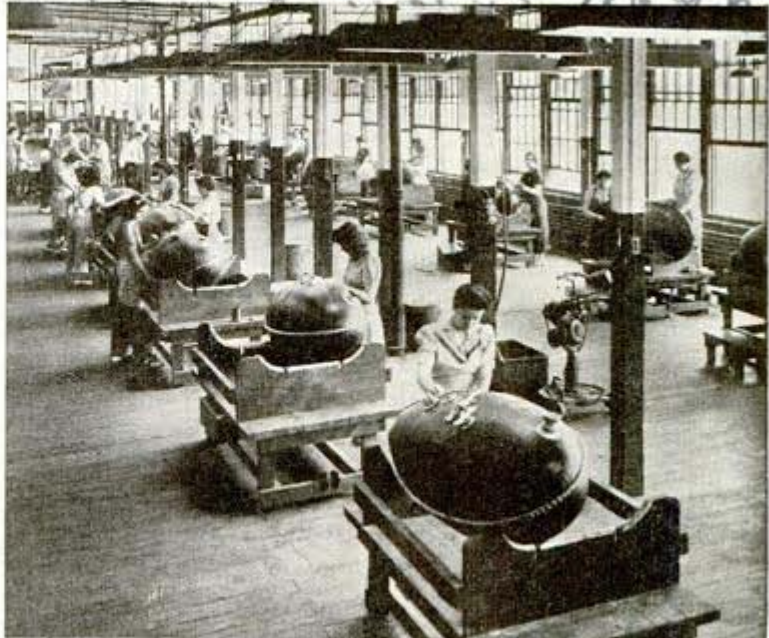


U. S. Signal Corps photos

*Rockefeller
Century*

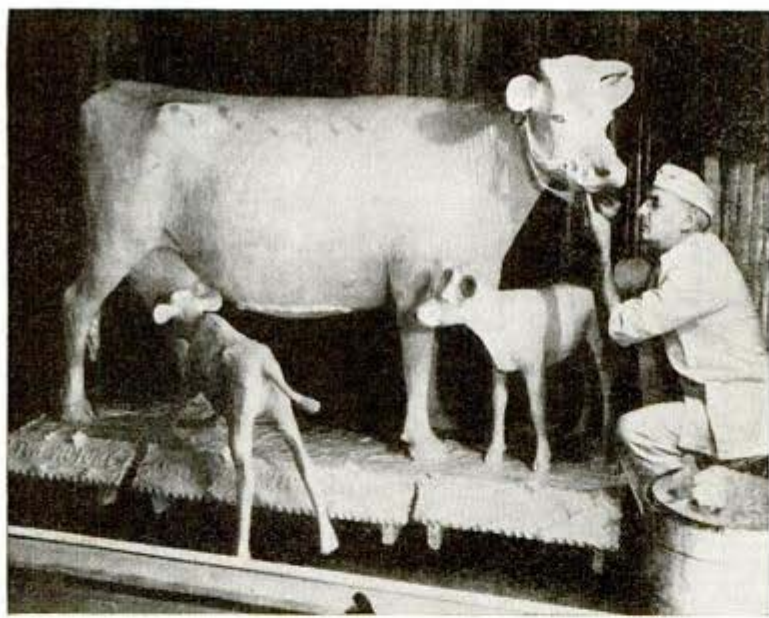
Spare Tank for Plane Is Dropped When Empty

Auxiliary gasoline tanks designed to increase the range of American bombers are carried on the outside of the planes and can be dropped when empty or upon entering combat. The tanks are streamlined to reduce wind resistance. They were developed by engineers of the United States Rubber Company and are constructed partly with converted tire machinery.



These streamlined "eggs" are for the air corps—not for breakfast but for the large bombers to carry extra fuel and increase range of ships

Statue in Butter of Cow and Calves Weighs 1,000 Pounds



Keeping cool at his work was a matter of prime importance to J. E. Wallace, Florida sculptor, who used butter in lieu of clay or marble to make a life-size statue of a cow with twin calves for a patriotic exhibit. The group, titled "Food for Victory," was displayed in a large glass refrigerator kept at low temperature. One thousand pounds of butter went into the statues.

Sculptor at work in his odd studio—a huge refrigerator where he made this life-size bovine group in butter. Temperature is kept at freezing

Deland

Inventors Advised Not to Invent Torpedo Nets for Protection of Ships

Of 100,000 ideas submitted to the National Inventors Council to help win the war, several thousand concerned nets, screens and other devices for protecting ships against torpedoes. Because this field has been so popular, Uncle Sam is suggesting to inventors that they would be wise to direct their efforts to other inventions that have not had such intensive consideration. Dur-

ing the first World War a similar situation prevailed when the Naval Consulting Board received 6,740 ideas in the same category. At that time it was reported that not one of the proposals had been approved, because the devices either were too heavy, difficult to hold in position, unmanageable in a heavy sea, or interfered with the speed and maneuverability of the vessel.

Army Air Forces Navigator School
Woods Texas.

Dr. E. W. Hatcher (Coordinator of Civilian Pilot Training and Prof. of Physics, Union College, Schenectady, N.Y.)

BACK SEAT DRIVER in a



It's the navigator who "brings 'em back alive." Above, shooting the sun through top blister; below, at the navigator's desk

21108
By Wayne Whittaker



THE navigator of a big Army bomber roaring over the jungles of Central America speaks into the plane's interphone system: "Navigator to pilot. In 14 minutes we'll be over the Panama Canal."

"Sure it's not Suez?"

"E.T.A. from this point," continues the navigator, "is not more than 40 seconds off original Estimated Time of Arrival."

"Forty seconds off! Say, they'll have you navigating a Great Lakes freighter if—"

"You can relax now," interrupts the navigator. "Looks like the ack-ack batteries will pass us up. You might also try keeping on the course for a change."

Under the good-natured banter of these airmen on an Army mission to the Canal Zone was the knowledge that an error of minutes meant sudden death. Every plane that flies over the canal is

BOMBER

an enemy plane unless proved otherwise. Gun crews are instructed to shoot first and ask questions afterward. Both navigator and pilot knew that their appearance a few minutes early or late due to faulty navigation, would be greeted with a stream of bullets.

This particular mission and others like it are considered routine—completely without risk—all because of the high degree of accuracy of Uncle Sam's aerial navigators.

The pilots call these back seat drivers "high altitude bookkeepers." They have a desk job, but their office is on a bomber and their desk beside the bomb rack. Every pilot, bombardier or gunner knows his navigator can guide him to any point on the globe—to Berlin or Rabaul, to Dusseldorf or Yokohama—and back to home base.

Even on training trips the navigation cadet—who is



Sextant in hand, the "back seat driver" sits behind the pilot checking plane's position. Fifteen weeks of navigation training and 15,000 miles of flight fit him for his job



A Navigation Cadet figures that the shortest way to the Far East is by a straight line along a Great Circle. His job will be to set the course, forecast weather during flight, read the maps and watch the wind drift, guide the bomber from base to target and home again. Left, operating a radio direction finder



Cadets must learn to fly by sun, stars and planets. Here two Air Corps cadets study a Pan American Airways navisphere showing how the world looks from outside

called a "jackpot," the navigation equivalent to pilot underclass "dodoes"—must navigate so well that a 500-mile jaunt is completed on the "destination dot" within two minutes of estimated time.

An officer at the Army Air Corps' Navigation School at Hondo, Tex., compares a bomber navigator's job to directing a blind



truck driver freighting 10 tons of TNT at 60 miles an hour. A cool head, accuracy, and ability to work with an array of instruments that would awe a layman are the requirements for a good navigator.

Thousands of smart young Americans are learning navigation in "sky classrooms" in schools conducted by the Army Air Corps. Their instructors are experienced Army navigators, navigators from Pan American Airways and a few recent graduates. The cadets are taught to navigate by landmarks, dead reckoning, the stars and radio instruments.

First, the prospective navigator must attend nine weeks of pre-flight school. There he receives refresher courses in mathematics, physics and other subjects, learns military discipline and courtesy and how to identify air and naval craft. He is selected for his training on the basis of his own preference and exhaustive psychological and physical tests. In pre-flight school, he often teams up with a future bomber crew buddy, the bombardier. Combat crews are close-knit units built on mutual confidence, respect and friendship.

After leaving pre-flight school, the cadet enters navigation school. There he is given a stiff 15-week course that covers the four fundamental methods of aerial navigation—pilotage, dead reckoning, radio navigation and celestial navigation. He studies meteorology so he can forecast the weather in actual flight. He is also trained in making aerial observations.

If he doesn't "wash out" during the 15 weeks, he is graduated and receives his navigator's wings as a full-fledged second lieutenant. Then he attends gunnery school for about five weeks so he can take his turn at the gun beside his desk in combat. Finally, he is assigned to a bomber training unit. The

Seated on a revolving mount in training school, a budding Air Force navigator works out a problem in skyway mathematics

process of converting an untrained civilian into a man who guides the destiny of a giant bomber over oceans and continents takes only 29 weeks!

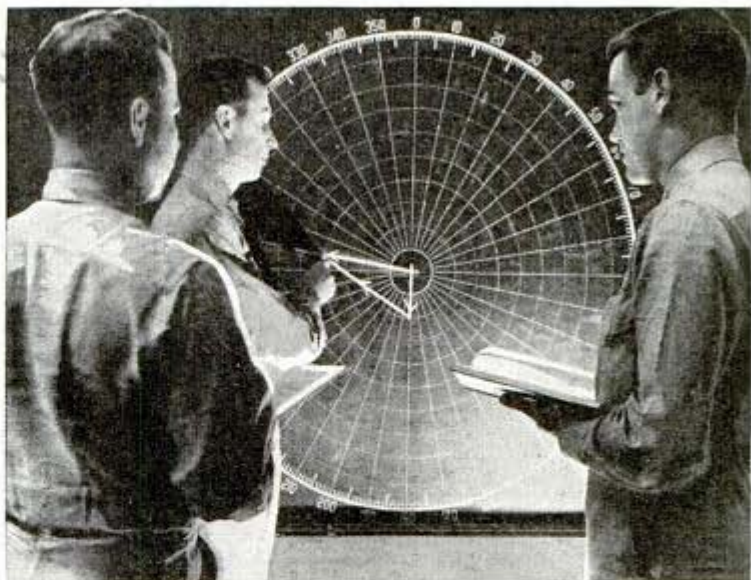
The simplest of the four methods of navigation is pilotage. This consists of recognizing landmarks which one already knows, or by comparing them to a well-marked map. If Brig. Gen. Doolittle's navigator, Lt. Henry Potter, had located Tokyo by first observing Hirohito's palace, he would have been navigating by pilotage. This method of navigating is best for short distances over familiar territory. It might lead to disaster over camouflaged enemy country and is virtually useless at high altitudes, at night or in bad weather.

The second method is dead reckoning—D.R. to the navigator. Its similarity to the medical abbreviation is appropriate, for dead reckoning is the "doctor" that has brought many a flier safely through storm and darkness to his destination. It was the only method of navigation used by Lindbergh on his flight to Paris.

Dead reckoning sounds much simpler in theory than it is in practice. Suppose you take off from a certain point and fly along a compass course at the rate of 300 miles an hour. At the end of one hour your plane position will be at a spot on the map 300 miles from your starting point. If the destination is 600 miles distant and the same speed is maintained, you can "reckon" that you'll be there in two hours. The wind, however, must be reckoned with, too.

The navigator's "map" for dead reckoning consists of a sheet of paper ruled with lines of longitude and latitude and dots for starting point and destination.

On the larger long-range transport planes the navigator has a big map table behind the cockpit
Courtesy Pan American Airways



Two "back seat drivers" headed for U. S. Navy blimp service take a lesson from an officer-instructor on the technique of aerial submarine hunts

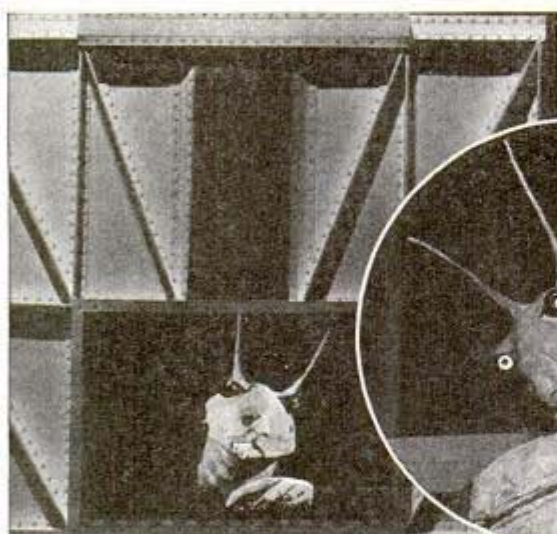
Navigation by radio is the third method learned by cadets. In flying the "ether" range, the cadet listens to the directional signals of a radio beam. The steady whine in his earphones, the "dit dah" and the "dah dit" tell him whether he is flying along the middle of the beam, or on either side. Commercial pilots swear by the beam, or "peanut whistle," but the bomber pilot over enemy territory doesn't have a beam to lead him to his target, nor can he tune in some convenient radio station with his automatic radio direction finder.

The direction finder, boon to clipper planes in peacetime, is especially valuable for ocean flying. The navigator sends out

(Continued to page 164)

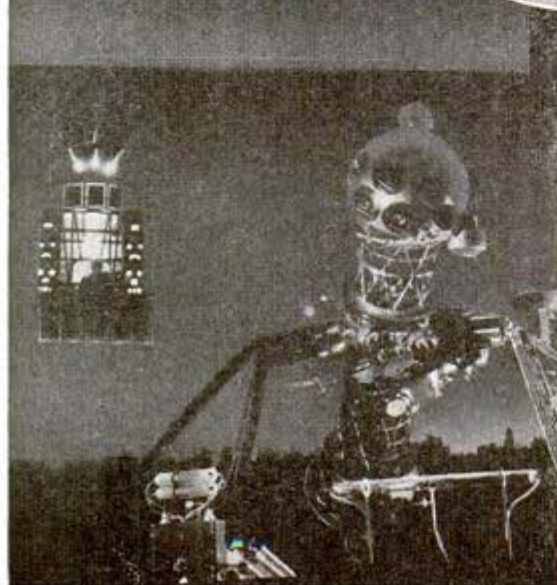


"Telescope" Movie of Planet Mars Is Thriller



Photos from American Museum of Natural History

Among bizarre "props" used in making colored movie of planet Mars were the 22-foot drum of papier mache (above) and "Man from Mars" at left. The lower view shows projector as Martian is flashed on screen



One sequence of the movie, "Mysterious Mars," projected on the dome of the Hayden Planetarium in New York combines fact and fancy to produce a closeup of the planet. The scene, filmed in color by the planetarium staff, shows how Mars might look if viewed through a hypothetical electron telescope. Images caught in this super-telescope of the future would be magnified electrically more than a thousand times. To make the "closeup" of Mars, the staff constructed a relief model by pasting colored papier mache on a huge drum. Mountains, valleys and peaks, the latter sprinkled with tiny glass beads, followed the latest astronomical knowledge of Martian surface. The motion picture was taken as the drum was turned, giving

Central Park west at 79th

the effect of traveling over the planet. The staff even created a fanciful "Man from Mars" with a head like an insect and an arm ending in a claw. The film runs so smoothly that many persons viewing it through what appears to be the metal viewplate of a giant telescope have to be told that it is a motion picture.

Lightweight "Lung" Held to Chest By Vacuum

Weighing only nine pounds, a rubber respirator is strapped lightly around the chest and held in place with a vacuum attachment. The chest is raised and lowered, forcing air in and out, with a handle on top of the "lung." No experience is needed to operate the respirator which can be used without danger of bursting or collapsing lung cells. It is useful for fire departments, schools, first-aid stations, at beaches, or any place where an emergency might arise. A small model is available for starting natural breathing in a new born child.



Lifting handle of respirator forces air into lungs

Huge Incinerator Takes "Walk" Under Tow of Tractor



Incinerator weighing 100 tons starting 300-foot journey at tractor plant

It was "moving day" recently for a big brick and steel incinerator at the plant of the Caterpillar Tractor Company. The incinerator, 64 feet high and weighing more than 100 tons, was moved 300 feet by a Diesel tractor with the aid of a cable and pulley blocks. Cribbed up on steel beams which rested on round steel bars, the incinerator was towed to a new location to make way for the installation of equipment designed for the salvage of steel chips and turnings.

Look in the index to find where to buy articles described in this magazine. Say You Saw It in Popular Mechanics.

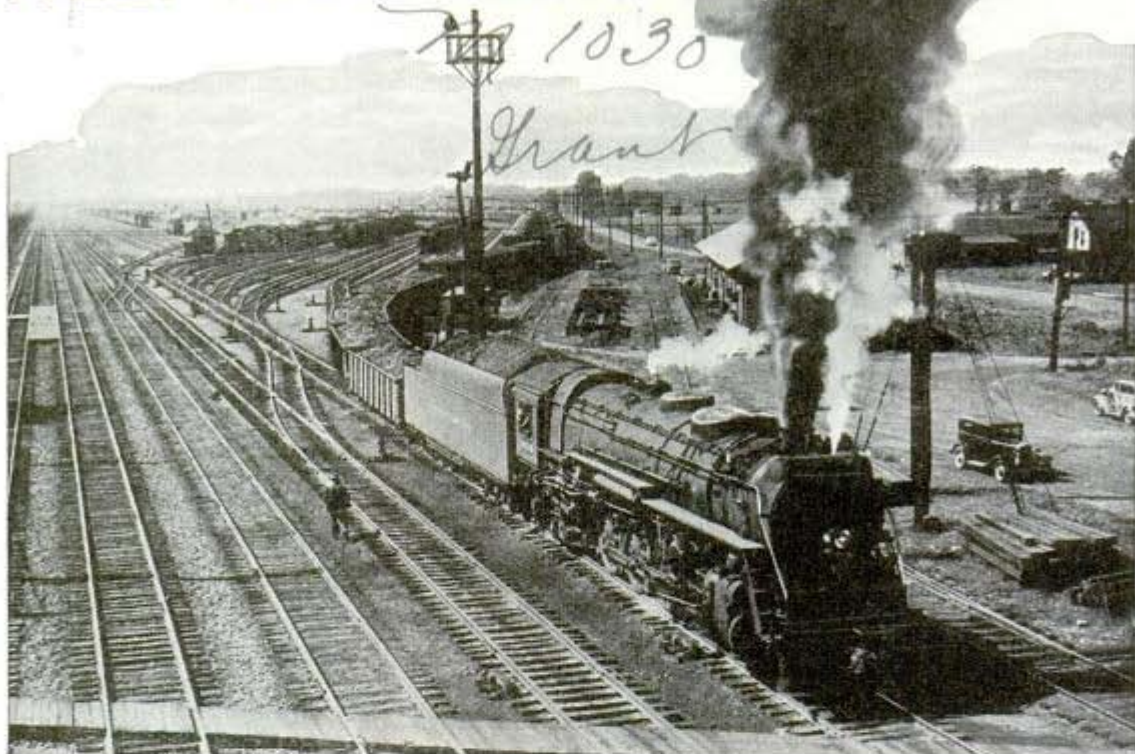
See! E. O. Bulward Co
 1337 N. Commercial St
 m 1079

m 803

Perous
 See

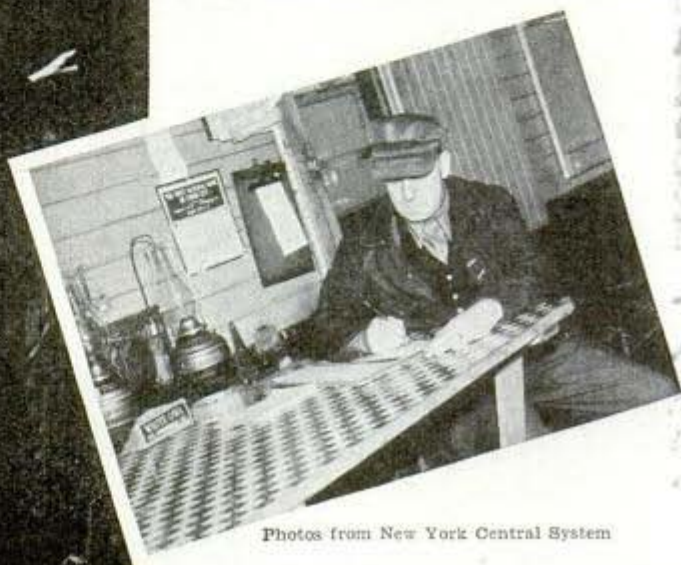
*N.Y.C. System Public Relations
Ladalle, Jr. Star Chicago*

The RAILROADS KEEP 'EM HUMPING



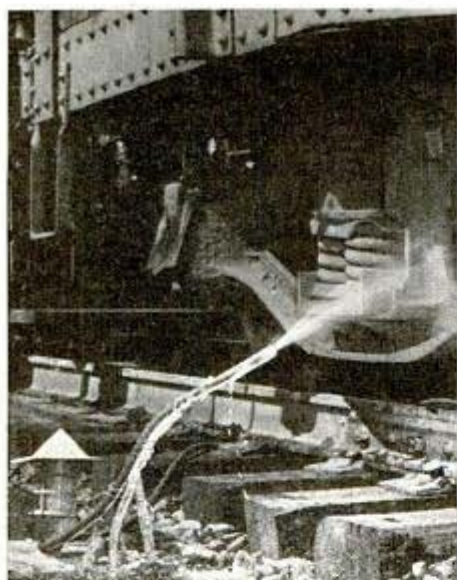
↑ Out of a classification yard in the east, a fast freight moves onto the main line of the New York Central, hauled by big Mohawk locomotive

← The "highball" signal waves to start a string of freight cars on an overnight run with a schedule as exacting as that of a passenger train

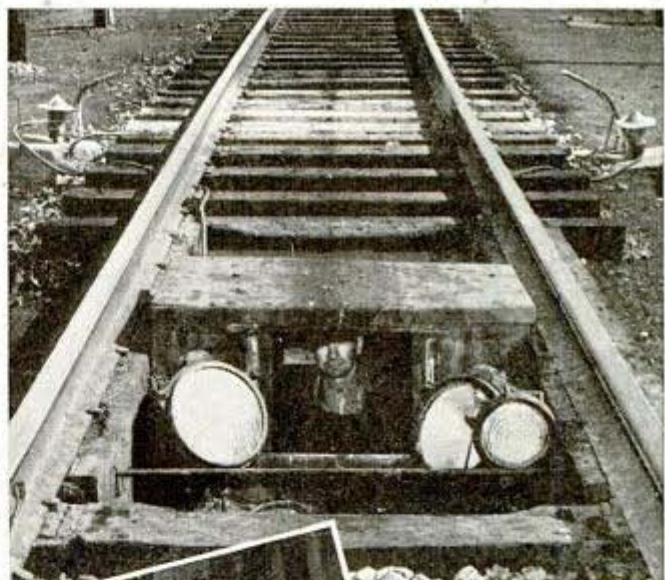


Photos from New York Central System

In his caboose the conductor makes up reports showing car numbers, weights and destinations, to be turned in at the yard office at end of run



Freight is the life-blood of the nation, and to keep it circulating the railroad equipment must be maintained in good order. Above, a spray of whitewash marks spot for repair crew

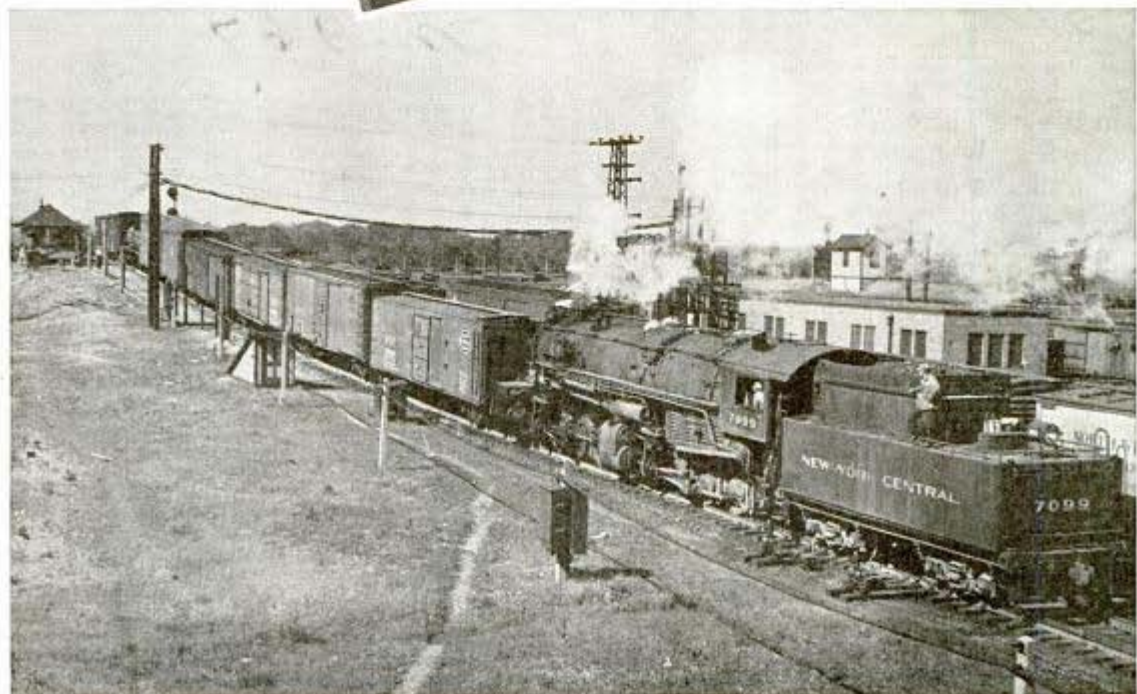


In a pit under track, as cars approach the hump, an inspector watches underside of cars for flaws. He controls valve that shoots whitewash marking truck of defective car for repair



Freight cars are sorted for various destinations in the classification yard. Tower man (center) watching cars go over hump controls speed by retarders, and routes cars to proper track

Below, a powerful Mallet engine with four cylinders and 12 drivers shoves newly arrived freight over hump at walking speed and cars are cut off at top to slide down maze of rails



British Combine Photos, Ltd
271 Madison Ave nyc.

"Island" on Big Carrier Is Nerve Center of Ship

M 1011



High above the flight deck on aircraft carriers is the "island," or control tower, where officers direct the activities on board the giant flattops. From their perch on the starboard side of the ship, flanked by pompoms and fuel tanks, they command a full view of deck, sea and sky. Alongside the tower are sturdy steel arms and cables used for hoisting seaplanes, and radio towers which are lowered to horizontal position during flight operations.

Starboard view of giant aircraft carrier headed toward sea, the control tower—or "island" as navy men call it—rising high above the deck. Officers of the flattop direct operations from vantage point of tower

Builder: W. Luak
5111 Ogden Ave. Cicero

Three-Wheel Coupe Seating Six Made From Motorcycles

M 967

Made from parts of several motorcycles, a small-size, three-wheel automobile is capable of carrying six men at 75 miles an hour and, according to the builder, will travel 50 miles on a gallon of gasoline. The car weighs 500 pounds and cost \$400. Used as a military vehicle it could mount five machine guns.



It's little but gives a lot of mileage per gallon and carries six persons

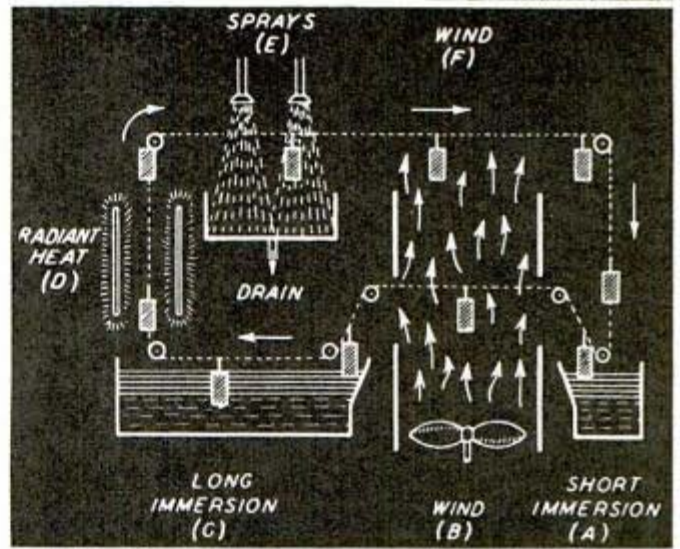
Contrary to general opinion, lightning strokes are more severe at low altitudes than in high mountains, General Electric men found during a five-year study.

*Illinois Inst. of Technology
3300 Federal Chicago*

"Homemade" Rain, Sun and Wind Test Metals

m 886

Within the limited space of a small cabinet there is continual rain, sunshine, wind and any chemical action desired, all man-made. It is a "corrosion tester," developed at Armour Research Foundation, Chicago, used in testing the durability of metals to determine the best ones for various working conditions. The "weathering machine" contains a spray chamber, a vertical wind tunnel, two immersion tanks, and a radiant heat chamber. Samples to undergo test travel from one chamber to the other on an endless chain, making a round trip in 85 minutes. Since water or almost any desired chemical may be used in the immersion baths as well as the spray, and the speed of the wind and degree of temperature in the heat chamber may be varied, it is possible to reproduce every known type of corrosion, such as galvanic corrosion, concentration cell corrosion, intermittent wetting, oxidation and chemical corrosion.



Arrows in diagrammatic sketch, right, indicate path taken by samples of metal hung on chain for testing as shown above. Weights of specimen before and after test are compared to find percentage of corrosion

Tire Truck Mounts Big Crane to Service Giant Vehicles

m 1016



Tires weighing more than 600 pounds are hauled and handled by a service truck used in making tire changes on big dumper vehicles working on a Panama Canal lock project. To speed the service and save manpower in swinging the huge casings, a crane is mounted on the truck. In a full load there would be 3,600 pounds of the precious rubber "doughnuts," one of which is 20 times the weight of an average automobile tire.

Tires too heavy for a man to lift are handled by crane mounted on truck

*Mack mfg. co
34 & 48, Long Island City, N.Y.*

PREPARING for the WORST



Decontamination squads are learning to clear areas of poison gas that a desperate enemy may eventually use

IF THE Axis powers, in sheer desperation, resort to the use of gas, the United States and allied nations will retaliate immediately, and in terrible fashion.

This is the reply of the President of the United States to the oft-repeated threats of enemy leaders that soon a "secret weap-

on" will be unleashed against the Allies. This weapon, many military observers assert, is gas.

It is known that Germany, Italy and Japan are equipped with chemical agents of warfare. When they are backed into a corner, most authorities believe they will not hesitate to flood the battlefields of the world with deadly fumes. It has been said frequently that this war never will be an "all-out" struggle until this happens.

The United States is determined to be ready, not only to offer an adequate defense but also to launch an immediate and terrible offensive. The Chemical Warfare Service of the Army is charged with research, development, procurement and manufacture and supply of those items pertaining to chemical warfare; in addition, the Service acts as adviser to the War and Navy Departments on all matters in this field. Unlike the other supply services, the organization is charged with training and combat functions. The Service supervises the training of the entire Army in gas defense and also trains chemical troops in the offensive use of gases, smokes and incendiaries.



Spraying neutralizing chemicals on a gas-infested terrain from chemical warfare car
Photo by A. G. MacNaull

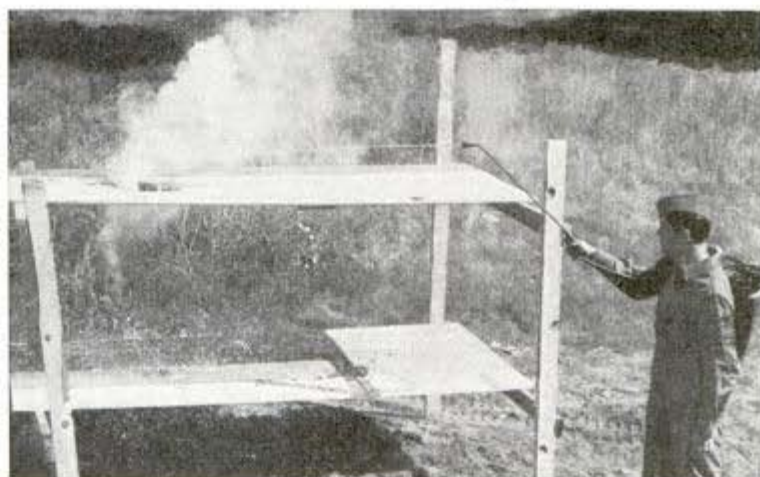
*Capt. J. P. Leggett, 2200 Far Hills Ave
Inkwood, Dayton, Ohio*

Defense against chemical agents requires many items, foremost of which is the gas mask. With the approach of war, plans were set in motion for the production of vast quantities of masks for the steadily increasing Army. The task was difficult. The gas mask consists of more than eighty parts, and it was necessary to procure activated charcoal, soda lime and other materials in tremendous quantities. The job of development included a fully molded rubber facepiece having certain advantages over the earlier type of mask.

Training of the Army in gas defense is a tremendous task. One of the big dangers in gas attack is the psychological response of untrained personnel. Because gas is a particularly frightening weapon, the men must be trained patiently and thoroughly in order that their instinctive fear may be overcome. The first step is to teach them that their masks will provide adequate protection. First, they are re-



Field training in real gas is a "must," and it taxes a soldier's endurance to sprint in his gas mask through smoke screen mixed with tear gas



Above, incendiary bomb burns through wooden platform while soldier demonstrates control method. Below, attacking pillbox with flame thrower





Members of a military police battalion practice in gas masks and carrying Garand rifles on winter maneuvers

quired to enter a room filled with tear gas while wearing the masks; then, at a signal, they remove the masks, give their names and Army serial numbers and rush for the door and fresh air, many of them with tears streaming down their faces.

Specialists in defense are developed by the Chemical Warfare Service. Decontamination duty is important, for it is the means by which a gassed area is cleansed of the poisonous fumes by neutralizing agents. One method of combating gas that may have settled upon an important road, air field, barracks or a pile of supplies is by sprinkling chloride of lime over the affected area, either from a small tank car-

ried on a soldier's back or from a 400-gallon tank truck. The big danger is that the decontaminators may get a whiff of gas or that it may saturate their clothing. Sufficient gas will cling to clothing, under certain conditions, to kill a man or put him out of action.

Another job for the chemical specialists is on the offensive—contaminating roads by exploding land mines filled with mustard gas. In practice, chemical agents that simulate the action of the gas are employed. These are sirupy substances that splatter over an area 40 yards or more in diameter to show the soldiers in training just how the real gas would spread.

One group of specialists is designated as the Chemical Field Laboratories. Units, complete with portable chemical and physical equipment, even to a technical library, are organized to operate in an advance zone of the theater of operations. These units are trained to make analyses of enemy chemical agents and munitions in the field so that Army commanders can be informed without delay and the proper



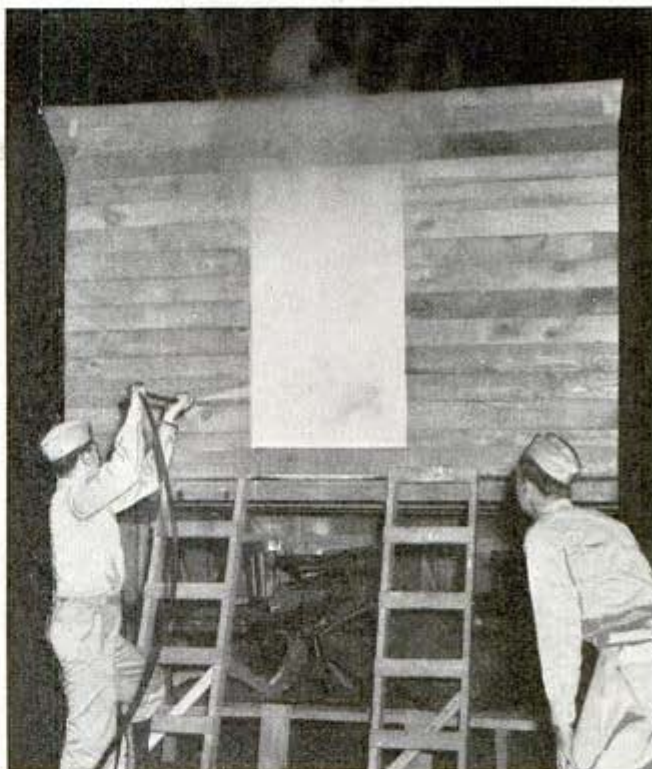
Fine spray of chemicals neutralizes gas contaminating the soil

protective measures instituted for safeguarding American forces.

The Chemical Warfare Service also is concerned with the training of firemen and other civilian workers for the defense of American cities against incendiary attacks. These workers in turn serve as instructors for thousands of civilian wardens. The service is working closely with the Office of Civilian Defense. One phase of this work has been the development of a suitable civilian mask containing a minimum of strategic materials.

Of the possibility that the Axis will turn to gas if sufficiently hard pressed, Major General William N. Porter, Chief, Chemical Warfare Service, says:

"Whether or not gas warfare will be used depends solely on whether Hitler's generals feel that the advantage to them would surely outweigh any disadvantages. Until now they have not felt so, and I think rightly, since persistent gas is primarily a defensive weapon and would have been of much more value to the retiring Russians than to the advancing Germans. Hitler understands well that mustard gas on British beaches would add



Chemical warfare men practice extinguishing incendiary bomb

materially to the precariousness of an invasion. On the other hand, should he believe one gigantic, overwhelming stroke with gas would win the war, I am convinced he would use it without question.

(Continued to page 171)

A scout car plunges into action in a smoke cloud and its crew learns what it's like to fight "blind" in gas



Club Aluminum Products Co
1250 Fullerton, Chicago
Home Bowling Alley on Turntable Tests Skill



M 1019

Bowling is a parlor game when played on a midget alley, using tiny glass bowling balls on a bed approximately 75 by 9 by 20 inches. The ball is started on an incline which permits the player to roll a "hook," "back-up" and other shots as on the big alleys. Mounted on a revolving turntable, the game may be rotated from one seated player to the other instead of requiring players to go to the game. A hinged racking device with holes for the pins makes it easy to set them quickly. As it is made of wood throughout, no critical materials are used in its manufacture.

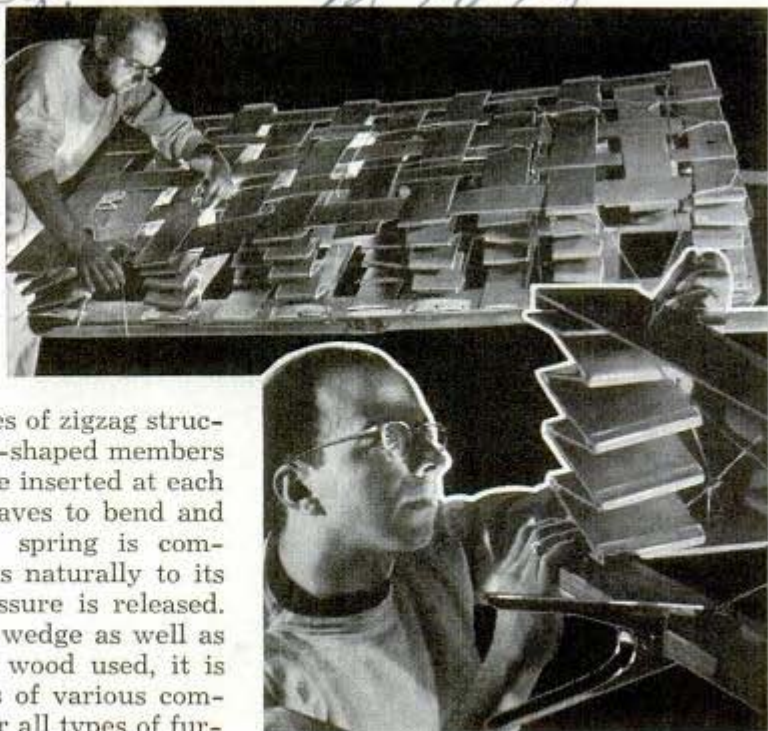
One player "spots" pins after other has rolled (insets). Alley is rotated after each play

247 E. Ontario

Wooden Springs Bounce for Metal in Wartime Furniture

Ref. M 1093

Students at the School of Design in Chicago, urged by its director, L. Moholy-Nagy, to bend their talents toward the development of wooden springs, have offered to furniture manufacturers wood substitutes for the metal springs banned under war priorities. One type of spring, for which a patent is being sought, owes its resiliency to a series of zigzag structures made up of several V-shaped members joined at the ends. A wedge inserted at each apex causes the wooden leaves to bend and offer resistance when the spring is compressed, and thus it returns naturally to its original position when pressure is released. By varying the size of the wedge as well as the dimensions or type of wood used, it is possible to produce springs of various compression weights suitable for all types of furniture, including chairs, studio couches, divans, box springs and innerspring mattresses.

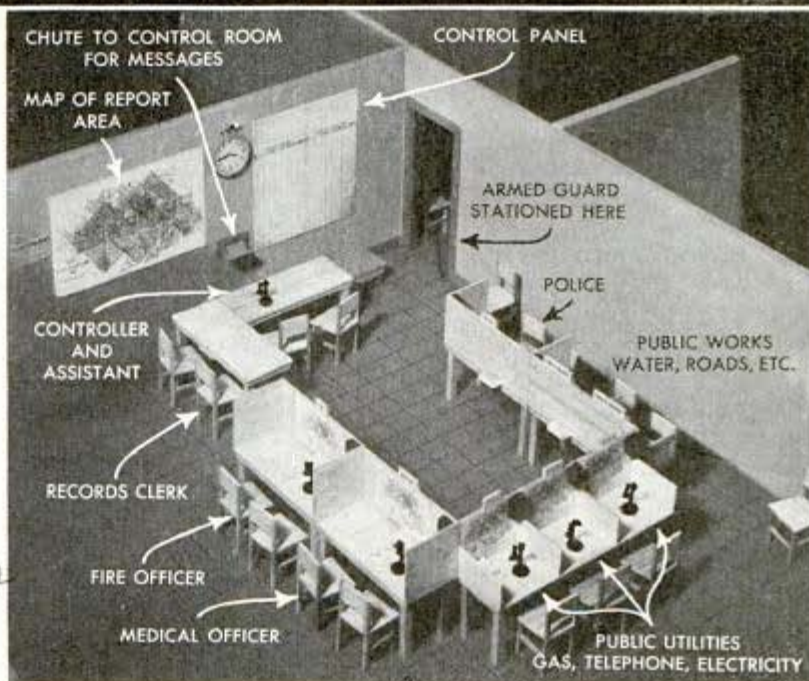


Bed spring made of wood has resiliency rivaling metal. Bottom, individual spring; note V-joints

Model Shows Ideal Air Raid Control Quarters



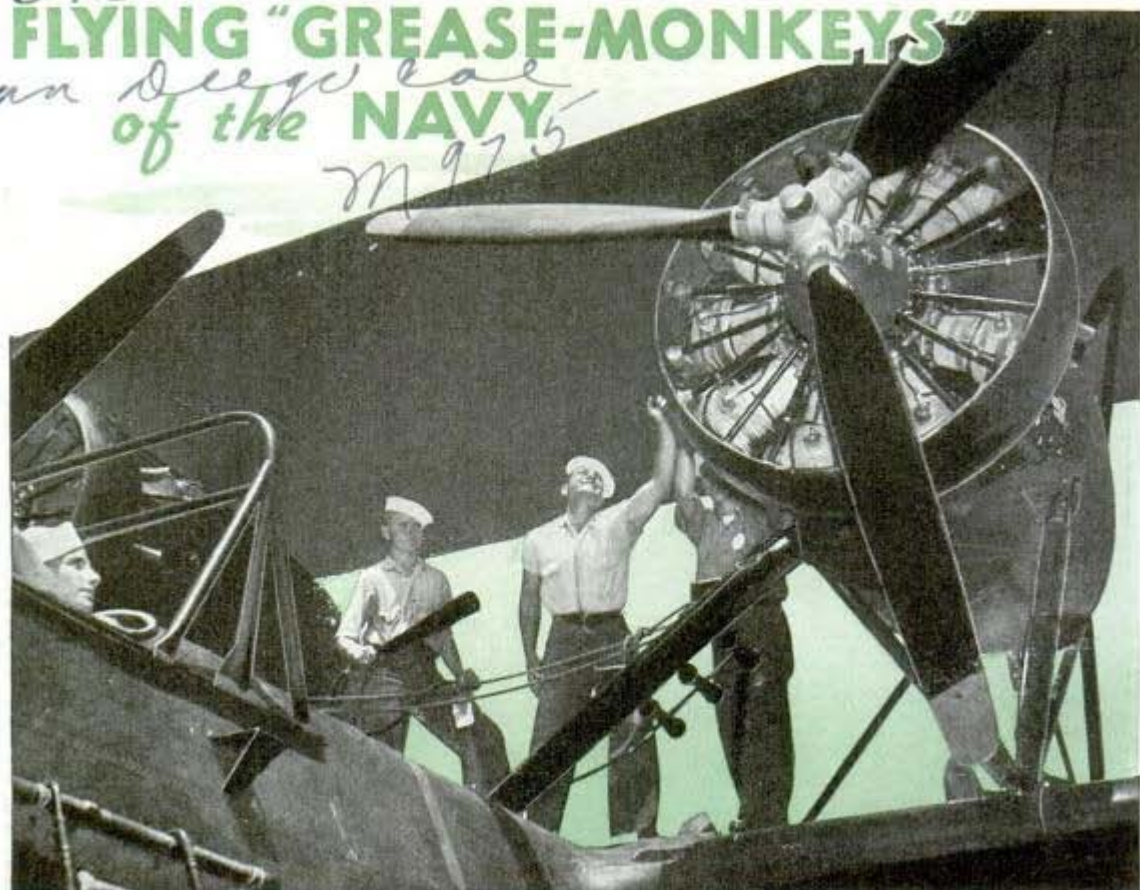
The war industry practice of pooling ideas has been carried over into civilian defense activities by two Cleveland citizens who are alert to the need for control-room standardization. First, they organized ideal "nerve centers" in East Cleveland and Cleveland Heights which attracted the attention of county and national officials. Then Robert P. Burrows of the Cleveland Heights center suggested that a miniature model could be used as a pattern for communities throughout the state. Robert E. Dirks of the East Cleveland center made the model on a scale of one inch to one foot. The walls are fastened to the base with pegs and can be lifted off and packed flat. The furniture is made of balsa wood and maps on the walls are photographic reproductions. The model includes a message room with stalls for telephone operators, control room with booths for staff



Photos courtesy General Electric Co.

officers representing fire, police, medical and other services grouped about the controller, and a small room for the armed guard. Messages from the telephone operators are carried by chute into the control room and from there are relayed by the controller into the proper channels. "Services needed" and "services dispatched" are recorded on panels mounted on the wall.

A. J. Hamilton
115 1/2 Akron St
San Diego Cal
of the NAVY
m 975



Winding up the starter gear on big airplane motors is a two-man job even for husky navy "grease-monkeys"

HE'D BEEN in the Navy long enough to earn the rating of Aviation Machinist's Mate, first class. But Roland Foster had never found himself in a tight spot like this before.

It was December 25, 1941. He'd been tinkering with the port motor of a big PBY flying boat moored alongside one of the 4,000 jungle islands of the Philippines. The rest of the crew had gone ashore to buy a turkey from the natives to celebrate the holiday.

Foster cocked his head, looked into the sky and swore softly. Two Jap Zero fighters were peeling off and coming down out of the sun.

"Those heathen so and so's won't even let you celebrate Christmas," he muttered.

Their motors groaning

Aboard an aircraft carrier, Aviation Machinist's Mates often man the machine guns when action starts

with power, the Zeros came straight for Foster, alone in the PBY. Machine guns blazed and as the Japs found range, they opened up with their cannon.

Foster jumped for the 50-caliber machine guns in the PBY's port waist as the





Loading bombs aboard navy seaplanes is another job assigned to the busy "AMM's." Below, a trainee at a naval station points out the destination of a pilot in the Link trainer to a radioman at plotting board

Jap planes approached. He gave them a good burst. As they zoomed over, machine gun bullets spattering all around him, he ran to the twin 30-caliber machine guns in the starboard waist and gave the retreating Japs another squirt of lead.

"Out of ammunition," he said as the trigger clicked helplessly.

He made his way to the bow for more ammunition. On the second run the Jap bullets set a mattress afire within the American plane. Between re-loading the guns, firing from both port and starboard waists, and manning a bilge pump to quench the fire, Foster was a busy man. Finally the Japs decided they'd had enough and turned tail.

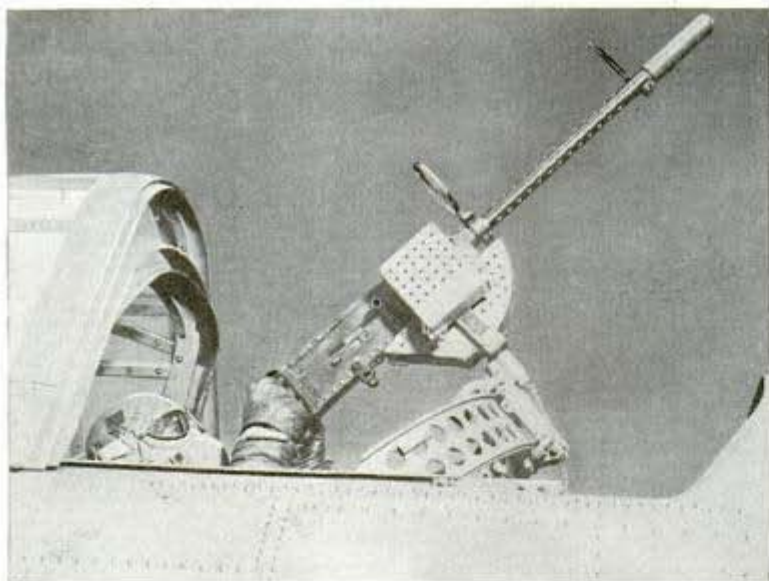
Foster took inventory. There were 250 holes in the PBV—ranging from small, 27-caliber Japanese machine gun bullets to



huge, jagged rents, 14 and 16 inches across, torn by cannon. Foster's crew mates came running back, but the fight was over. One of them told Foster later:

"We thought you must have had a full crew aboard, the way you kept those guns hot!"

Foster is typical of the enlisted men in the United States Navy who wear the pro-



The gunner in a Douglas dive bomber sights his 50-caliber machine gun

pellor and wings insignia and who "keep 'em flying, fighting and floating." Sometimes they're called "flying grease-monkeys," but they don't care much for that title. They're proud of being Aviation Machinist's Mates—or AMM's, as the service dubs them.

The pilots and cadets are the "glamor boys" of Naval Aviation—the backfield men who get the glory and headlines. The AMM's are the plodding linemen who do the dirty work and clear the way for the boys who get the glory. But theirs is the satisfaction of doing a job well, of seeing that planes are in tune, every wire taut, every support solid. Each man is a spe-

cialist at his job with a terrific responsibility.

They get their chance to go aloft, too. In a PBV, for example, the Aviation Machinist's Mate is an important member of the crew. It's his job to see that the two big motors sing as quietly and effortlessly as a purring kitten. Then when the enemy attacks, he's in there slugging behind a machine gun. Some AMM's are allowed to take flight training and win their gold wings as Naval Aviation Pilots. Others, perhaps too old for flight training, pick it up in line of duty.

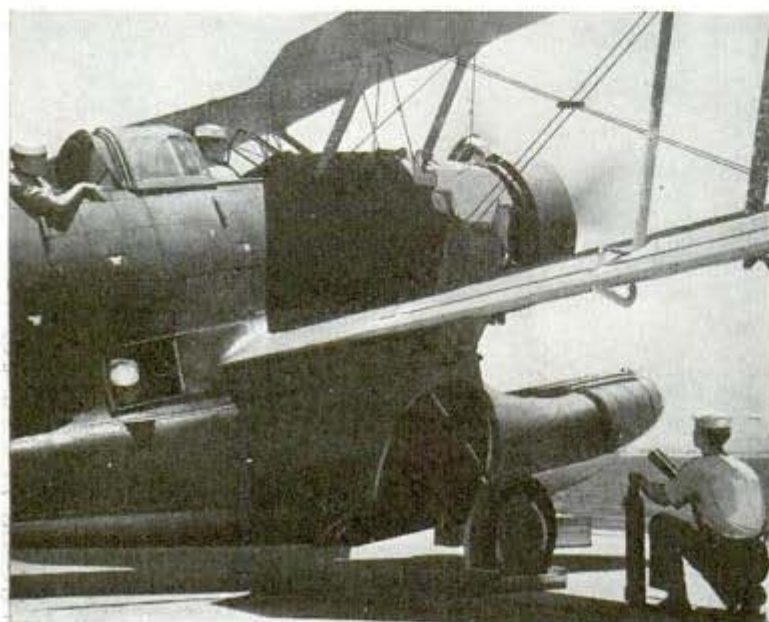
Several of the outstanding Naval heroes of this war have been Aviation Machinist's Mates. One was Harold Dixon, the pilot whose plane crashed on a patrol flight in the South Pacific and who spent 34 days adrift in a rubber boat. Another was Donald Francis Mason, whose laconic report "Sighted sub, sank same" quickly became a Naval classic.

The Navy's AMM's come up the hard way. First, they go through "boot camp" as raw recruits in a rumpled white uniform and a half-inch haircut. At the end of a few weeks, they are sent to a special Aviation Machinist's school—"wrench and pliers college" as some call it.

One of these schools is at San Diego, Calif. Others are at Alameda, Calif., Seattle, Chicago, Dearborn, Mich., Norfolk, Jacksonville and Pensacola, Fla., Memphis, and Norman, Okla.

Right now the San Diego school is a hornet's nest of toil and study. The six-month course is mostly work with very little play. There is instruction in primary and advanced gunnery. The

Five "AMM's" ready a plane for takeoff. One has just wound the starter, another stands by with fire extinguisher, inside men check controls and instruments



Navy men study models of all types of Allied and Axis planes—so they won't make the mistake of shooting down friendly craft. Then follows a complete course in airplane mechanics, which ends with taking apart and re-assembling obsolete planes. After a while the students can make repairs with their eyes shut.

After graduation the AMM's are assigned to a Naval Air Station on shore or to an aircraft carrier. The outstanding men are chosen as plane captains and second mechanics—thus getting a chance to go aloft. Some of the lucky graduates are picked for flight training and go to Corpus Christi, Tex., and Jacksonville and Pensacola, Fla., to win the most coveted of Navy enlisted men's ratings—that of Naval Aviation Pilot.

It's a road that leads to high adventure. Four AMM's were among the crew of eight in the Navy bomber last March which rescued 17 shipwrecked passengers from a watery death in the Caribbean. The big plane was winging its way across the blue waters between San Juan, Puerto Rico, and Guantanamo Bay when a life raft containing 16 men and one woman was spotted.

Crews of the big navy flying boats make many rescues of shipwreck survivors



Instructor points out differences between U. S. and enemy craft

"Grease-monkeys" must be expert gunners as well as mechanics





The Navy also trains Marines in essentials of keeping 'em flying, fighting and floating. Three Marines here study warplane maintenance

The plane alighted near them and it was learned they were survivors of a merchant ship torpedoed. They had been adrift 60 hours.

Although the plane was heavily loaded with bombs and gasoline, the pilot, Ens. Francis E. Pinter took all 17 survivors aboard. This made 25 persons in a plane built for a crew of eight.

A heavy sea was running and on the slow, cumbersome takeoff, the plane bucked from wave to wave. Finally, with skillful handling by Ensign Pinter at the controls and Aviation Chief Machinist's Mate Lewis McKinley Thompson at the

engine throttles, the ship rose off an angry swell and became air-borne.

The citation Thompson received later said:

"Thompson manned the engine throttles; with an extraordinary demonstration of professional skill and judgment he applied the maximum power of the engines at the right instant and in perfect harmony with the senior pilot's manipulation of the controls such that the overloaded and overcrowded patrol plane was taken off in a superb demonstration of airmanship."

The heavy load of bombs was not jettisoned. When Thompson was asked why this extra weight was retained, he said simply:

"Thought we might spot a sub on the way home and we wanted to have something to hit her with."

There's plenty of courage and heroism to be found in the Naval records of the AMM's who serve aboard aircraft carriers. Bruno Peter Gaido was commended for "distinguished devotion to duty, extraordinary courage and disregard for his own safety" in three famous battles—the Wake and Marcus raid, the Coral Sea battle and the Gilbert and Marshall Islands raid.

A seaplane is launched from shore in 60 seconds and the men bring back the wheels that rolled it into water



*some new picture
461-820 nyc.*

Tricycle Carts 'Rush Rivets From Icebox to Bomber

In the latter raid, Gaido was aboard a carrier. Working on deck, he saw a Japanese plane afire and heading for the flat-top. Quick as a flash, he realized the Jap was going to make a suicide landing on the deck.

Gaido sprinted for an American plane parked on the deck and grabbed the machine gun in the cockpit. The flaming Jap plane came straight for him but he held his chattering gun squarely on his target. His stream of bullets deflected the enemy plane enough so that, though it grazed the tail of the plane he was firing from, it fell harmlessly into the sea.

Another saga of naval heroism is the story of Aviation Machinist's Mate Peter Cornelius DeVries. He saved the lives of several comrades in a less spectacular way. But he paid with his own.

Working under the direction of Lt. James S. Clarkson in a compartment of a ship, De Vries noticed the officer had been overcome by fumes and had fallen in about two feet of water. Instead of attempting to get out of the deadly chamber, DeVries shouted to others outside:

"Don't come in here—gas! Throw me a line and I'll try to get the lieutenant out."

When a rescue party with gas masks got into the compartment, both men were dead. But "Pete" DeVries had saved others.

The men who make the best Aviation Machinist's Mates don't mind getting their knuckles skinned and they'll mix it up with anyone who is willing. They have plenty of that good, old, Anglo-Saxon word—guts. Like Bannowsky. Last summer, somewhere in the South Pacific, a lone PBY out on a four-hour patrol from an advanced base roared over island-studded waters. Suddenly a warning crackled over the inter-plane phone system:

"Twelve Japs ahead—man your guns!"

The PBY was cruising at 12,000 feet. The pilot knew the slower patrol bomber was no match for the speedy Japanese fighters. There were clouds below. Maybe he could reach them. So he put the big ship into a dive—straight down like a dive bomber—in hopes of eluding the attackers. The big ship whined downward in eerie crescendo and when the pilot looked out the fabric was ripping off the wings.

"Bail out, men," he ordered, then jumped himself.

The third pilot, C. J. Bannowsky, an AMM, looked aft and saw that four mem-



Ice cream bar compartment contains ice cold rivets.

Tricycle carts, similar to ice cream wagons, are used in Consolidated Aircraft's San Diego plant to distribute rivets from main refrigerators to various departments. Ice cold rivets have greater holding power when they expand, according to officials, and are used in building Liberator bombers and PBY flying boats.

bers of the crew hadn't bailed out. They were trapped in the tail and couldn't make it.

Bannowsky grabbed the controls of the diving plane and gritted his teeth.

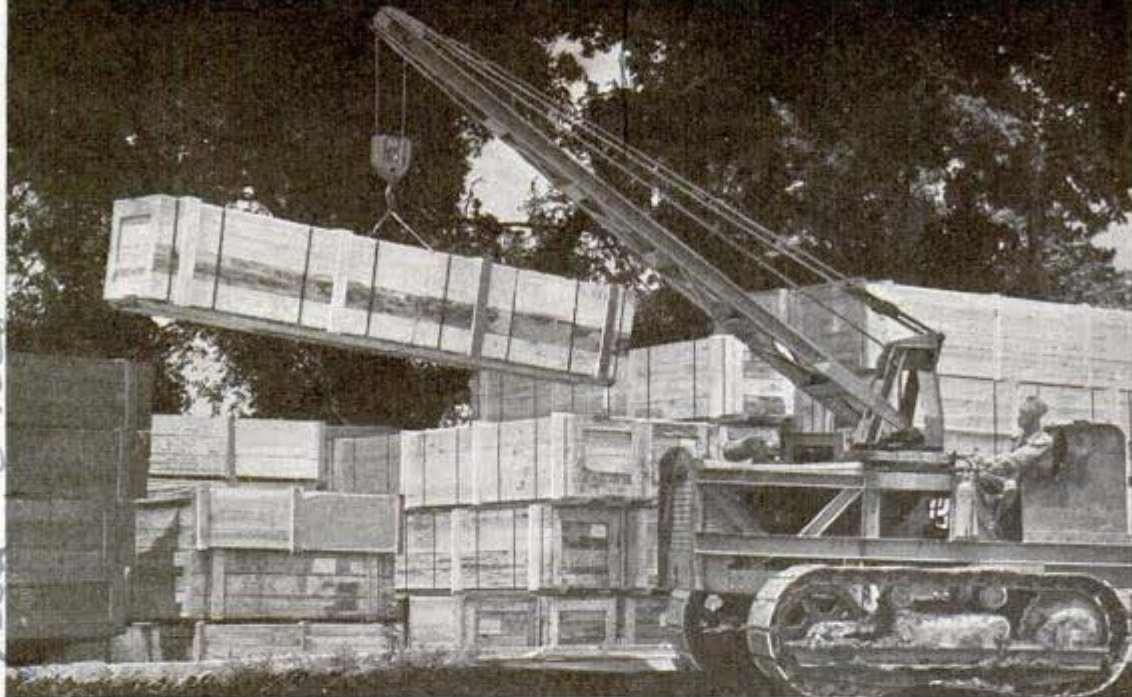
"Maybe I can pull her out. . ."

The PBY was screaming toward earth, the fabric still peeling off the wings and Jap fighters peppering away with machine guns. But somehow Bannowsky pulled her up out of her death-dive and landed near a small island. How he did it, he can't tell you, but it's there in the record—a brave act that saved his own life as well as that of his shipmates.

Before this war is over, there will be many more thrilling yarns of heroism and courage performed by the enlisted Navy men who wear the propeller and wings on their sleeves. The "flying grease-monkeys"—a term of genuine respect, not derision—are doing their share, and more.

*The Hughes-Reynolds
Ranstabasi Crane. Mansfield, Ohio*

AIR DEPOTS on WHEELS



Boxes of aircraft parts to "keep 'em flying" being handled with tractor and crane at air depot near front

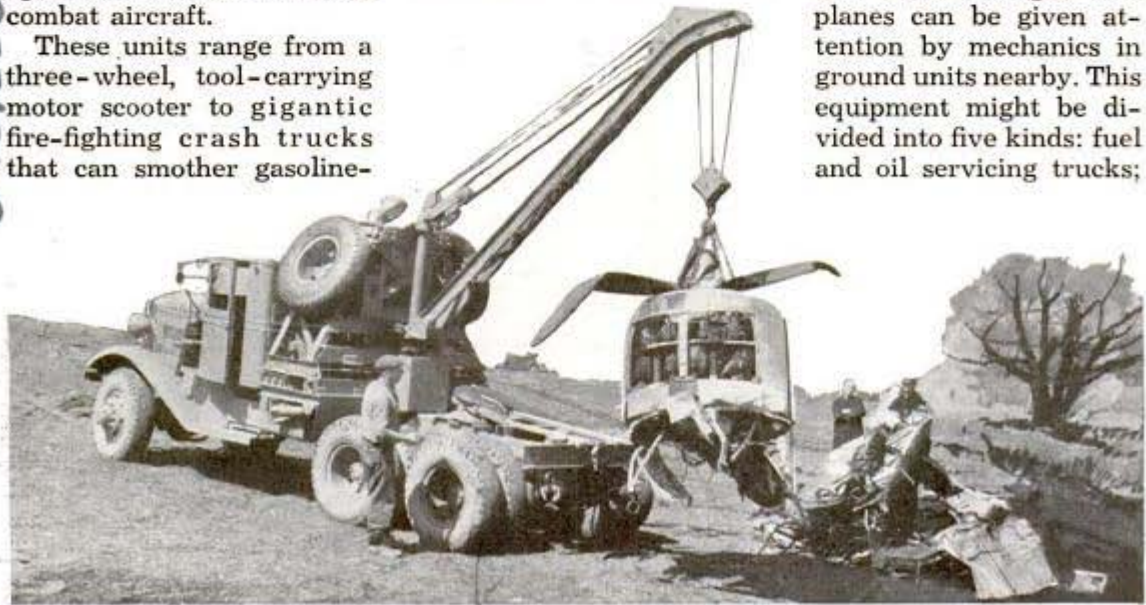
EACH fighting pilot must have the support of 15 to 25 men on the ground. Each pursuit or bombing airplane requires the services of more than a score of ground vehicles. The Army Air Corps, in addition to half a hundred types of trucks standard to all branches of the army, has 25 varieties of motor transport equipment specially developed to meet the needs of combat aircraft.

These units range from a three-wheel, tool-carrying motor scooter to gigantic fire-fighting crash trucks that can smother gasoline-

fed flames with thousands of pounds of carbon dioxide, then pick up the wreckage of the largest airplane and transport it to a repair base.

There is special equipment to meet climatic and terrain conditions anywhere on the globe; thus the Army Air Corps can do battle from Alaska to the tropics with assurance that their damaged airplanes can be given attention by mechanics in ground units nearby. This equipment might be divided into five kinds: fuel and oil servicing trucks;

Clearing plane wreckage from field with a special truck-and-trailer outfit

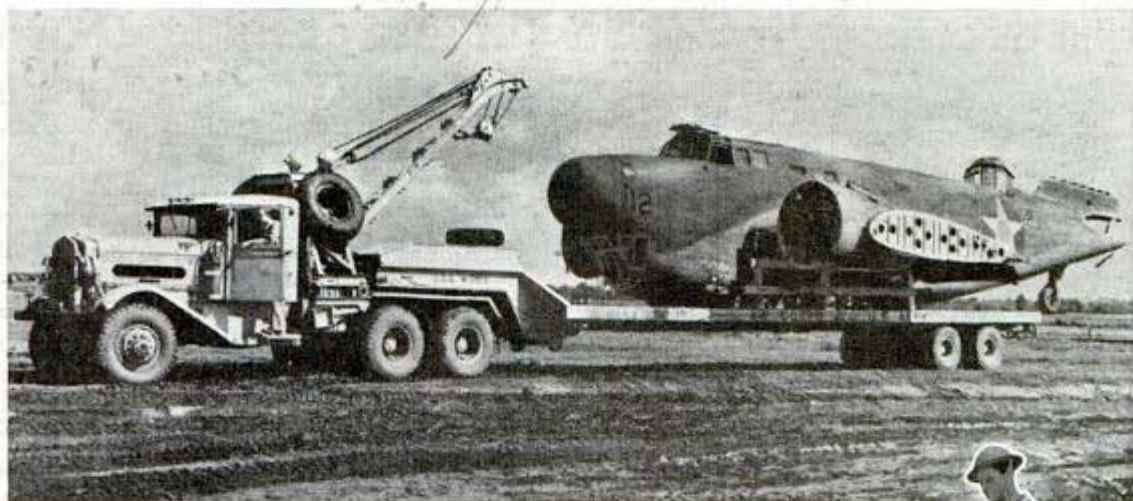


*Copy J. P. Leggett 2200
Cedarwood
Fairfield, Ohio*

POPULAR MECHANICS

*Silent Hoist Winch and Crane Co
541-63 st, Brooklyn, N. Y.*

Материал, специально подготовленный для публикации



shop and laboratory trailers, used for aircraft field repair, technical supply and photographic work; salvage and reclamation trucks, wrecking trucks and mobile cranes, which haul wrecked airplanes from scenes of disaster; airplane tugs, the tractors that tow planes to the flying line or to "disperse locations," for safety, rather than concentrating on the flying line where they are more susceptible to enemy bombs; headquarters trailers employed for maintenance of communication and as flight operations offices.

Ordinary gasoline trucks are useful on city streets and at permanent airports, but for the des-

(Continued to page 178)

The roughest terrain holds no terrors for tractor, right, used in preparing landing fields. Below, big grader used for leveling landing strips after brush is cleared

Crash truck with elongated trailer, above, is used to speed cracked-up planes to repair depot. Right, soldier changing filter on a fuel trailer



*Some Newspictures Inc
461 - 8th Ave. NYC*

Sea Spotters Direct Cannon Fire at Enemy Ship



m 1003
Movement of all ships coming and going in U. S. harbors is controlled from observation stations which also serve as range finders. Sea spotters working at a plotting table in a Harbor Entrance Control Post chart the course of every ship. If a vessel is challenged and fails to give the proper recognition signal an alert is flashed to Coast Artillery batteries. A three-inch shell is fired across the offender's bow and if the ship doesn't stop, larger guns take better aim.

Charting course of ships at harbor entrance control post

Army's Winged "Eyes Upstairs" Can Hover at Slow Speed

*arm newspaper photo
461 - 8th Ave NYC*
Called the "eyes upstairs" of the army, the new Stinson Sentinel airplane can hover above the lines of battle at 45 miles an hour, directing artillery fire or the movement of troops and tanks. Capable of taking off at an angle of almost 45 degrees, the craft needs no better operation base than a cow pasture, a highway or an improvised landing field.

Army plane, rising at sharp angle, hovers to spot enemy



Manganese Added to the New Nickels to Satisfy Fussy Slot Machines

To make them acceptable to fussy vending machines, our new nickelless nickel coins, containing 56 percent copper and 35 percent silver, have been given a nine percent part of manganese. Without the manganese, many slot machines used for selling cigarettes and candy would bounce the coin right back through the rejection slot because the silver and copper combination are such good conductors of electricity. The new five-cent piece is bright and shiny,

m 1125
more like a new dime than a nickel, but it tarnishes more quickly and turns yellowish gray. It carries the Monticello design on the back, and has the mint mark directly over the dome—S for San Francisco, D for Denver and P for Philadelphia. This, by the way, is the first coin to bear the mark of the parent mint in Philadelphia. If the war ends before December 31, 1946, no more will be minted, since the act authorizing the nickel will expire on that date.

*Science Service
Nov 23-42*

*Acme newspapers, Inc
461-8 av nyc.*

"Submarine" Goals Add Thrills to Water Polo



Swimmers playing the new game of underwater polo with submerged goals keeping all action beneath surface

Submarine activities of an original and non-sinister nature are demonstrated in the new game of underwater polo recently introduced at the Los Angeles Town House

Pool. The goals, which are submerged, are wire nets which retain the ball when a score is made. Three swimmers make up a team and all of the action is under water.

Auto Bumper Is Made of Wood So Metal May Go to War

Motorists who strip the metal bumpers off their cars and add them to the scrap pile in a patriotic gesture, can now obtain substitute wooden bumpers. Made for both fore and aft protection, this wartime product is a five-ply laminated bumper said to serve satisfactorily the same purpose for which steel bumpers were designed. They are strong and reasonably priced without sacrificing attractiveness. A V-shaped guard at the center indicates that it is serving the cause of Victory by releasing metal for war purposes.

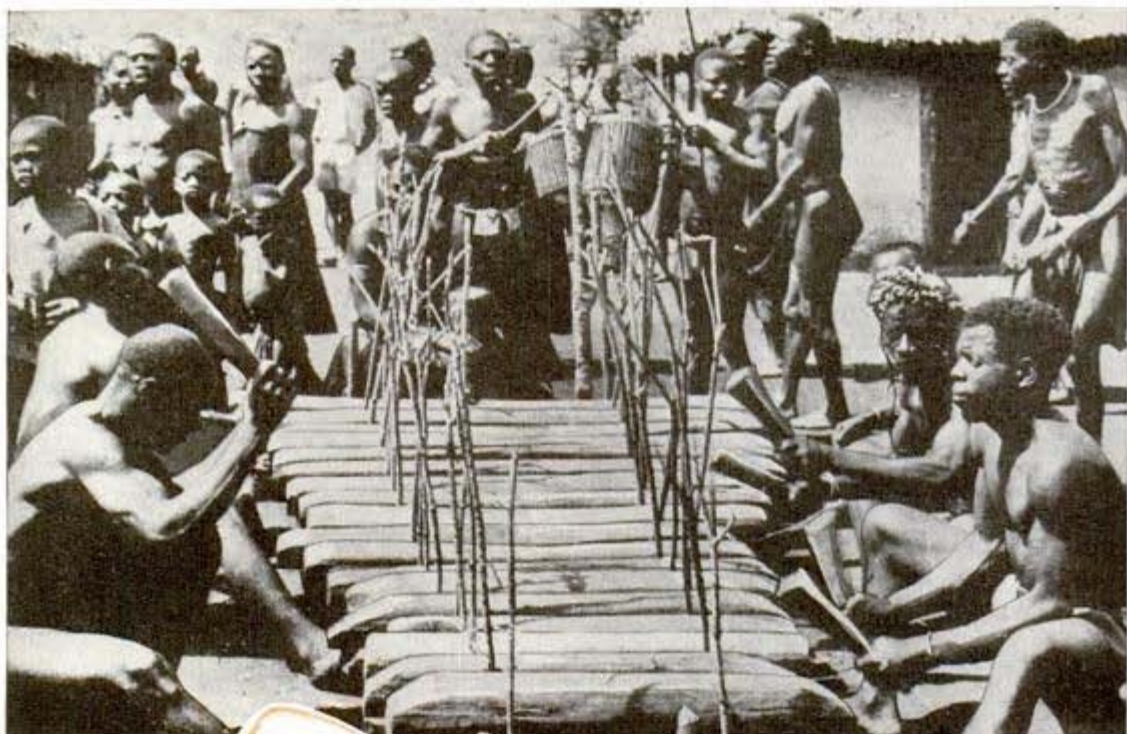


Look in the index to find where to buy articles described in this magazine. Say You Saw It in Popular Mechanics.

"V" guard symbolizes wooden bumper's aim at victory

MARCH, 1943

*Weyerhaeuser Sales Co.
332 Minnesota St.
St. Paul, Minn.*



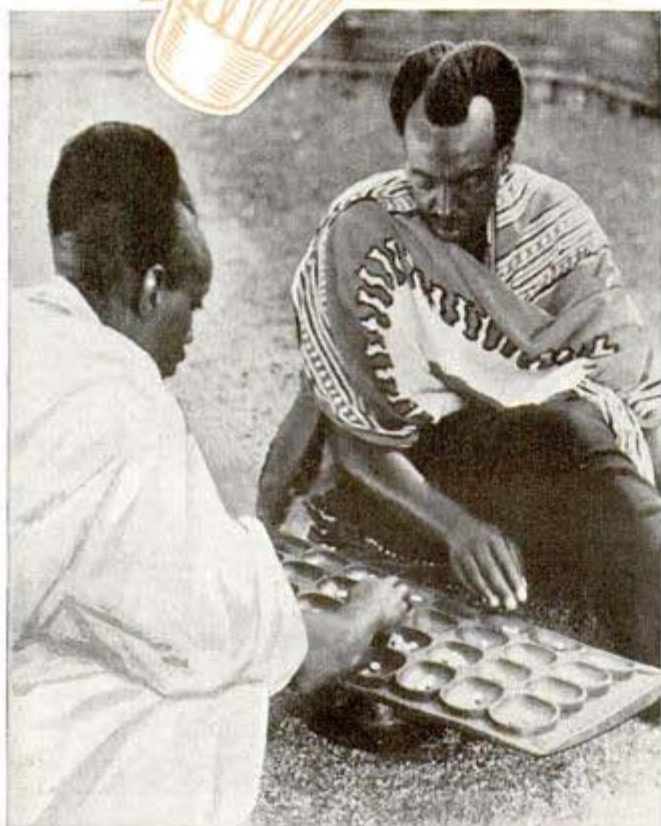
JUNGLE MECHANICS



m # 483
By **Attilio Gatti**

Author of "Great Mother Forest" and other books, and leader of ten scientific expeditions into Africa

Stockbridge
PART II
Mass



LOW in a dune of that land of drought, sterility and misery which is the Kalahari Desert of South West Africa, an ostrich hen sits on her eggs. All day she has been faithfully sitting while the cock bird has been around feeding on what little grub he could find within a radius of many miles.

Now the sun is getting low, and Papa Ostrich should be back any minute, to let Mama Ostrich go find herself a snack. Meanwhile, neither Mama, nor Papa, gives the slightest thought to the Bushmen, and that's where they make their big-mistake. For at that very moment a family of Bushman are giving a lot of thought to the ostriches.

The poor little Bushmen are starving. They are some of a thousand or so miserable survivors of

Top, a village orchestra strikes up a tune on the Grand Piano of the Veldt. Below, Watussi giants play a game they invented



a race which at one time occupied all Africa and South Europe, which studded both with astonishingly beautiful rock paintings and with cities of stone which are still a marvel to behold.

But throughout hundreds of centuries, the Bushmen have been persecuted, decimated. And finally segregated in the Kalahari, which nobody else wants, they have become inured to famine and privation.

So, just now, the ostrich hen looks decidedly appetizing. Her meat is delicious and abundant. Her skin makes marvelous clothing. Her feathers are the best for a warm bed. Her eggs make a first class omelet. And, properly opened, their shells supply the Bushmen with receptacles in which to conserve the scarce, precious water.

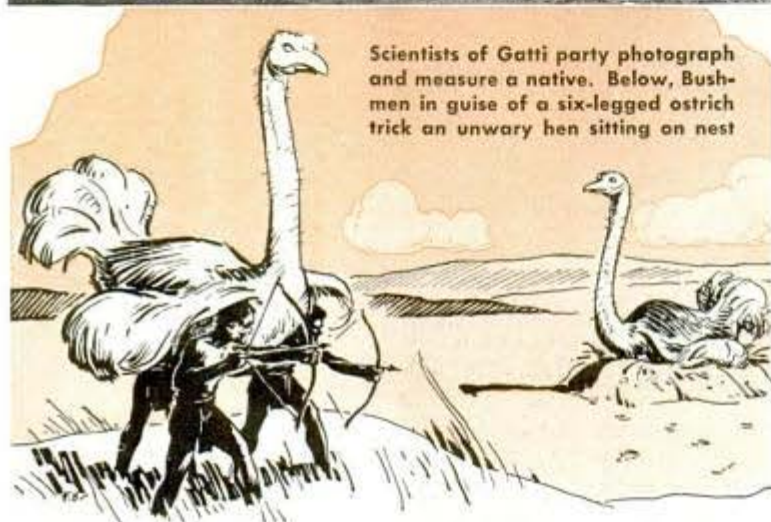
But the Bushman's only weapons are the most primitive bows and arrows of Africa. He makes his arrows deadlier with poison, but he cannot throw them farther than 40 or 50 feet. And the desert offers no help. Mama Ostrich might have a stupid head, but she doesn't keep it buried in sand. Her beady eyes can see a good distance, and her long hard legs are equally efficient in kicking a man to



Weapons are useless against a rhino's tough hide, so the ingenious native lures it into a sticky net, then leads the half-blinded beast into trees till he's tired out and groggy



Hollow reeds serve as straws for drinking from a huge log "bowl"



Scientists of Gatti party photograph and measure a native. Below, Bushmen in guise of a six-legged ostrich trick an unwary hen sitting on nest

death or in running away. So the Bushmen apply their inventive genius. The family parts into two groups, which melt away behind sand dunes, in opposite directions. A little later, Mama Ostrich hears a light noise. Her neck extends upward like a periscope. In the dim light of dusk, she sees a long neck appearing in the distance, then a big feathered body.

Knowing that nothing can hurry Papa's lazy bones, she sinks into a nap. Her cursory glance however, has missed a lot. She has not noticed Papa's eccentric walk, his abnormally stiff neck, nor his three pairs of short, brown legs!

So, while one part of the Bushman family watches for the return of the real cock bird, the Six-

legged Ostrich slowly advances. Within 30 feet or so, it stops, and from its chest three little arrows dart straight to the heart of the unsuspecting hen. A cry of assembly, and the other Bushmen arrive. The "Trojan horse" skin is dropped and folded for the next occasion. A big fire is made, to roast the meat for a feast.

The law of the jungle is cruel. Yet the natives must live, must protect themselves, and eat. But their ingenuity has its gentler sides too. Their every-day life shows evidence of it in many ways.

One instance is in the way they conquer the tropical rivers, by cutting down a straight tree trunk and burning and carving it into a relatively light, perfectly balanced canoe. To carry it to the water, they use round poles as rollers. To drive it through rapids no motorboat could cross, they build the canoe so long that 50 or 60 men can stand in it and push it forward with slim paddles. To synchronize the stroke a tambour player beats the rhythm on the stern.

When age opens holes in the canoe's bot-

Insangas, royal cows of the Watussi, are constantly watched by attendants and wear neck and head ornaments of colored seeds



tom, the native fills them with a clod of expanding grass, and in a few days roots are cramming the gap so tightly that what little water gets through they bail out with half of a tortoise shell.

When a fishing trip is undertaken, central heating is applied in a jiffy, by fashioning in the middle a round fireplace of quickly drying mud, on which to burn wood and over which to cook food. The river is filled with turtles, which supply meat and a cooking pot at the same time.

A small canoe has another use, too, for special occasions. Either out of milk or honey, banana or pineapple juice or boiled corn, each tribe knows how to ferment some kind of drink. Comes a great festivity, and a small canoe is filled with the local beverage. On the shore there are plenty of hollow reeds to serve as drinking straws.

Music? Plenty of drums, dry-seed rattles, whistles made of the tail of a buffalo, guitars, horns made from the heads of cows or antelopes or buffaloes. And, on occasion, the Grand Piano of the Bush.

It arrives dismounted; the maestro bounces ahead, picks the proper spot. Two assistants follow, each carrying a freshly cut trunk of banana tree, and laying them down, side to side, a yard or so apart. Then the pianists, each brandishing his own "key," a square log of light wood, of different lengths. Each key is deposited

Straw-roofed homes of the Watussi are partitioned into separate rooms for every member of the family



Africa produces strange contrasts, the smallest and largest men. Above, the dwarfs—supermen despite their size, for they conquer a hard world by their ingenuity. Below, the Watussi, giants eight feet tall



across the banana trunks, in order of size. Pegs planted in the ground keep some space between logs. Each of the 18 musicians produces two short, wooden mallets and crouches before his key. A signal, and eighteen pairs of hands go to town. It might not be a grand piano. But it surely is the hottest xylophone that has ever made hundreds of feet itch to dance.

To see the most picturesque dance, one must go into the very heart of Africa. There the Great Watussi, the magnificent, seven to eight foot descendants of the an-



The Wambas look pretty grim, from the business end of a spear

cient Pharaohs, demonstrate not only the excellence of their ballets and prancings, but also their cleverness in combining pleasure with physical culture, for the fitness of their race. Being excessively tall they cannot afford to grow fat and flabby. But they recognized the importance of keeping trim centuries before the white man ever composed the words "physical education."

Just as, for the Watussi, the year has three seasons (the cold one, the hot one and the rainy one), so a man's day, from childhood to old age, is divided in three periods: eight hours of sleep, eight of family and state affairs, eight of physical exercise. The latter consists of symbolic dances involving every muscle of the body, and in long walks to watch their herds of cows. These cows, incidentally, have horns 12 to 14 feet long from point to point. They are kept with the same care we give to pure-breds. And the finest of them, the royal ones, or insanga, are constantly watched by an attendant each, decorated with ornaments of colored seeds and taught to perform for their master's pleasure.

Travel in Africa has its discomforts. One occasionally rouses a crocodile or hippo

The inventive skill of the Watussi has manifestations which we might adopt with advantage. One is his method of partitioning houses. Though almost on the equator, the mountainous country of the Watussi is extremely chilly, especially in the cold season. So he has to live with his family in a great hut, thickly thatched and with the only opening a door, which must be closed at night. But he wants privacy, too, and plenty of air. So, instead of dividing the interior into many cubicles, he uses screens of raffia, forced in between poles. In the morning, all screens are removed to ventilate the whole house. At night, they are put back into place to give each member of the family seclusion.

A new child is born, a relative comes to visit, and more poles are planted in the floor to hold more screens, and a new room is obtained in a few minutes.

The Giant Watussi leave the greatest part of manual work to their subjects, the Bahutus. There is nothing the clever hands of these Bahutus cannot obtain from Nature's store. Out of wood, they make plates and platters and milk bottles. Out of gourds, they produce spoons, pitchers, calabashes for churning butter. With clay, they build beautiful fireplaces, amphoras and cooking stoves in which to burn charcoal. What clay remains they give to their children who entertain themselves making





The tribal Witch Doctor, by his own uncanny means, picks out a culprit from the assembled villagers

statuettes, usually of cows, and thereby learn graphically about the all-important cattle.

And with a basket of bird lime, a few pieces of hide and leather thongs, a Bahutu goes out to dispose of the heavy Tank of the Veldt, no less a creature than the irascible, ponderous, armored rhinoceros.

Let's take a case. A poor Bahutu woman starts homeward, her child hanging from a leather belt she wears bandolier-like, a heavy load of wood piled on her head.

Matata, her husband, is waiting for her. When she is some hours overdue, he gets alarmed and goes to see what has happened to her and the child. He finds them, trembling with terror, perched high in a tree. A great bull rhino has attacked them. The woman had just time to climb a few feet when—bang!—the rhino butted into the trunk and almost broke it. The woman and the child, terrorized, kept quiet and finally the beast left.

Matata takes his family home. But tomorrow the story may start all over again and end differently. Matata must get rid of that monster of a rhino. His usual weapons are useless, but his race has devised other means.

Grimly he makes his preparations. He drives two four-

foot sticks in the ground, four feet apart. Between them he makes a net of leather thongs. To it, he attaches scores of small pieces of soft, light, well-brayed hide, which will gently move in the breeze. Next morning he goes off with his contraption, a strong knife in his belt and a bag of bird lime on his shoulder. As soon as he finds the rhino's fresh tracks he plants the sticks and smears the whole network with the sticky, messy stuff. He slips ahead, studies the lay of the land, discovers where the rhino is feeding, goes back to get his net. Holding the two sticks well apart, he returns and approaches his quarry.

When he is about 50 yards away, the rhino scents him, throws up his head in fury, and charges straight toward the man.

Instantly Matata plants the two sticks in the ground, and, bending low, rushes to

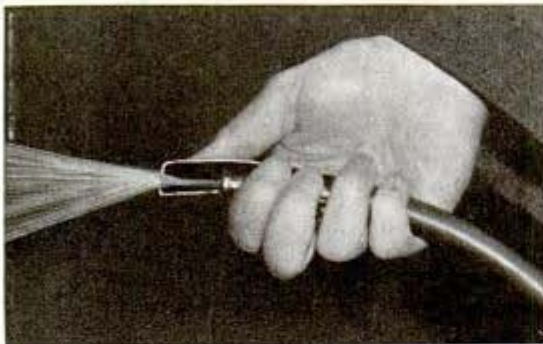
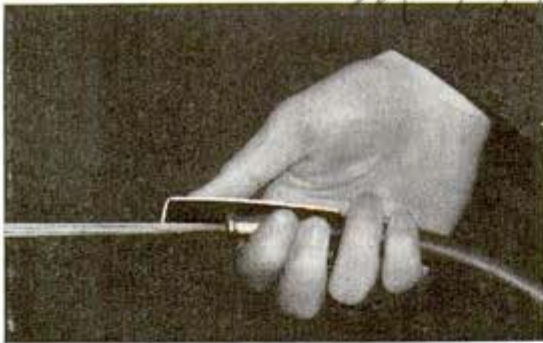
(Continued to page 180)



These statuettes of cows were carved in clay by children of the Bahutu tribe

*Extinguisher Supply Co
560 Belmont Ave.*

Extinguisher Thumb Spray Breaks Up Solid Stream



Flexing the spring steel deflector into stream from extinguisher nozzle sprays water over a wider area

Attached to the hose nozzle, a "thumb spray" now available breaks up the normally solid stream of a fire extinguisher for fighting certain types of industrial fires and for wetting down the area around a burning incendiary bomb. It fits the $\frac{3}{8}$ -inch hose and nozzle of standard soda-acid, foam, gas cartridge and pump tank extinguishers. A spring steel deflector, operated by thumb pressure, is flexed into the stream after leaving the nozzle, and thus does not interfere with the volume of the flow, nor does it affect normal operation of the extinguisher.

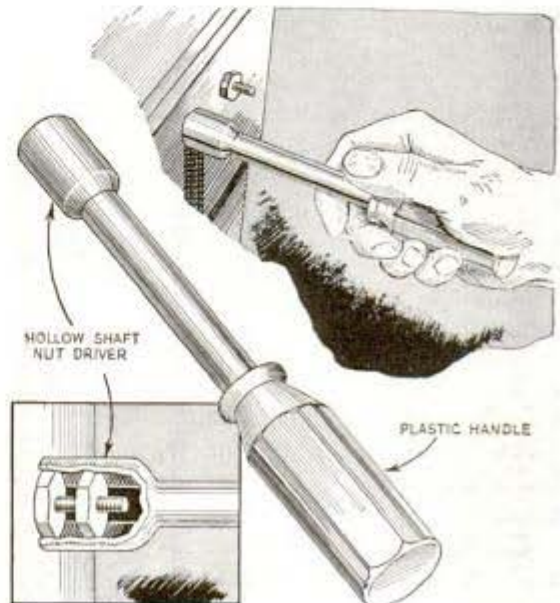
Adulteration of Wartime Coffee Detected by Simple Tests

If the coffee you purchase on your ration coupon tastes flat or lacks the expected kick, this may be due to adulteration. You can learn the truth by two easy tests described by C. E. Shepard, chemist of the Connecticut Agricultural Experiment Station at Hartford. One test, to detect chicory, is made by examining a pinch of ground coffee spread on a piece of white paper. A small magnifying glass is helpful,

Newark, N. J.
but not necessary. Coffee grounds are usually brown and granular, while particles of chicory are fibrous and darker in color. A "water test," made by placing half a teaspoonful of coffee in a glass one-fourth full of water, shows up the difference even more distinctly. Most of the coffee stays on top for a time, but grains of chicory and other fibrous vegetable material quickly become water-soaked and sink to the bottom, often coloring the water brownish. After ten minutes, the water is drained off and the grains spread out in a dish. On prodding them with a match some of the granules appear hard and resistant and "jump away"; these are most likely coffee. Chicory and other unwanted substances are plastic, almost like gelatin in consistency. Addition to coffee of chicory, which is made from the root of a perennial vegetable, as well as other harmless vegetable material, is not illegal, provided the presence of the adulterant is plainly indicated.

Nut Driver With a Hollow Shaft Slips Over End of Long Bolt

Handy for electrical and radio work, the shaft of a time-saving nut driver is hollowed to admit the long protruding end of a bolt or stud when the nut must be driven all the way down. Such nuts can be handled speedily without damaging the panel or injuring the thread. The tool comes in several sizes to fit most standard nuts.



Hollow shaft of socket nut-driver receives the long threaded portion of bolt to drive a nut all the way

Ref:

New Haven, Conn

Disks
POPULAR MECHANICS
Belmont Radio Supply
1921 Belmont, Chicago



Specially trained helpers of Boston firemen are a group of dalmatian dogs which aid in rescue work, run errands and perform watch duty. Above, several of the schooled canines are straining their acute hearing, keen sense of smell and sharp eyes to locate a person known to have been trapped in the debris of a razed building. With barking and accelerated activity they notify rescuers of success in their search



Left, one of the working mascots, agile in bounding up ladders, had to be restrained to pose for the cameraman. Below, the same dog finds an unconscious fireman. If his barks bring no help, he will go and fetch it. Between fires the dogs carry supplies or messages for the Red Cross in little pack saddles, guard ruins against looters, and play watchdog at the firehouse where they have eliminated thievery



SAVING *the* AIR FORCE "REJECTS"



Pilot's reactions to extreme low temperatures above 30,000 feet are tested in Boeing Aircraft Company's cold room. Below, pilots in grotesque flying suits and masks emerge from sub-stratosphere laboratory



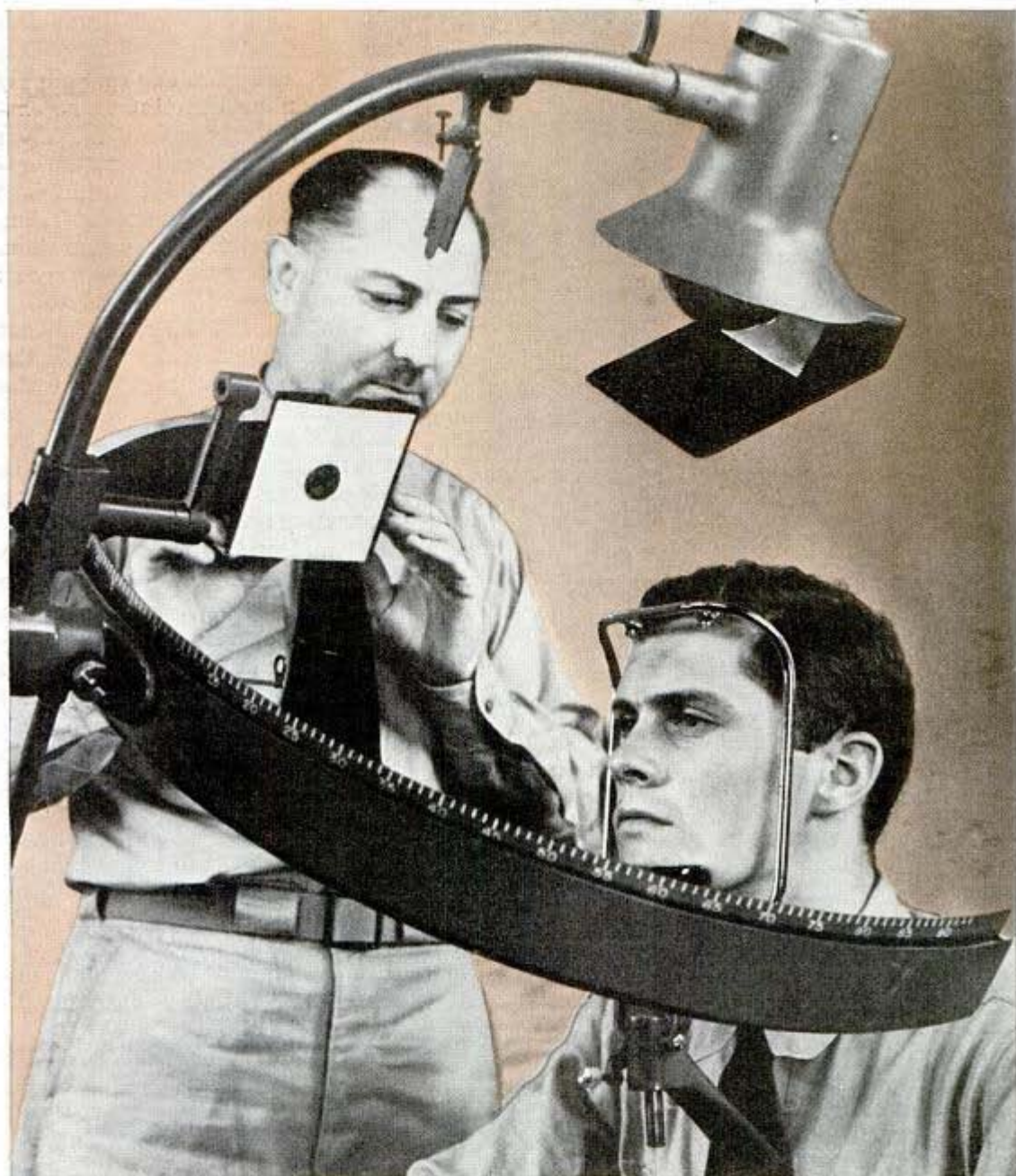
SO URGENT is the need for trained personnel to man the mighty air fleets the United States is assembling to hurl against the Axis, a program has been launched for salvaging manpower from the large number of air cadet candidates rejected because of failure in physical or mental tests and examinations.

This program is based upon the knowledge that many "rejects" have only minor physical defects which can be treated successfully and the candidates accepted upon re-examination, or educational shortcomings which may be remedied by study.

Already, close to 10,000 young men, who failed in their original examinations for the Army Air Corps or the Navy's flying arm, have applied for assistance to the American Flying Services Foundation, which is supervising the salvage program. Dr. Samuel M. Strong is director of the foundation.

The foundation's procedure is to place those candidates rejected for minor physical defects in the hands of qualified medical men for correction of whatever may have blocked entry into service; others, who failed to pass the mental tests, are sent to educational institutions to "cram" in

M. D. Medical
Director, A. F. S. F. Medical



Testing angle of vision of cadet who soon may be flying a fighting plane. Doctor adjusts card with black spot to point where it disappears from vision; exceptional vision spans 160 degrees

trigonometry, physics, geography, English and other subjects.

That the foundation is succeeding in its work is certain; particularly is this true of those cases involving minor physical defects. Most of these candidates, after correction of the disabilities, are accepted for service when they are examined the second time. Thus is being tapped a valuable source of manpower that otherwise would be lost to the air services.

The salvage program came into being after it was discovered that more than half

of the air cadet candidates for the Army and Navy were being rejected because of minor disabilities, which could be corrected. Perhaps one candidate needed dental work, another might be suffering from a hernia and a third might have diseased tonsils; these men could be treated, and treated successfully.

The cost of saving an average "reject" for the air services is in excess of \$100, the bulk of which is assumed by a sponsor who literally "adopts a pilot." Before receiving treatment, or "cramming" on the subject



Pilots exercise vigorously while inhaling pure oxygen to drive nitrogen from blood stream before entering Boeing cold room

in which he failed originally, the rejected candidate is informed that he is being "sponsored," which generally provides more incentive for the effort to get into service. At the same time, the sponsor is kept informed of the progress of the treatment, or the study course. Thus is maintained a close relationship between the two—although they may be hundreds or thousands of miles apart.

When the foundation began its work, flight surgeons unofficially referred the "rejects" to the organization. That is unnecessary today, because the word has spread that help is available. Through regional medical committees, arrangements are made for such surgery and hospitalization, medical or dental attention, as may be necessary. The

Testing the eyes of a candidate for the air arm of the U. S. Navy



foundation sees that hospital fees and doctors' bills are paid. The use of the applicant's own family physician or dentist is recommended, wherever feasible. Upon completion of treatment, the applicant is referred to the flight surgeon, who first examined him, with request for reconsideration. Most cases handled this way result in acceptance of the candidates.

The foundation sees to it that only the defect which barred the candidate is corrected in the shortest time possible, keeping in mind that time is essential, that the man must be brought into the air services immediately, because tomorrow may be too late.

Dental problems constitute one of the main reasons for the failure of candidates. Careful attention must be given here, because a pilot's duties involve certain strains to which the ordinary person is not subject. For instance, when dentures become necessary, dentists are instructed to install only fixed dentures. Many times in flying, a sudden jolt or "air bump" so jars the pilot's body as to create a sudden reflex inhalation. Such a condition might result in the dislodging of a removable denture, perhaps causing the wearer to swallow it.

In spite of the urgent need for air manpower, Dr. Strong, speaking for the foun-

dation, emphasizes that physical standards must not be lowered. He adds:

"Probably no class of human beings will ever be placed under greater stress than aviators in time of war. Only those of the highest physical standards can survive under the great stress of the centrifugal forces of turns at high speed. There is, and has been for some time, a clamoring by some individuals, who do not understand the stress of flying, for a lowering of the standards in order that the young man who believes he should become a pilot may become one. As physical standards are lowered, so will the airplane crash rate be increased.

"If that happens, we all stand to lose, because the Government values a pilot at \$100,000 and each airplane of certain types at \$500,000. Aside from the money value, the loss of a pilot and a plane might cost us the war. Too much is at stake to take needless risks."

Here are some of the questions that examiners must keep in mind when an air cadet candidate appears: What can this man stand? What effect will engine fumes, high-velocity turns and dives have on him? Is he in physical condition merely to keep alive at high altitudes?

(Continued to page 176)

Pressure and temperature go down as this group of pilots begins a simulated flight at 35,000 feet



In dogfights and dives, dizzy pilots are not wanted. So the candidate for the Air Corps gets a spin test from which he must emerge steady

Many applicants join the "reject" list after eye tests. Besides the standard examinations using reading charts, each is given a color test

Below, testing the convergence of a cadet candidate's eyes, the doctor slides the divider back and forth to determine the precise point



Service Industries Inc
 2025 So. Calumet Ave
 Chicago 40

**Mat "Tailored" to Fit Desk
 Saves Rug From Chair**



Part of mat extends under desk to protect carpet

Made with a "wing" projecting from one edge, a mat of special fiber is shaped specially for use at a desk so it will extend deep into the knee-hole section and thus give full protection to the floor covering against scuffing by the feet as well as scoring by the chair. Intended primarily to replace rubber mats, the fiber mat is produced in different colors and shapes.

Washington D.C.

**Dispute Over First Plane to Fly
 Ends in Favor of Wrights**

Controversy for some 40 years over whether the Wright brothers or Dr. Samuel P. Langley, former secretary of the Smithsonian Institution, built the first airplane capable of sustained flight was ended recently by Dr. Charles Abbot, secretary of the Institution. After much research the Institution now asserts that the Langley machine could not have flown as it was built in 1903, the year the Wrights made their epic flight at Kitty Hawk, N. C. Although the Langley plane was wrecked without getting into the air, many persons contended that the plane, or "aerodrome" as it was called, could have flown. In 1914 the Langley plane was taken from the museum, reconditioned and given a new en-

gine. Several takeoffs were made, but the Wrights pointed out that the reconditioning included 35 changes in construction without which the machine could not have flown. Officers of the Institution, however, then contended the 1914 tests were proof that Langley had "succeeded in building the first aeroplane capable of sustained free flight with a man." Dr. Orville Wright refused to allow the original Kitty Hawk plane to be shown in the museum with the Langley machine and sent it to a museum in England. In refuting all claims made for the Langley plane, Dr. Abbot said he hopes the way has been cleared for the return of Wright's ship to the United States.

**Measuring Wheel Stays on Line
 By Absorbing Body Motion**

Better accuracy is claimed for a patented field measuring wheel equipped with a specially designed handle that takes up walking motions of the operator and prevents them from affecting the measurements. The wheel, 10 feet in circumference, stands about three feet high, and replaces the bicycle wheel which would often take a slightly zigzag course across the field. In starting position, the white spoke should be pointed downward, and upon each revolution of the wheel an arm trips the counter. The counting mechanism is protected so high weeds cannot cause it to register accidentally.



Large wheel measures in 10-foot lengths as it rolls

Science
Service 01-24-22

Acme Newspictures, Inc
461 - 8 av nyc

Mountain Regiment Trains on Steep Log Ramp

m. 933



Keeping in the pink of physical condition for a mountain-climbing expedition—with the nearest mountain hundreds of miles away—is the trick performed by mountain infantry units of the Army. The men scale almost vertical log ramps, above and at right, with toe notches and safety ropes

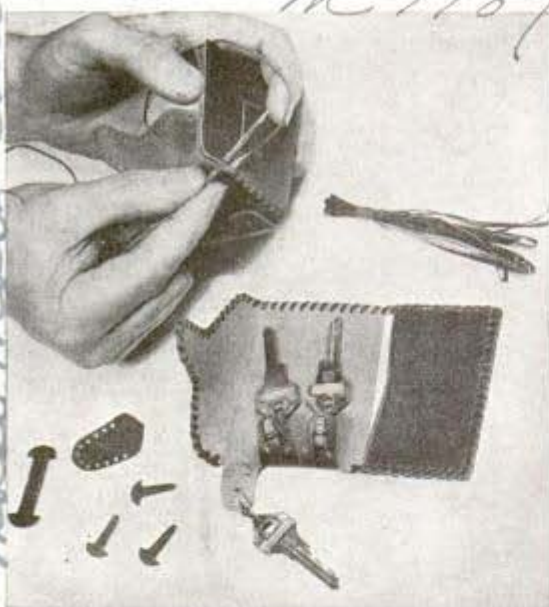


For Lewis Mink



A "mountaineer" team, tied together with ropes, drills on a rocky ledge during basic training. The second phase consists of rigorous training in mountain country. In winter, mountain infantry units of the Pacific northwest are organized as a ski troop battalion of 1,400 men

Keycase From Kit of Parts Easily Made at Home

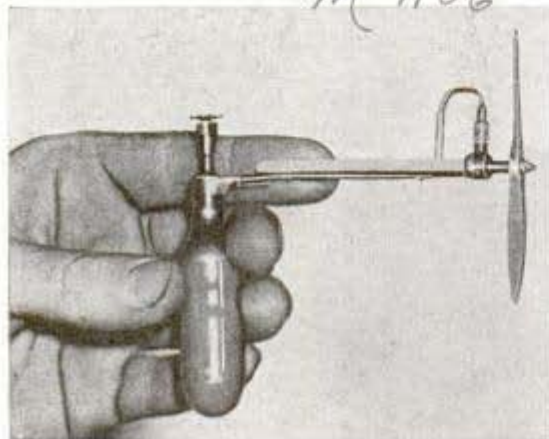


You can't go wrong in lacing, as holes are punched

Pocket leather cases, such as keycases, billfolds, coin purses, and cigarette, coin, match, comb and memo-pad cases, can be made at home without tools from parts supplied in kit form. Everything needed for the finished product is of leather, and the job consists mainly of lacing the pieces together. Small leather tabs and flaps easily anchored serve to hold the cases in closed position and to fasten the keys.

Model Plane Engine $\frac{3}{4}$ Inch Tall Runs on Carbon Dioxide

Made on a watchmaker's lathe, a tiny model airplane engine no bigger than a



Tank is connected with tiny engine by "steam pipe"

thumbnail and weighing only four grams is the work of William L. Brown, employed in the school of engineering at Pennsylvania State College. Fed carbon dioxide to power a one-eighth inch piston, the mite produces an estimated .005 horsepower. In two minutes the engine, three-fourths inch tall, uses eight grams of liquid carbon dioxide, running at about 10,000 revolutions per minute.

State College, Pa

Winter Shield Covering Window Prevents Escape of Heat

Home owners concerned about heating their rooms with limited fuel rations can stretch the heat supply by fitting windows with a weather shield that forms a blanket of dead air between the glass and itself, effectively blocking that avenue of escape for the warmth. In color, this window seal

M 1088



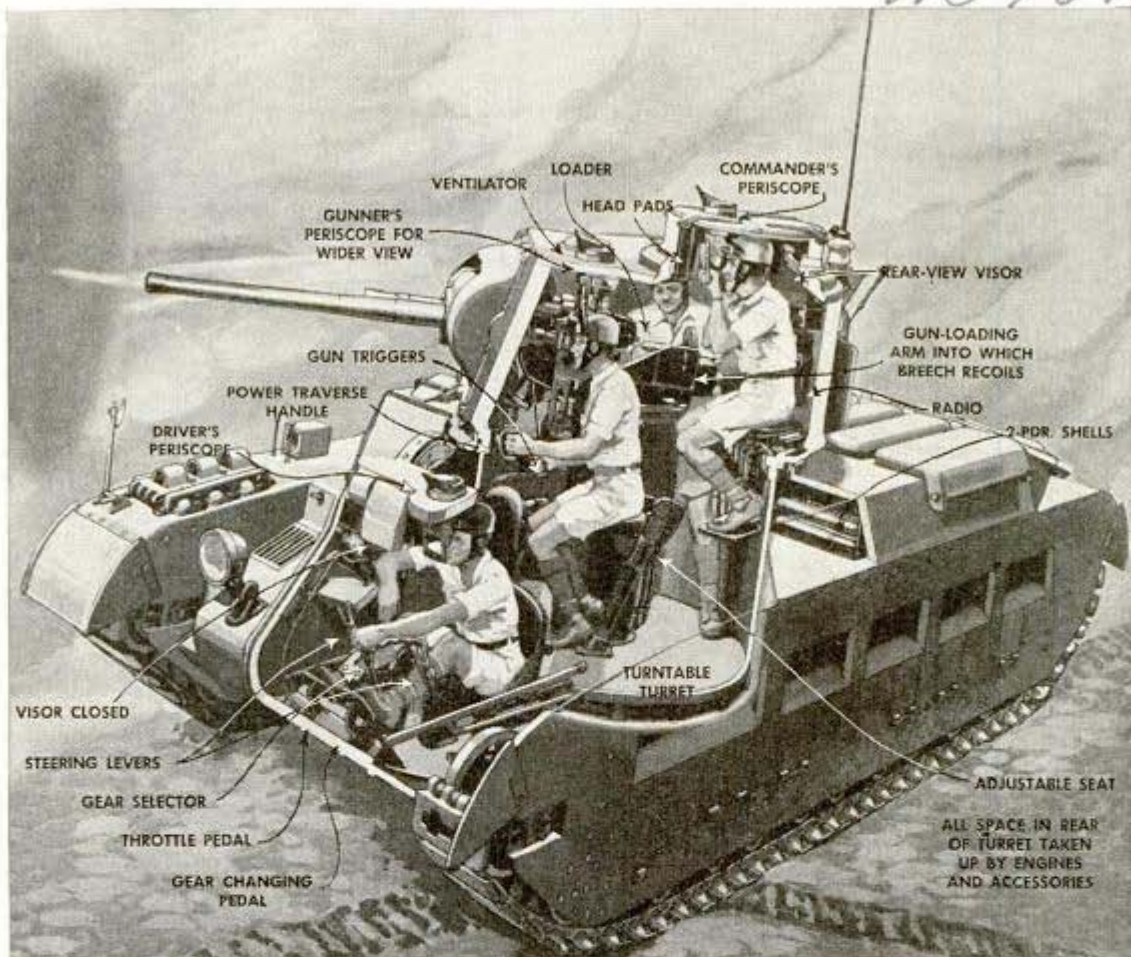
Sealing crack with tape (left), and applying shield

matches most buff shades used in homes and excludes less light than the average window shade. It is applied inside directly to the entire sash, both upper and lower if desired, being held in place by special adhesive tape all around the edges. Air leaks between the sash and window frame can be stopped by sealing all such cracks with the same tape. The latter method of application, of course, should be used only where windows are not to be opened for ventilation during the winter months. If the house already is fitted with storm windows, this treatment it is claimed will double the protection.

*Solicide Labs, 51
James St. Montclair, N.J.*

POPULAR MECHANICS

Tank Crew Rubs Elbows in British "Fortress" *m 1015*



Copyright S. W. Clatworthy

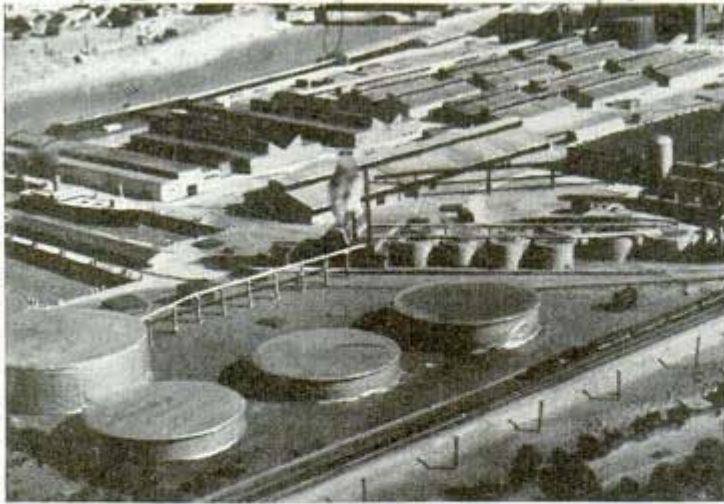
Revolving turret of a Matilda, which holds three of four-man crew, permits firing gun in complete circle

Tank commander, gunner and loader of a British Matilda occupy cramped quarters in the revolving turret and the fourth member of the crew, the driver, is squeezed into a forward seat. Teamwork is the keynote in battle when there's not an inch or a second to spare. Although each man in the "rolling fortress" is trained to take over the duties of any disabled member, the injury of any one of them is serious for the full crew has plenty to do. If the loader is knocked out it slows up firing of the guns; loss of the commander means lack of direction, and if the driver is hurt it's disastrous for his seat cannot be reached internally from the turret. The gun loader in the four-man crew usually doubles as radio operator. The commander maintains radio communication with his squadron leader and gives orders through an interphone system to his crew. With glasses and periscope he picks out targets when he

is not busy studying and marking his map or attending to scores of other duties. Protection against lurching of the tank is provided in his cramped cupola with an interlining of head pads, and brow pieces are fitted to periscope and visor. The gunner, who sits just below and slightly forward of the commander, can swing the power-operated turret around with ease and his guns can cover a complete circle. In earlier tanks that lacked a revolving turret, larger crews and more guns were required. Both gunner and driver have periscopes with limited fields of vision, but the loader works "blind." To the rear of the Matilda's turret are the engines, two six-cylinder 95-horsepower units. Heat from the two powerful engines and from the guns, as well as that generated by shells striking against the turret, make the temperature within the tank extremely uncomfortable, especially when operating in the desert.

Ref: Premier Oil & Lead Works
3950 Medford St, Los Angeles, Cal

PLAYING



Here is a beautiful target for bombers. Unconcealed petroleum tanks and sharply outlined factories cast shadows that would attract a bombardier's eye at a great distance. Notice the railroad



Here is the same area—partly concealed, above, by low-visibility and infrared-resistant paints; and below, subjected to total camouflage including artificial foliage, nets and plywood shapes



"THE TARGET for tonight is an airplane factory. From Dusseldorf, follow the railroad 200 miles east to its end. Bomb the immediate terminal area." Those orders were easy to follow and the British pilots who received them flew straight to the target and destroyed it.

Then, a few nights later, every railroad in Germany seemed to have disappeared. The British couldn't find any of the rail lines that had served as such handy markers in the moonlight. Apparently every German train was spraying dark paint on the right-of-way behind it.

On another occasion United Nations pilots thoroughly bombed an enemy oil field on a daylight raid and went home convinced that every well was demolished. But reports came back from friendly inhabitants that the oil field hadn't been touched. The wells were hidden by camouflage, and all the bombs had been dropped on a decoy area 15 miles away.

Still another time, United Nations pilots on a night flight spotted a German air-drome that was lit up to a suspicious degree. A few miles north, however, they observed a few subdued runway lights and caught the flicker of a signal lamp. That was the real target, obviously, and they bombed the hidden field into a welter of churned earth. But they learned later that camouflage had tricked them again. That night, the real field had been lighted up on purpose just to convince them that it must be a fake.

These enemy examples give you an idea of some of the ways camouflage is being

con: Thos. C. Stinson; Jr. 3872
Franklin Av, Los Angeles, Cal

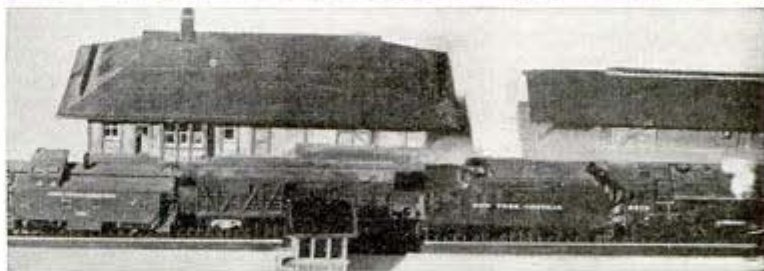
HIDE and SEEK for KEEPS

used and how effective it can be. For security reasons it's best to describe what the enemy has done instead of revealing all we are doing ourselves.

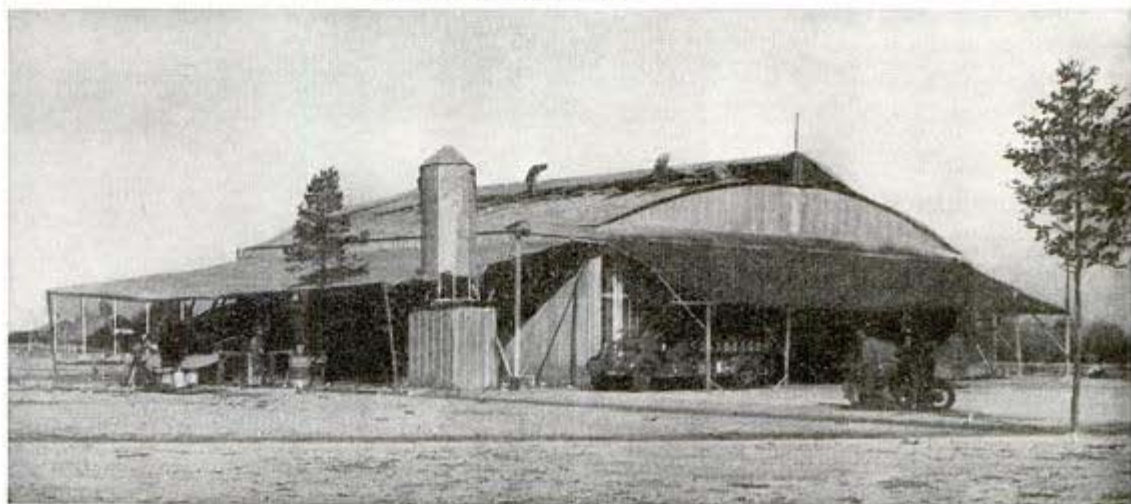
It's no secret, though, that some of our war plants are so well camouflaged that enemy bombardiers would have a difficult if not impossible job in finding them. Some of our airports are so well hidden from the air that veteran pilots who have been using them for years suddenly need to make three or four approaches before they can be sure just where to land.

Some of the newest effects in this "architecture of concealment" have been borrowed from the movies. For years motion picture artists and set designers concentrated on tricking the eye and camera into seeing things that really aren't there. Today they are doing just the opposite, using the same motion picture technique to trick the eye and camera into not seeing things that really are there.

One of the new stunts is



Above, Harper Goff tests camouflage ideas by throwing shadows and outlines of trees and shrubbery on model railroad with slide film projector. Below, soldiers hide an Army Air Corps hangar with canvas fly extensions. U. S. Army Air Corps photo





To plan a concealment scheme, the camoufler uses an aerial photo of the plant and sketches on tracing paper various patterns of "confusion"

a better method of giving a third dimensional quality to a flat surface. Thus they can transform a flat factory roof into what looks like a lot of small houses.

An old-time camoufler would try to do this by painting exact pictures of house tops on the flat roof. But his house shadows would be correct only during a short time each day and during part of the day his shadows might even point toward the sun. His perspective would be correct only from one angle.

The movie camoufleurs avoid these troubles by painting a colored pattern, across roofs and grounds, that gives the effect of a residential area no matter at what time of day or from what angle it is viewed. You can't pick out a single house from the air but you seem to see a lot of houses. This illusion is created with large squares and rectangles of low- and high-visibility paints. The effect can be explained partly by one example: A patch of brilliant primary color seems to pop out and give the impression of height when placed next to such background colors as olive drab or grey. "Bad"

Spraying infrared paint on ground to give illusion of residence area



combinations of colors that artists have always avoided because they displease the eye are also tried out. These combinations create optical vibration as well as erroneous impressions of depth and dimension.

Not even infrared film, used as an X-ray for piercing man-made camouflage, will always reveal a war factory that is disguised in the new way. Special infrared paints have been developed in many shades and are being used to fool that type of film.

It does little good today simply to camouflage a military objective all by itself. Bombardiers will line

their sights up with known reference points such as a crossroads or a bend in a river, then bomb the neighborhood where they know the concealed factory is located.

Today the whole area must be camouflaged. Reference points that might be used are either so obscured or are duplicated so many times that an enemy bombardier literally becomes lost. Even though he is certain that he is over the target area, there is nothing in his range of vision to give him the "fix" he needs when the whole area has been camouflaged intelligently.

Area camouflage is the reason why, if you live near a war plant or in a defense zone,



Reversing field glasses to obtain distant view, camoufleur studies oblong building with balconies to break up its outlines



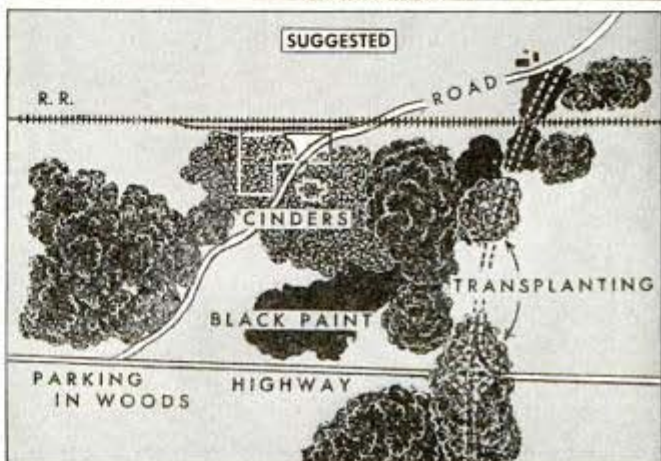
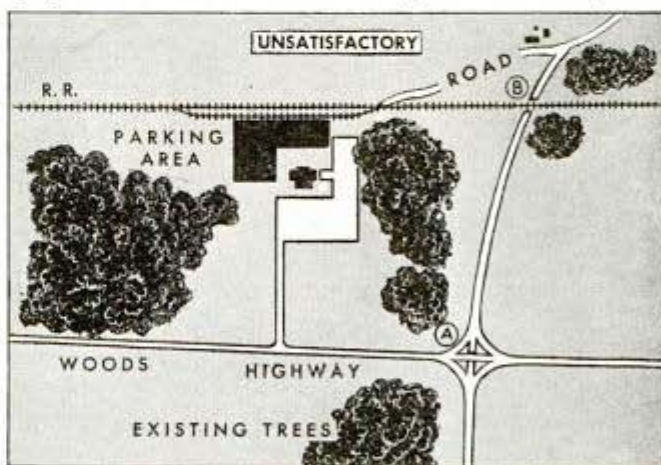
Working with a model of what actually is an industrial area, to which infrared paints and canopies have been applied to play "hide and seek" with the enemy reconnaissance planes

you may have been asked to paint some of your windows with dull paint to prevent light from reflecting from them. Certain roads may be closed to travel. If you live in such an area you may have noticed that wide patches of ground have been painted in subdued colors and you may have wondered how such crude work could possibly fool an aviator.

Harper Goff, a member of one of the movie camouflage units, found out how effective this sort of disguise can be when he went up in a plane recently to get a "bombsight" view of a big factory that he had camouflaged. First he was annoyed, then pleased, for he couldn't locate his own work. A few weeks before, the big factory had been conspicuous from the air.

To illustrate the principles of modern camouflage and yet not reveal any details of actual "cam jobs" that are being done, Goff built some table top miniatures of

Drawings show methods of landmark concealment by which a road junction is hidden
Office of Civilian Defense





U. S. Army Signal Corps photo

Sniper wears a suit that blends into his background. Below, burlap strips in chicken wire conceal factory



an imaginary industrial area such as would be an obvious bombing target. On one of these models the factory of a chemical concern can be seen adjacent to a bridge that crosses a river. Obviously, all a bomber pilot needs to do is to follow the river until he gets to the bridge, then bomb the adjoining factory.

But when you see the model after it has been camouflaged you begin to wonder. Paint and motion picture technique have removed the industrial area and you can't even find the bridge or the section of the river where it had been. The river is there, to be sure, but its banks no longer follow the same curves. There is a bridge, but it is a different type from the one you are seeking. And where the chemical factory had been there is now a residential area. At least, that's the impression the camouflaged model gives from "high altitude."

But when Goff explains what he has done with the model, you begin to see that it's the same area after all. The river banks have been built out and given new contours by means of log booms. The quiet water behind the booms is filled with floating trash. Barges are moored here and there in this debris. Masts on the barges support canopies of "garnish" that give the effect of trees.

The bridge is the same bridge after all, but one side has been built up with painted canvas sides and top to alter its appearance. The chemical works itself has been sprayed with paint patterns, breaking up the large expanses of roofs. The big smokestack no longer smokes and its visibility is reduced by wide balconies attached to its stack that help to blend it into the background. The Army has not yet accepted this technique as practical in full scale use.

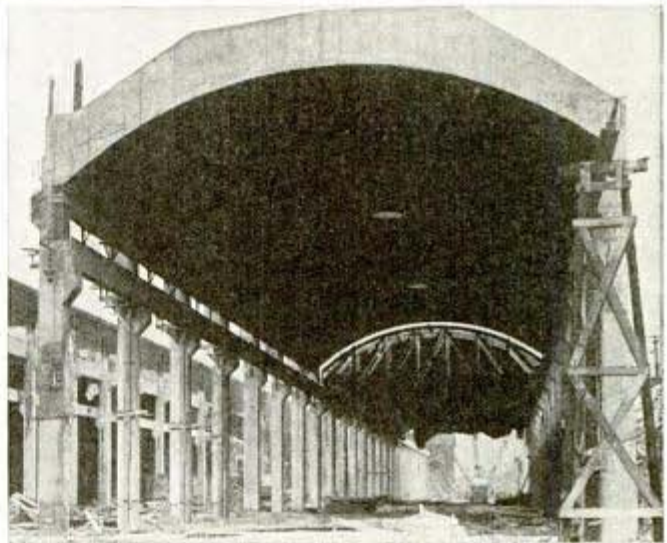
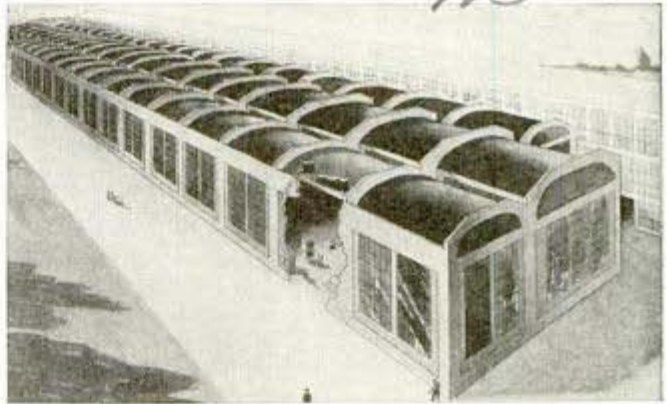
In this case most of the camouflage paints that are used are of the infrared reflection type, a group of pigments developed by various firms including the Premier Oil & Lead Works of California, at Los Angeles. Most paints absorb infrared or heat rays, and even black paint appears white when photographed with infrared film and a red filter. The secret of the infrared paints is that they reflect the heat rays instead of absorbing them, thus providing dark images on infrared film. An additional virtue is that since solar heat is reflected away from buildings coated with such paints the interiors remain much cooler.

It is not always necessary for camou-

fleurs to hide a military target completely from aerial observation. Partial camouflage, enough to make the bombardier's aim uncertain, is often enough. Ordinarily a bombardier must fly his straight "collision course" for at least a minute while approaching the bomb release point. The bombsight must be trained on the target during the last 35 seconds of this approach. But if the bombardier hasn't positively located his target at the 35-second point, the bombs will fall wide of their mark. Camoufleurs feel that they have succeeded if their work confuses three out of ten bombardiers. Interceptor planes, anti-aircraft fire, and other ground defenses should be able to bag the other seven planes in a perfect defense set-up.

Often a decoy target resembling the hidden factory is built nearby in the expectation that the bombardiers will unload their bombs on the dummy. The Germans were elated recently when they watched a British bomber attack a fake factory that they had erected. But no bombs exploded. For fun, the pilot was dropping wooden bombs on the decoy.

"Egg-Shell" Factory Saves Steel And Construction Time



Artist's sketch of plant, and looking down one of the arches

Built after the same design that gives the fragile egg shell resistance to breakage, a Westinghouse war factory required 60 percent less steel than a conventional building, the saving amounting to about 2,400 tons in the 1,100-foot-long arched structure of reinforced concrete. Also, like the egg, it is without windows and sky lights, but air conditioning makes it cooler in summer than many buildings, and a white ceiling adds to the effectiveness of the lighting. It is said that an explosion within the building would cause only local damage which could be repaired quickly, while internal fires would be resisted as long as two hours without collapse, as compared with 15 minutes for a steel and wood building. Besides this, the design enabled builders to shave four months from the construction time.

Lighter Ignites Fuel in Cup To Light Lamp or Torch

With a cup to hold liquid fuel which it ignites with a flint spark-er, a matchless lighter creates a flame specially convenient for lighting blow torches, construction warning lamps and similar devices. The cup must be filled with fuel—not heavier than kerosene—each time the lighter is used.



Sparks from flint ignite the fuel in tiny reservoir

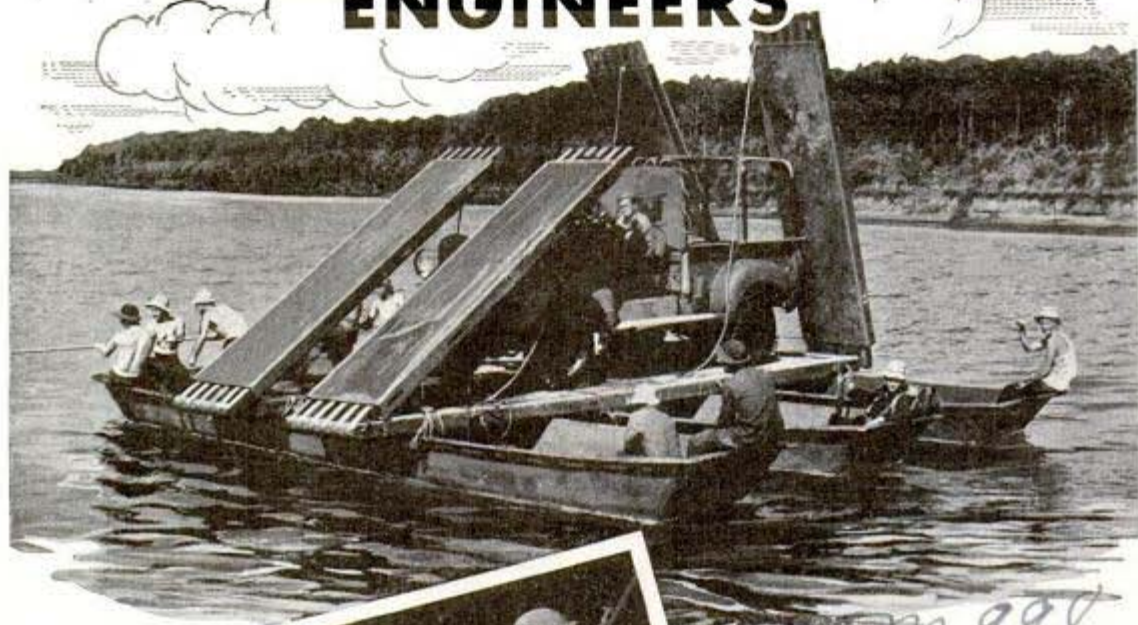
Write to the firms listed in the Where-to-Buy-It index, to learn more about products described in this magazine. Say You Saw It in Popular Mechanics.

Westinghouse Co. 306-400
 P.O. Box 1000
 Pittsburgh, Pa.

Westinghouse Co. 306-400
 P.O. Box 1000
 Pittsburgh, Pa.

Capt J.P. Leggett, 2200 Far
Hills av, Oakwood, Akron, O

The FIGHTING ENGINEERS



Engineers advance with fixed bayonets (above) on a foot bridge hastily built under enemy fire. Below, another type of foot bridge with some of its builders racing across—engineers are trained for speed



In battle against wilderness, the engineers building Alaska highway launch ponton which will help to support a bridge. They have conquered many a nameless stream between Fort St. John, Canada, and Fairbanks, Alaska

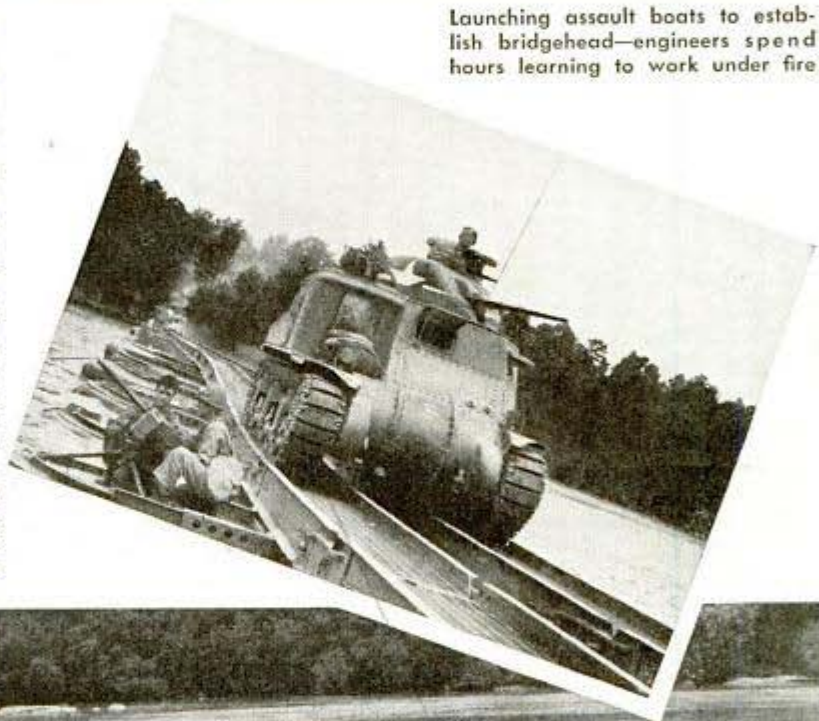


866 m



Above, laying metal strips for landing field at Allied outpost is one of the ways engineers co-operate with air corps. Holes in portable strips permit grass to grow through, helping camouflage field. Medium tank (right) is rolling across a ponton bridge built by engineers on maneuvers. The sturdy spans will support quite a surprising tonnage. Another means of getting an army and its equipment across stream is shown below. Here two anti-tank guns and their crews are being ferried across on a raft composed of two rubber floats powered by an outboard motor. Engineers are famed for ingenuity as well as speed and courage

Launching assault boats to establish bridgehead—engineers spend hours learning to work under fire



"Shooting" the Grand Canyon Tops All Thrills

M 1022

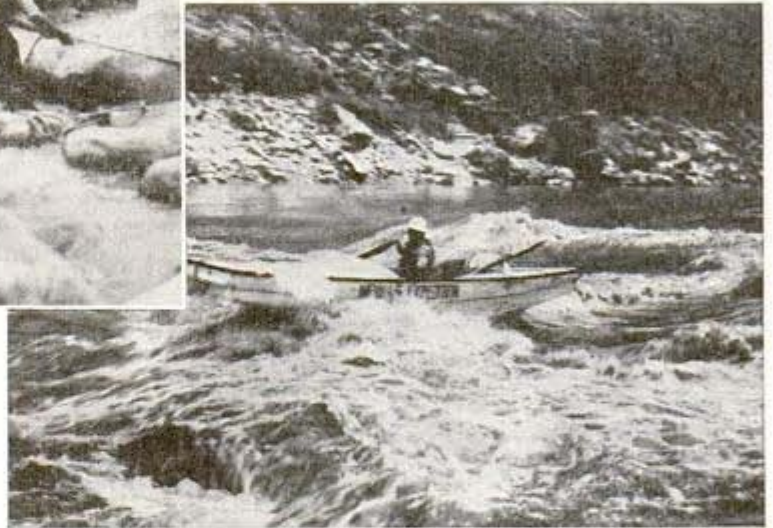
myian Bluff Utah



one who says he is not afraid is either a liar or an idiot. On every one of the more than 200 rapids you have to run, your throat gets dry as you come over the brink of the rapid's tongue, you wonder what possessed you to come on a trip of this kind; yet the minute you dive into the 25-foot waves and fly by rocks that would mean sure

Left, "lining" a boat by rope past a rock barrier. Boulders like these lurk under the waters that toss and spin the plywood boats like cork. The two spots below are relatively mild portions of the Canyon

For a matchless thrill, every second of which promises to be your last, try shooting the Grand Canyon of the Colorado in a 16-foot plywood rowboat. Norman Nevills, rancher and boatman of Bluff, Utah, makes it a business. The only man who has made four trips down the spectacular and violent canyon, Nevills has taken passengers ranging from 13-year-old boys to men in the seventies in these unsinkable boats of his own design without so much as a sprained ankle among the courageous tourists. The 225-mile bone-shaking cruise is from the historic river crossing at Lee's Ferry, Ariz., to Lake Mead. The trip takes 21 days, on most of which the boat is rarely in smooth water more than a quarter of a mile at a time. Preston Walker, former Grand Junction, Colo., newspaperman now in the U. S. Army, handled one of the three boats taking nine men down the canyon on the most recent journey, and said afterward: "Any-



trouble if you hit them, and look over the brink of holes in the river that would be death if you went into them—you start having fun." Once in the canyon, there are only two or three places "where anything but a fly can climb out." Nevills' cataract boats are virtual submarines, able to float when the cockpit is filled with water. Seven watertight compartments give them

Acme Newspictures, Inc
461-8 av, NYC
Army's Vast Phone Switchboard
Has 30 "Information" Girls
m 1001

buoyancy. The thickest wood used is half-inch Super-Harbord plywood, which withstood two terrific crashes against rocks during Walker's trip. The boats are designed to pivot on a point two feet from the stern, and a boatman, guiding the craft downstream stern first, can virtually snap the necks of his passengers by reversing oars. Before entering the worst rapids, the boatmen land to survey the channel; occasionally the passengers disembark while the boatman takes his craft down alone, and in impossible passages the boat is "lined" around, let down the edge of the river with 75-foot bow and stern ropes snubbed around rocks. Occasionally the boats dropped out of sight in 15-foot holes, whipped around bow foremost, and once two men plunged overboard as a boat capsized, but they made shore safely. Nevills has taken non-swimmers on the Canyon trip. One unscheduled thrill came to two members of the 1942 party when a boulder weighing a ton dropped between them as they walked along the river edge.

Arctic Troops Wear Paper Underwear

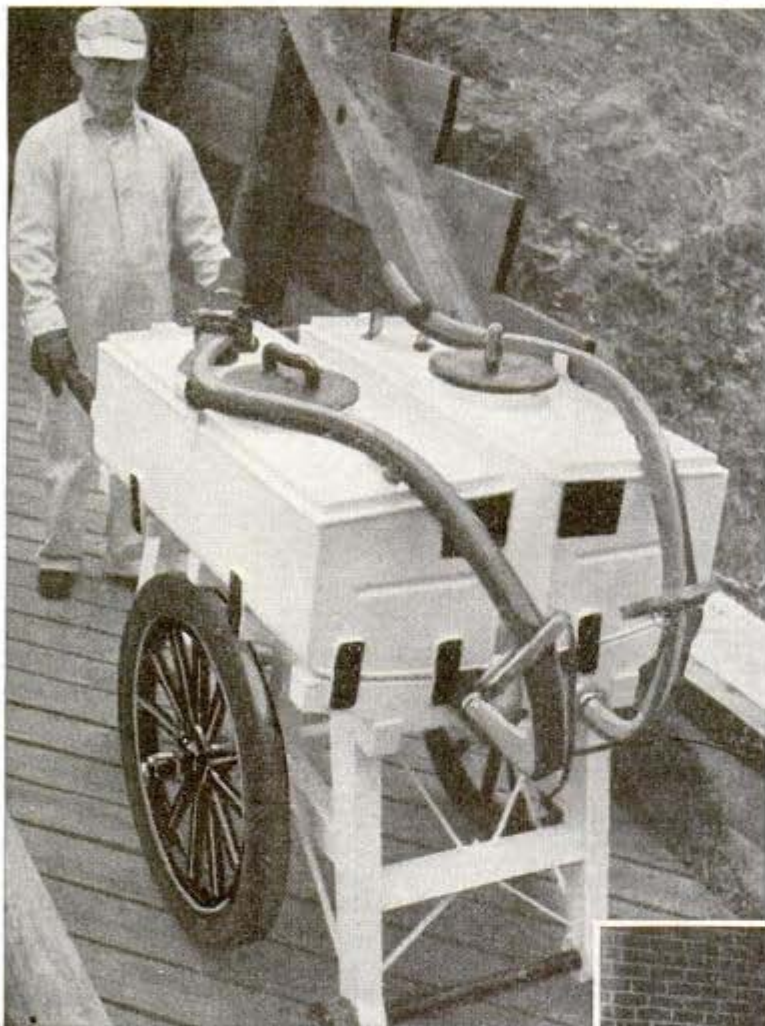
One war development that may last is paper underwear so inexpensive it can be thrown away after one wearing. Originated for extra warmth for troops in the arctic, it is made of pulped cotton clippings, contains two sheets of paper joined by a thin coating of asphalt.



"Information" operators at long table dig out numbers from rotary files

To handle calls to and from the 15,000 war-vital telephones in the War Department's new \$35,000,000 office building across the Potomac from Washington, required installation of the world's biggest private switchboard. The information section alone needs the attention of 30 operators, experts in hunting up the numbers of the thousands of army officers and civilians working in the building. The switchboard, staffed by 125 call operators, plus supervisors, is adequate to serve a city the size of Erie, Pa., or Wichita, Kan. More than 86,000 miles of trunk wires are used inside the building, and there are 370 incoming central trunk lines, 200 outgoing trunk lines, and 200 long-distance loops. The various offices of the War Department require four times the telephone facilities used in the first World War.

TORNADO *in a* BOMBSHELL

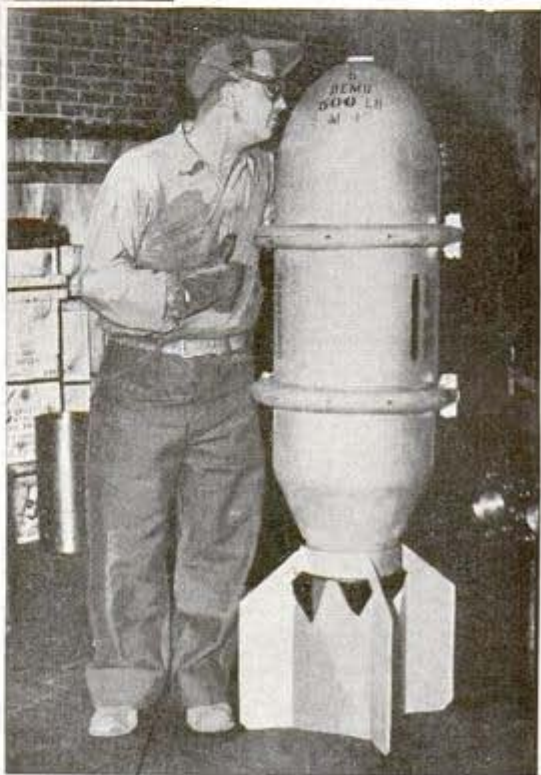


m 802
 becomes a veritable tornado of destruction.

Tests are actually made in which a 22-pound weight is dropped from a height of four feet upon a small piece of TNT without exploding it. Such tests are always carried out in the laboratory by specially trained men, of course, under carefully controlled conditions where every precaution possible is taken to insure safety in case there is an explosion.

The relative insensitivity of TNT to shock is a principal reason why it is one of the most commonly used military high explosives in the world. An-

at
 Courtesy Hercules Powder Company
 Moving explosive from storehouse to "mix" house with nitro-glycerin buggy. Below, inspecting a 500-pound bomb ready to be shipped to loading plant



Ref: **By Dr. C. M. A. Stine**

Vice President Advisory on Research and Development
 E. I. du Pont de Nemours & Company

Wilmington, Del
 FROM the nitrogen and oxygen of the air we breathe and from the carbon and hydrogen of coal or petroleum, chemists have fashioned one of the most powerful but obedient of all war explosives.

TNT (tri-nitro-toluene) is a chemical giant which answers to a specific type of detonation "command" and to no other. Riding in a shell, the TNT is undisturbed by the shock of the charge which propels the shell from the cannon or by the terrific impact as it crashes through a building or the tough hide of a battleship. But once within the building or battleship, the shell's primer and booster charges, going off in turn, wake up the sleeping giant and he

Memby: Crosby Research Foundation
7 Inc. 170 East California St
Pasadena, Cal



These giant armor-piercing shells carry load of TNT which is resistant to shock of impact

other reason is its terrific power when it does go off. Why does it have such a powerful "kick"? The answer is that organic compounds with "nitro" groups tend to be explosive, and in general the more nitro groups a material has the more explosive it is. Tri-nitro-toluene, as the name implies, has three such groups.

The toluene part of the deadly combination, strangely enough, is named for the sleepy little town of Tolu, Colombia. There on the high plains of northern South America grows a tree whose fragrant resin—known as the balsam of Tolu and widely used to give a pleasant taste to cough syrup—provided the original source of the chemical.

It was from a lump of the balsam of Tolu that a French chemist, Deville, just a hundred years ago, isolated a compound which became known as toluol or toluene. Other chemists, at about the same time, obtained the same chemical from pine resin and—appropriately—from "Dragon's Blood," a brilliant red resin from certain Oriental palm trees. They gave it other names, but toluene is the name that stuck.

The balsams of the forest have never yielded toluene in quantities. It was coal tar, a veritable store house of chemicals, that supplied the toluene for the TNT that filled the shells of World War I.



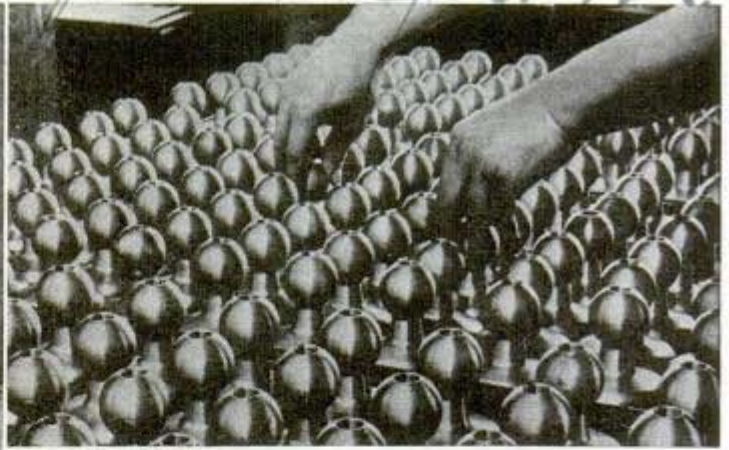
Courtesy Du Pont Company

Dynamite blast helping to build new channel for a river in Mississippi. Below, pouring explosive into shells with non-metal bucket made specially for job by B. F. Goodrich Company



Read Machinery Co
plant York Pa

Darryl Crowley



Rows of firing caps for 60-mm. mortars move along under capable hands of inspector. Left, radio controlled bomb, called "blind pig," scoots over ground on three wheels to target

Coal tar, a by-product of coke production, was also supplying most of the toluene for the shells, bombs and depth charges of World War II until about a year ago when the petroleum industry began to build plants for synthesizing this essential chemical from petroleum.

Production of toluene from petroleum and from domestic heating and illuminating gas was started before the end of the first World War, but the Armistice terminated these operations and they were not resumed until after the beginning of the present war. Then a new government-owned toluene plant was started. Today

petroleum is far ahead of coal tar as a source of toluene for TNT, and will be much farther ahead when projected additions and new plants are finished. This means a total output of scores of millions of gallons that will play a vital part in defeating the Axis powers. The exact toluene capacity of the country is, of course, a military secret.

There are two or three processes for making toluene from petroleum. One process starts with a chain of carbon and hydrogen atoms. At about 1000° F., and in the presence of a catalyst, a hydrogen atom is lopped off each end and the disturbed and excited straight chain whips around and grabs its own tail—like a playful puppy dog.

In so doing it becomes a ring molecule. Further removal of hydrogen atoms pares it down to toluene.

In the nitration of toluene to TNT, which is a delicate job requiring great skill and well safeguarded equipment, three nitro groups are attached to the ring molecule. In this process nitric acid is mixed with sulphuric acid to form a suitable mixed acid which acts upon toluene to form TNT. Such a mixed acid acts also upon glycerin to form nitroglycerin, and on cellulose to form gun-



The tubular chutes leading from this U. S. Army munitions loading plant are emergency exits

cotton or nitrocellulose, the base of all modern military smokeless powder.

The unique advantage of TNT over other explosives is that it is very powerful, yet, in comparison with most other high explosives, relatively insensitive to shock. Without this property a shell containing TNT would explode on the impact of a propelling charge of smokeless powder and destroy the gun and crew.

When the shell arrives at its destination, the timing mechanism fires the primer and this in turn touches off a booster—usually a charge of tetryl—and that detonates the main charge. Thus, we have an agent of terrific power, yet sufficiently stable to withstand not only the force of the explosion of the charge of propellant powder, but also the shock of penetrating a steel target.

The "nitro" part of TNT is a combination of one atom of nitrogen with two atoms of oxygen. The chief function of nitrogen in the production of explosives is to hold the oxygen needed for burning the explosive. The burning coal or oil under the boiler of a locomotive draws oxygen from the air, but a material such as TNT must supply its own oxygen. At the moment of combustion the various atoms of the solid TNT rearrange themselves to form gases, and these gases, which are very hot, expand with such tremendous force, and so rapidly, as to cause a violent explosion.

Nitrogen is just so much wasted breath as far as the immediate needs of our bodies are concerned, but it is a key element in almost every charge of explosive. Plentiful and free as the air itself, nitrogen is nevertheless in the "critical" category of war materials.

Skill, machinery and men are required to pull nitrogen out of the air and "fix," or combine, it with elements so that the resulting compounds may be used in the manufacture of explosives. Indus-

(Continued to page 162)



After the bombs come demolition squads to remove hazards on streets. Here worker, on top of crane, fixes steel cable to wall. Below, loading "boosters" for shells behind a shield



*Breinig 1500, Inc
3 x Hand Lts
Nov 1933
M1009*

Long Handle for Paintbrush Extends Painter's Reach



Painter reaches high on wall with long-handle brush

Painters can speed up the work of scraping or painting large surfaces of buildings by using an adjustable extension brush handle that provides a long reach and saves frequent change of the scaffold. It also increases efficiency in painting the sides of ships from a suspended cradle or from a small boat alongside. The brush is attached to a pivoted bar at the end of the handle. Two springs hold the bar in position permitting natural movement of the brush instead of a rigid fitting that would be tiring to use. A tug upon a tape attached to one end of the bar changes the angle of the brush for work on ceilings or walls.

Luminous "Paint" in Sheet Form Resists Damage by Moisture

Suitable for civilian and military use, especially outdoors, a prefabricated phosphorescent paint film sandwiched between transparent plastic films is nonabsorbing and chemically neutral. It is made by laminating under heat and pressure. The material can be excited to fluorescence by daylight or photoflood lamp in 20 seconds,

*96 Fluorescent Pigments
Corp, 440 N 41 St, N.Y.C.*

or in 20 seconds to a minute by an ordinary 100-watt lamp depending on its distance, and it remains visible for 24 hours at 70 degrees F. The afterglow can be accelerated by exposure to infrared light, and a red light will quench it.

Guide for Making Enlargements Has Set of Sample Prints

Photographers making their own enlargements could improve the quality of their prints with the aid of Eastman's new guide, embodying virtually all needed information for handling various types of Kodabromide printing paper. Contained in a pocket folder about 3½ by five inches, and ½-inch thick, the guide includes a 32-page booklet crammed with valuable advice and instructions on print-making and various kinds of paper, an exposure-time dial, a negative to help in sharpening the focus and measuring the degree of enlargement, and a set of sample prints representative of all the surfaces in which Kodabromide is available. Each sample gives a full-range gray scale, graininess and resolution charts, processing recommendations and other data. Once the photographer has determined the correct exposure time, he can set the exposure dial to calculate the time for larger or smaller magnification, for a different lens aperture, or for a different type of printing paper.



Enlargement guide and dial; note sample print, top



The

CRAFTSMAN

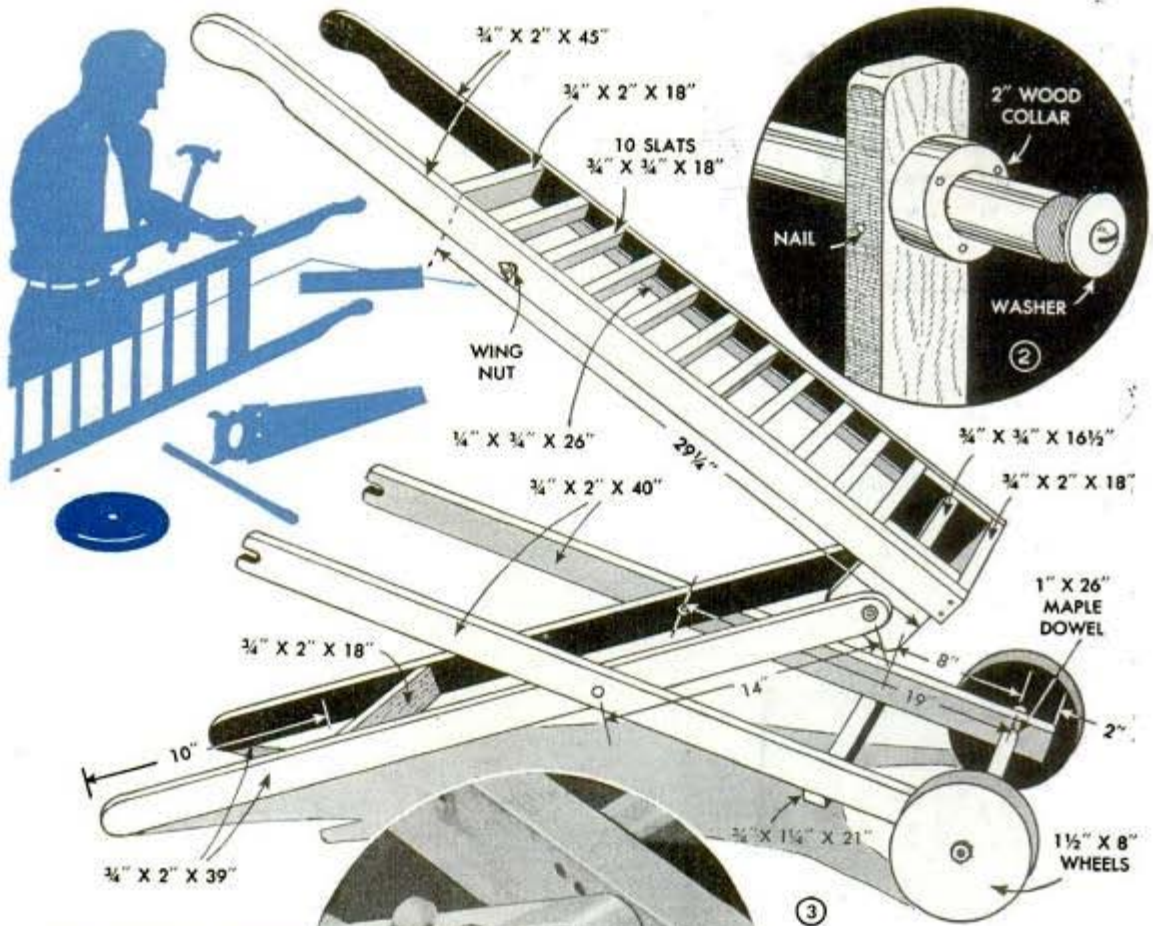


By Walter E. Burton

DESIGNED primarily to eliminate stooping when hanging out laundry, this folding cart is handy for other purposes such as hauling garden tools or serving outdoor luncheons. Various attachments can be added, such as hooks for a clothespin bag, special trays to hold garden tools, cut flowers and other garden equipment, as well as gaily painted food and beverage trays when the cart is used as a tea wagon.

The original was made of redwood, which is highly resistant to the effects of moisture. Other suitable woods include cypress and such less durable



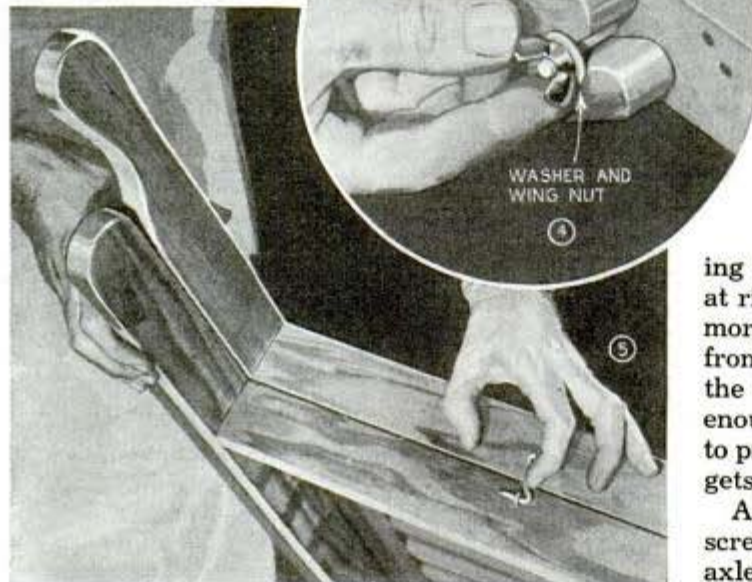


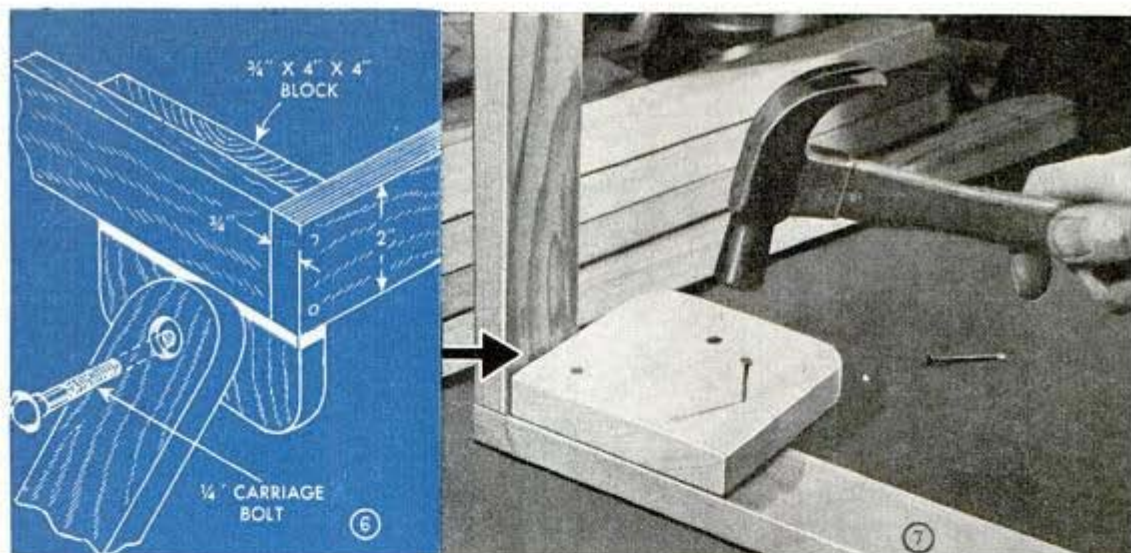
with a large dowel that serves as an axle for two wooden wheels, which are spaced from the frame with wooden collars as detailed in Fig. 2. It is best to build up each wheel of two $\frac{3}{4}$ -in. pieces, gluing and screwing them together with the grain at right angles. This will produce more durable wheels than if cut from solid blocks. The holes in the wheels will have to be large enough to fit loosely on the axle, to prevent binding when the wood gets wet and swells.

A large washer and a wood screw, driven into the end of the axle keeps each wheel in place. All edges and corners of the parts

are rounded except the ends of the slats and the braces that fit between other pieces. The upper assembly, which extends to form handles, has a slatted surface and is pivoted to the leg assembly by means of two bolts and blocks as shown in Figs. 6 and 7. The bolt heads must be set in counterbored

material as pine. Waterproof glue, bolts and nails hold the parts together. Fig. 1 shows how the cart is folded, and Fig. 5 shows how a screw eye and hook are used to keep it in the folded position. The cart consists of three separate units pivoted together as in Fig. 3. One of these is fitted





holes so the cart can fold. The wheel and leg assemblies are pivoted together as indicated, and the slotted ends of the wheel assembly slip over the bolts on the slatted portion as in Fig. 4, where they are held by wing nuts to keep the cart in the opened position. It is well to peen over the ends of the wing-nut bolts to prevent the nuts from working off. The location of these

bolts will determine the height of the cart.

If the cart does not stand level when set up, alter the lengths of the legs. Paint, enamel or brushing lacquer may be used as a finish, although a cart made of redwood may be left unfinished if the nails are protected against rust. Another way of finishing the cart is to apply several coats of linseed oil.

Water Line Closed for Repairs by Freezing With Dry Ice

Recently the water shut-off valve in our home had to be replaced in the line leading to the main, and being unable to shut off the water near the main because of a damaged valve at this point, I solved the

problem by freezing the water in the line near the shut-off valve. This was done with Dry Ice held around the pipe by a tin can, which was slit down one side and halfway across the bottom so it could be slipped around the pipe where it was held by binding it with wire. If Dry Ice is unavailable, the same results can be obtained by using regular cracked ice and salt, although it will take a little longer to freeze the water. After the repair has been made, the ice inside the pipe will soon thaw. There is no danger of damaging the pipe as the water is frozen for only a few inches, thus permitting plenty of expansion endwise.

—W. F. Schaphorst, Newark, N. J.

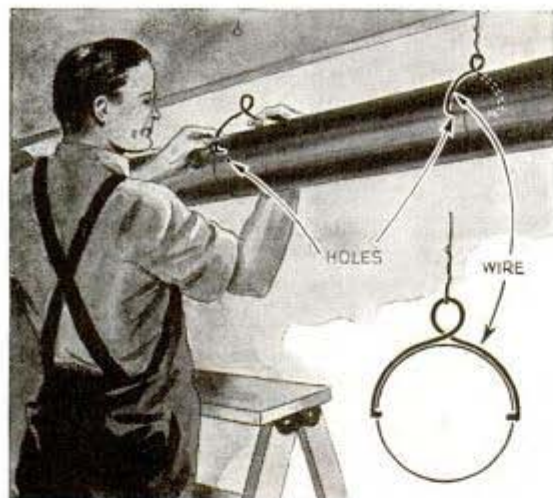


Sanding Painted Surfaces

Sandpaper will last longer when sanding a painted surface if you first dust a small amount of fine pumice on the surface of the work. It will be found that the pumice helps prevent paint from clogging the paper and in addition to this contributes to the abrasive action.

—William A. Landau, Chicago.

Horizontal Stovepipe Supported By Bails Made of Wire



To keep horizontal lengths of stove pipe from becoming disconnected and to support them with less wire than with the usual method, one workman uses these wire bails. Holes are punched in opposite sides of the pipe at the joints to take the bail ends, making the holes through both thicknesses of pipe. In this way, the pipe is prevented from slipping apart at the joints. Light wires are tied to the ceiling and to the bails for the supports.

Newsboy Keeps His Card File In Pocket on Carrying Bag

In order to handle his paper route in a businesslike manner, one newsboy carries a card file of all his customers in a leather pocket riveted to the side of his bag. In this position, the file is easily accessible for reference when delivering papers and



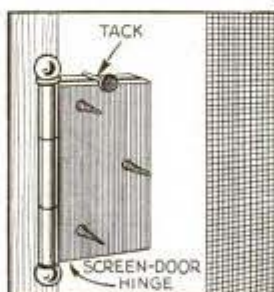
making collections. Such an arrangement is also handy when a substitute carrier must take over the route for a day or two as all records of the customers are right at hand for the new boy.

Shoe-Polish Can Found Quickly When Kept on Side of Kit

The trouble of locating a can of shoe polish in a polishing kit and removing the cover, when no release lever is provided, can be avoided by tacking the cover to the side of your kit. This permits the can to be twisted from the cover with one hand. If the same brand of polish is always used, it will not be necessary to pull the tacks and change covers.



Hinge Screws of Screen Door Held Safely in Storage

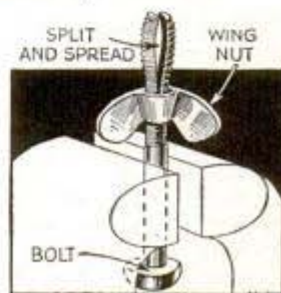


When the hinges of a screen door must be removed to take it down for winter storage, accidental loss of the hinge screws can be avoided as shown. The loose half of the hinge

with the screws in place is folded against the door and tacked at the edge of the hinge to keep it in the folded position.

Pin Vise From Split Bolt

If you need a pin vise and none is at hand, just split the end of a long bolt with a hacksaw to provide a couple of jaws, screw a wing nut onto it and bend the halves as shown.



By locking the bolt firmly in a bench vise, the wing nut can be turned up or down easily to operate the small jaws.

Asbestos Ring Helps to Protect Stove Enamel



If a large cooking utensil is set on an electric stove, the porcelain enamel surrounding the burner sometimes becomes checked because of excessive heat directed against it by the utensil. An easy way of avoiding this damage is to use a large asbestos ring, which is placed over the enamel next to the burner. The ring is cut from sheet asbestos, using two or three thicknesses cemented together with sodium silicate. Asbestos rings of this type are especially



suitable at canning time to protect the stove should acid-type fruits and vegetables boil over accidentally.

—Kenneth Murray, Colon, Mich.

Wedge Prop Holds Wallboard While Nailing It to Ceiling

When applying wallboard to a ceiling singlehanded, this prop to hold the board in place while nailing it will be found convenient. Made by nailing an old stub broom to the end of a T-stick, the prop is better than a plain stick as the broom provides a flexible "wedge" against the floor.

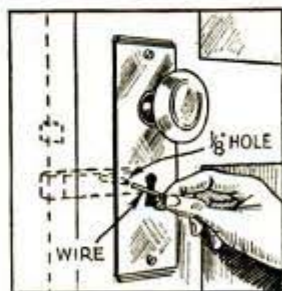
If large sheets of wallboard are being applied, it is best to use at least two props.

—G. E. Hendrickson, Argyle, Wis.



Opening Door With Skeleton Key Avoided by Pinning Lock Bolt

To prevent a door lock of the type shown from being opened with a skeleton key, a small hole was drilled through the lock bolt and plates for the insertion of a steel pin or nail. As the effectiveness of this treatment depends on the hole being inconspicuous, it should be made as small as possible, and the pin should be pushed in so that it cannot be seen and thus give away the secret. When unlocking the door, a piece of wire is pushed into the hole to remove the pin.

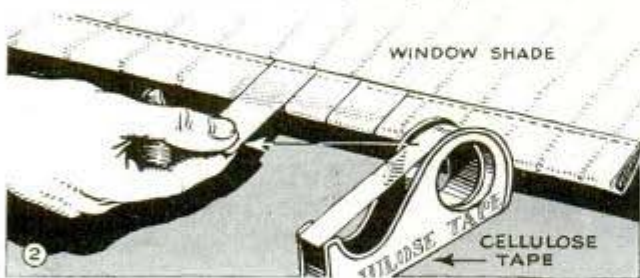
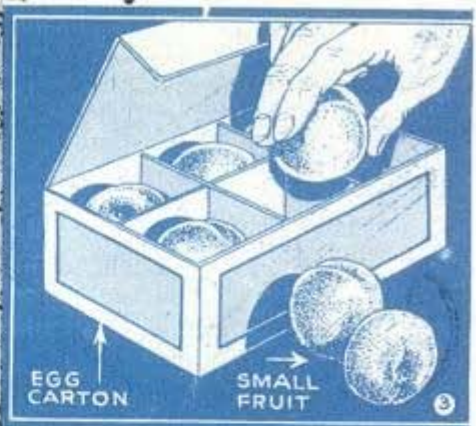


—A. H. Waychoff, Phoenix, Ariz.

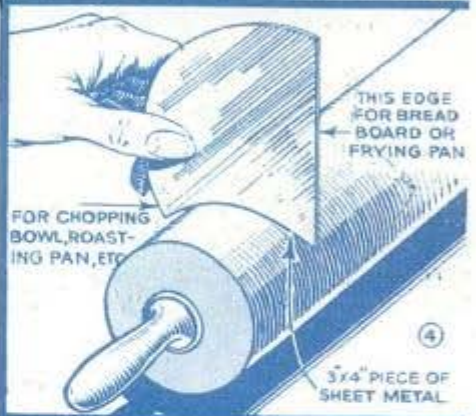
Solving HOME



1—Shoes are kept off the closet floor in neat order by placing them in notches cut in the edge of a piece of plywood, which is screwed to the baseboard. 3—As plums, apricots, etc., are easily crushed, cardboard egg cartons provide ideal containers for them when packing a picnic basket

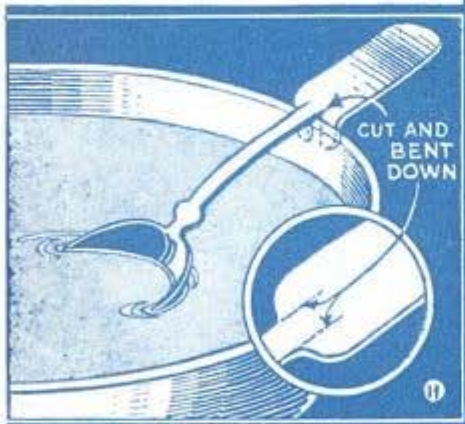
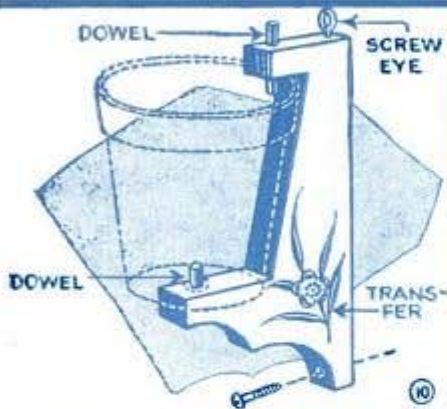


2—There will be no unsightly finger marks on window shades where they are grasped repeatedly at the hem if several strips of cellulose tape are applied over this area as shown



4—When cut to the shape indicated, a piece of sheet metal makes an excellent scraper for cleaning rolling pins, breadboards, and many other kitchen utensils. It's a good idea to run a file over the edges of the scraper before using it in order to avoid cutting your fingers on sharp edges of metal. 5—Instead of throwing away an old safety razor, take out the blade and keep the razor to remove hair and threads from brushes. 6—Scouring kitchen pots and pans with a wad of steel wool is done without scratching off nail polish or getting small pieces of metal in your fingers if the wad is slipped over the tines of an ordinary table fork

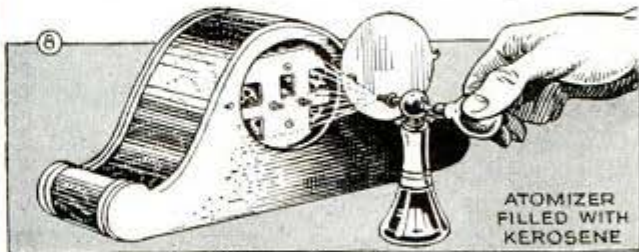
PROBLEMS



10—Jigsawed from a small piece of hardwood, this attractive flower-pot holder occupies little space on a kitchen or porch wall where several of them can be used to take the place of large flower boxes. Decalcomania transfers offer a quick method of adding colorful decorations. 11—The annoyance of "fishing" a spoon out of a large mixing bowl or dish is eliminated by a stop on the spoon handle. The stop is made by cutting and bending a portion of the handle as shown. 12—Pinched over an opened corner of a salt sack, an adhesive-tape spool and ring provide a handy spout, enabling you to fill shakers quickly without spilling



7—To hang a number of garments on a closet door, hook the hangers on a chain stretched across the ends of a shelf bracket which is screwed to the door. 9—Crumbs that slide off this breadboard are caught in a trough formed by strips of cove molding nailed along the edges



8—Instead of setting a bottle of kerosene inside a clock and waiting for the vapor to lubricate the movement, try spraying it lightly with an atomizer for quick results



Potatoes Baked in Tin-Can Ovens While on Camping Trips



Where potatoes are baked in a campfire, considerable time is usually required as it is best practice not to put them in until the fire has burned down to provide hot coals. However, if you want to hasten the meal, baking can be done quickly by placing the potatoes under inverted tin cans and then building the fire over them. Thus, the cans serve as small ovens.

Heated Enamels and Lacquers Will Brush Easily



The next time you have to brush heavy enamel or quick-drying lacquer, instead of cutting the material with prepared thinner, heat a basin of water to a temperature of 150 or 160 degrees, never more, and place the opened can of enamel in the water, submerging it a little more than half the height of the can. Enamel or lacquer heated in this way will brush easily without dragging and

without streaking or piling. Where a large surface is to be covered, use two water containers, heating one while the other is in use. Never place the can of enamel in the basin while it is over a flame.

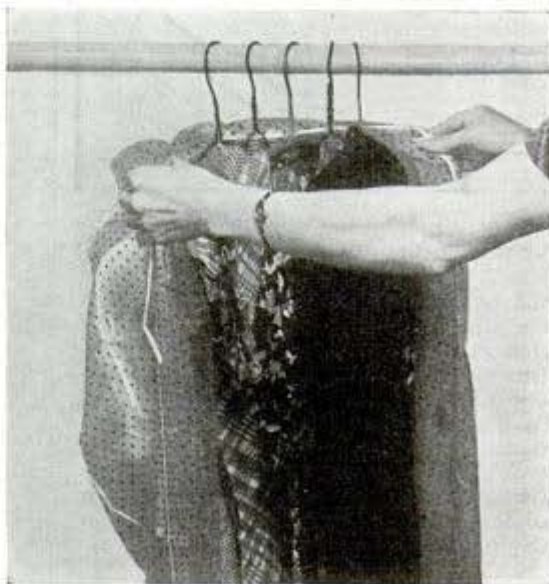
Screen Wire Protects Small Trees Against Damage by Rabbits

If you have some screen wire available, especially some that is no longer serviceable for use on windows and doors, form it into sleeves to keep rabbits from gnawing the bark from young trees. It can be used year after year, and is much handier to put on and take off than cloth or paper, which are often used for the same purpose.



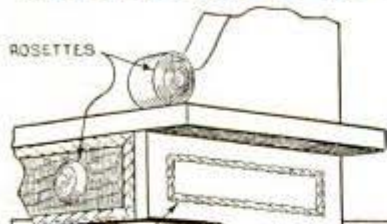
Raincoat Serves as Dust Shield For Garments in Closet

Instead of folding a Cellophane or oiled-silk rain coat and storing it away when not needed, use it as a dust cover for garments hung in the closet. It will protect several garments when slipped over them as indicated in the photo.



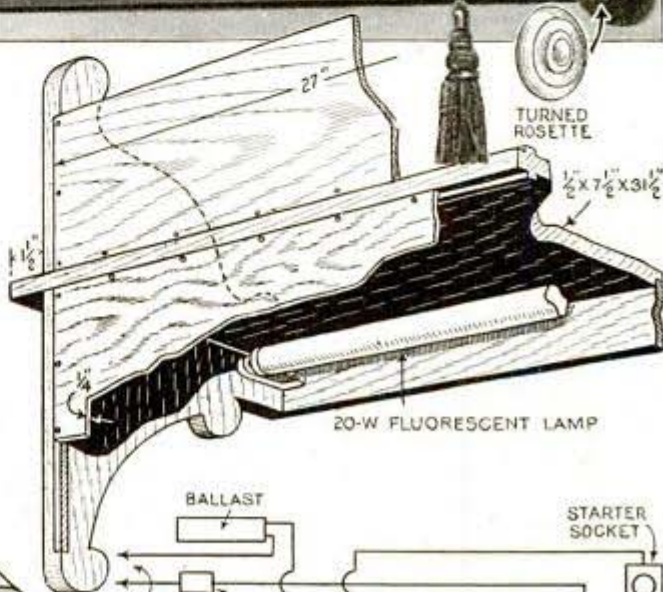
100 W.P.

Distinctive BOOKSHELF includes a lamp



ROSETTES

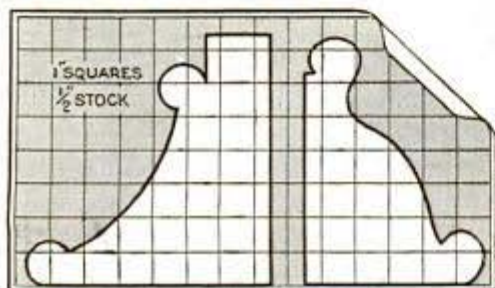
"ROPE" MOLDING
GLUED AND
BRADED



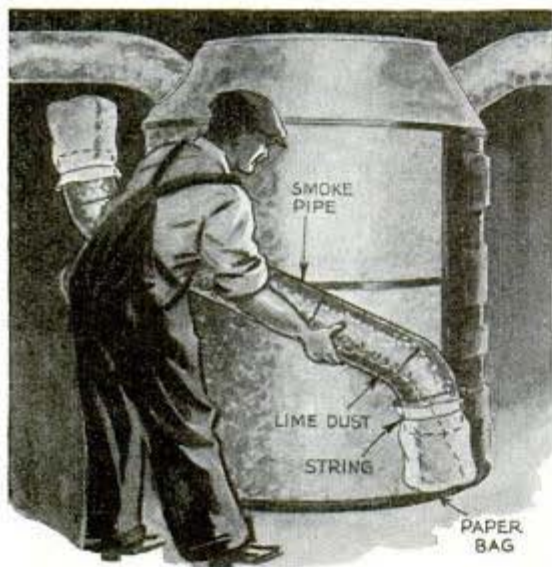
TURNED
ROSETTE

$\frac{1}{2} \times 7\frac{1}{2} \times 3\frac{1}{2}$

20-W FLUORESCENT LAMP



Smokepipe Lime-Coated Easily To Prevent Corrosion



The messy job of coating the inside surface of a smokepipe with lime to prevent corrosion during the summer months when the heating plant is not in use can be avoided by doing the job as indicated. Take down the pipe intact if possible, clean it thoroughly, and pour in the lime and tie paper bags over the ends. Then tip the pipe up and down so that the lime will come in contact with the entire inner surfaces. The sacks will prevent spilling out the lime and confine the dust. They can be left in place while the pipe is in storage to help keep out moisture.

Sample of Water From Deep Well Obtained in Weighted Bottle



Desiring to obtain a sample of water from the bottom of a deep well for testing purposes, one chemist used a small bottle or vial weighted with a fishline sinker. First the bottle was corked lightly, after which a long string was tied to the cork, then around the neck of the bottle and finally to a sinker as shown. This arrangement prevented water near the top of the well from entering the bottle as it was lowered

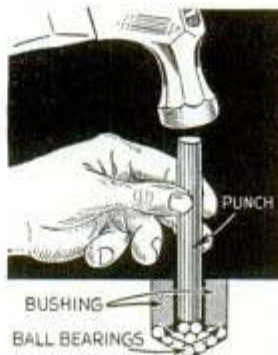
to a position near the bottom. A firm jerk of the line pulled the cork and allowed the bottle to fill, after which it was pulled up.

Loose Collar Kept on Dog's Neck By Notched Leather Strips

As a tight collar on a dog often causes goiter trouble, many over-cautious owners leave the collars so loose that the dogs soon learn to slip them over their heads. To avoid this, one fancier recommends that notched strips of leather be riveted inside the collar as shown. Although harmless to the dog, the ends of the strips will prevent him from attempting to slip off the collar.



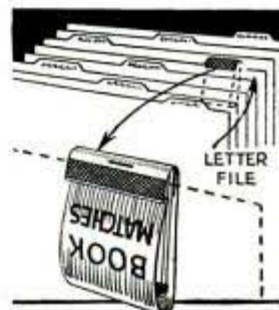
Bushing Forced Out of Blind Hole With Ball Bearings and Punch



Confronted with the problem of removing a bushing from a blind hole without damaging the bushing or surrounding metal, one mechanic accomplished the task by using small ball bearings. A punch that fitted loosely in the hole was then used to apply pressure to the bearings which pushed against the lower end of the bushing to force it from its socket.

Match Book Is Handy Marker For a Letter File

A match book provides a handy marker when correspondence is removed from a letter file. The striking surface is slipped over the folder adjoining the empty one.



Kitchen

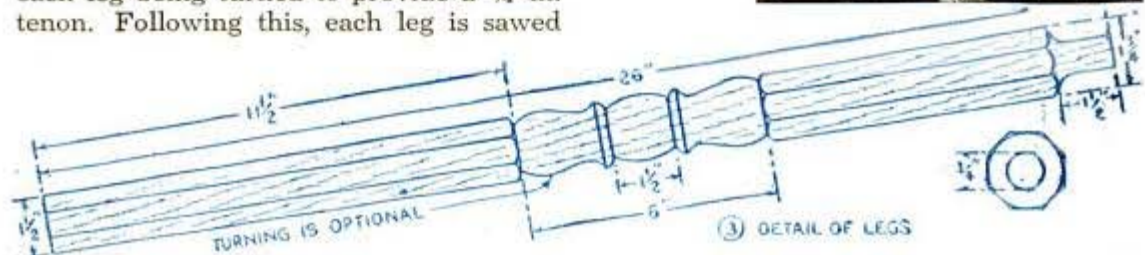
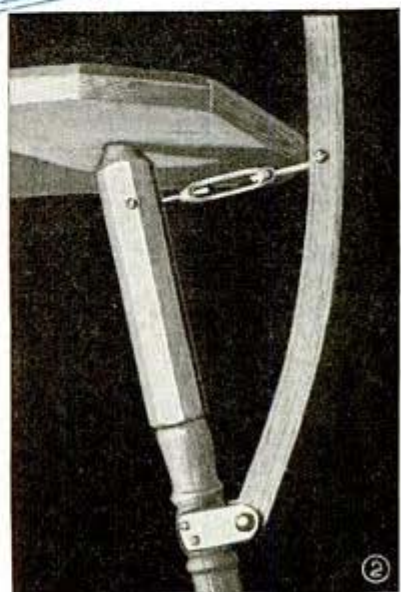


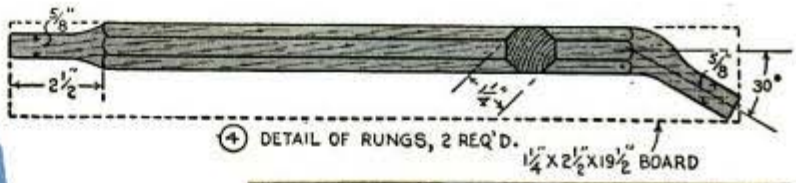
or Shop

Novel
WORK STOOL
has adjustable back

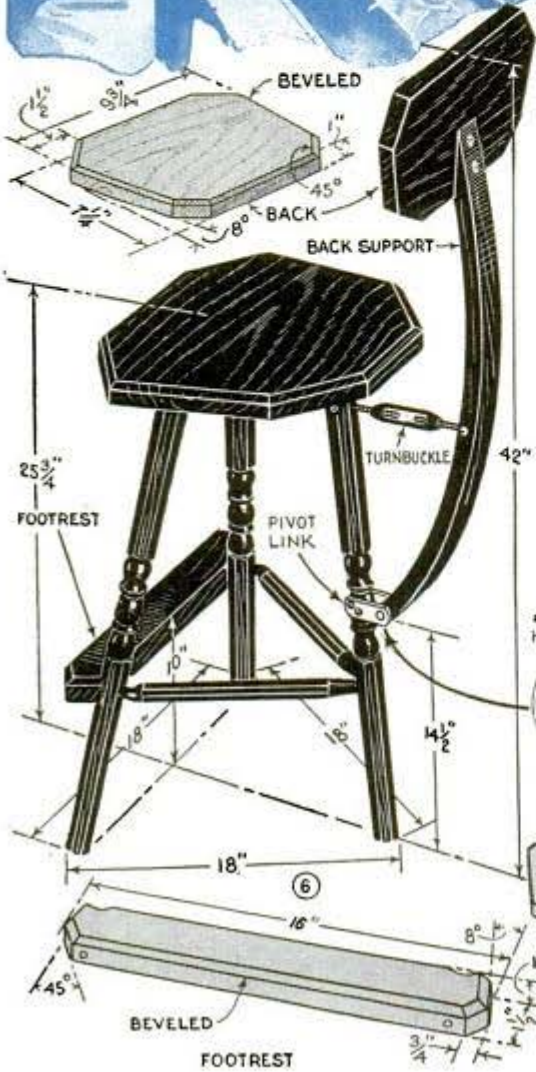
SUITABLE for use in either your kitchen or home workshop, the sturdy, well-designed stool shown in Fig. 1, has a back that can be adjusted quickly by means of a turnbuckle as in Fig. 2. Oak or maple is the best wood to use for making it, although other hardwoods will serve.

Begin construction with the three legs, which are turned to the dimensions given in Fig. 3, one end of each leg being turned to provide a $\frac{3}{4}$ -in. tenon. Following this, each leg is sawed





and planed to a straight, octagonal taper which reduces from $1\frac{3}{4}$ in. at the tenoned end to $1\frac{1}{2}$ in. at the lower end. The additional turning at the center of the leg is optional, but adds to the appearance of the stool. Two rungs are required. Due to the angle of the tenon at the rear end, it is necessary to saw these from stock that is $2\frac{1}{2}$ in. wide as indicated by the dotted lines in Fig. 4. This done, the major section of each rung is planed to an octagonal shape and the ends formed with a spokeshave as in Fig. 5, to provide tenons $\frac{5}{8}$ in. in diameter.



The seat, back and footrest are cut from 1-in. stock to the shapes and dimensions given in Fig. 6. It is well to guard against warping by making the seat in three pieces glued and doweled together. Special care must be taken when boring the $\frac{3}{4}$ -in. holes into which the leg tenons fit in order to give the legs the desired spread. An 8-in.

circle is scribed on the underside of the seat and the locations of the three holes are marked equidistantly on the circle, the rear one being located on the centerline of the seat. Then, $\frac{3}{4}$ -in. holes are bored into the underside, taking care to avoid letting the tip of the bit break through the top of the seat. The rear hole should be

bored at a 10-degree angle from the vertical so that the rear leg will extend outward. Then the two holes for the front legs are bored at a 15-degree angle. When boring these holes keep the bit lined up with radial lines drawn from the center of the circle to the points where the holes are started. Also, as an aid in getting the angles correct, you can use small blocks having one edge inclined the desired angle as a guide for the bit. The blocks are clamped to the seat while boring.

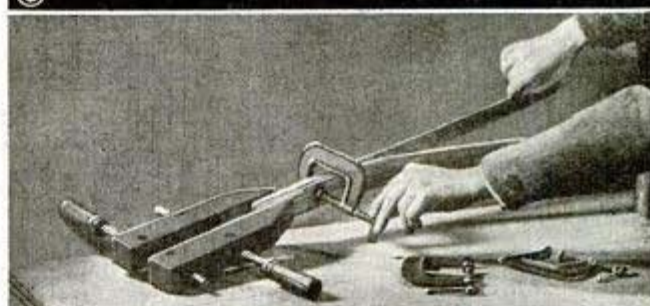
Next, without applying any glue, the legs are fitted into the seat holes and are marked to determine the position of the rungs and footrest. The holes for the rungs must be bored at an angle so that the rungs will be parallel

to the edge of the seat. Likewise, the footrest is notched to fit the front legs and is doweled or screwed to them. After this preliminary fitting has been done, the parts are reassembled permanently with glue.

The backrest is screwed and glued to a curved support piece, which is detailed in



8 First, two glue-coated strips are sprung around dowels set in a flat board and left 24 hrs. to dry

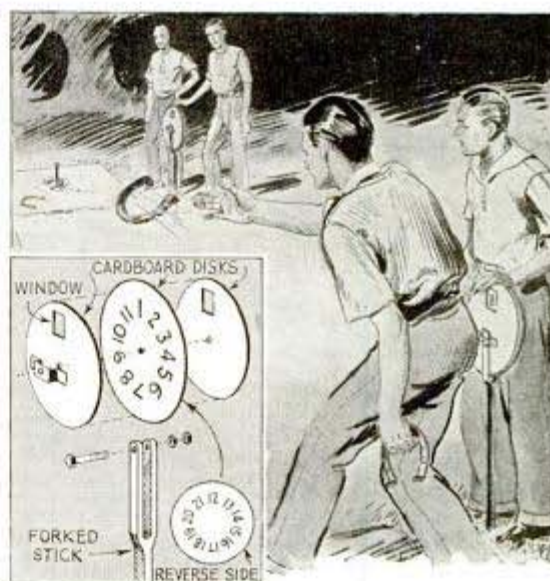


9 Then the two strips are removed from the form and additional strips are glued to them, one at a time, letting each one dry before adding the next

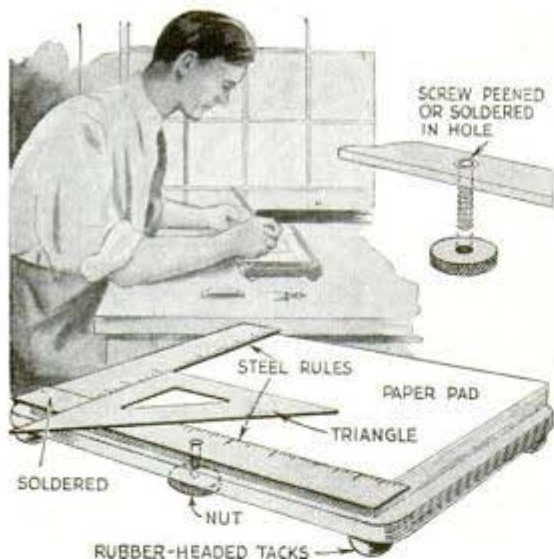
Figs. 7 to 9. Although it can be sawed from a single piece of hardwood it will be stronger if glued up from $\frac{3}{16}$ -in. strips, using a form to obtain the curvature. Pieces of flat iron screwed to the rear leg provide a pivot link for the back support and a 6-in. turnbuckle permits adjustment.

Horseshoe-Game Scoreboards Set in Ground at the Stakes

Keeping score in a horseshoe game with this scoreboard is just a matter of turning a cardboard disk each time a point is made. Opponents or teams each have one, which is pushed into the ground where it will be within easy reach. Each scoreboard consists of three cardboard or thin wood disks pivoted side by side in a forked stick or wooden support shaped as shown. The center disk is numbered on one side from 1 to 11 and on the reverse side from 12 to 21, the numbers being positioned so they can be seen one at a time through windows cut in the two side disks. The center disk is slightly larger in diameter than the other two so it can be turned by pressing on the edge with the fingers. A coat of paint applied before the numerals will help preserve the scoreboard.



Sketching Board Has "T-Square" Built-In Along Sides



Anyone needing a small sketching board that can be carried to various places in a shop will find this one ideal. A supply of sketching paper is carried right on the board. A board of the desired size is selected and two steel rules attached along one side and end. The rules are silver-soldered together to form an accurate right angle, after which the one along the side is fitted with a screw peened and soldered in place to take a knurled nut on the underside of the board. This screw makes it possible to hold the square in position and to clamp the paper in place. The rules serve the same purpose as a T-square on a regular drawing board, making it possible to draw almost any lines desired with the aid of 45-degree and 30-60-degree triangles. A small piece of metal soldered on the square where the right angle is formed acts as a guide for a triangle when working so close to the edge of the board that the rules cannot be used.

—R. Boettinger, Englewood, N. J.

Palm Plate to Rotate Screwdriver With One Hand



If your work requires the use of a screwdriver, this ball-bearing palm plate will enable you to press against the driver with one hand

while turning it with the other to tighten a screw. The plate is nothing more than an old auto valve inserted into a hole drilled into the end of the screwdriver handle. The valve stem is cut off to shorten it and a ball bearing is placed in the bottom of the hole for the valve to bear against.

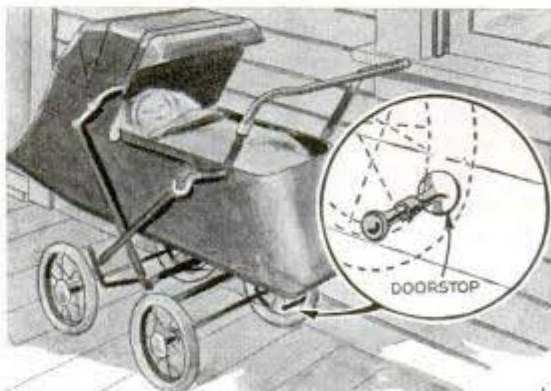
Perforated Can Aids in Cleaning Dirty Paint Brushes

You will find that paint brushes can be cleaned more easily if the bottom section of a tin can is perforated and dropped into the cleaning container in an inverted position. The perforations provide a good scrubbing surface against the bristles, and they also allow the dissolved paint to settle to the bottom of the container away from the brush.



Doorstop Keeps Baby Carriage From Rolling Off Porch

To avoid any possibility of a baby carriage rolling off a porch, especially on a windy day, one mother fastened a doorstop

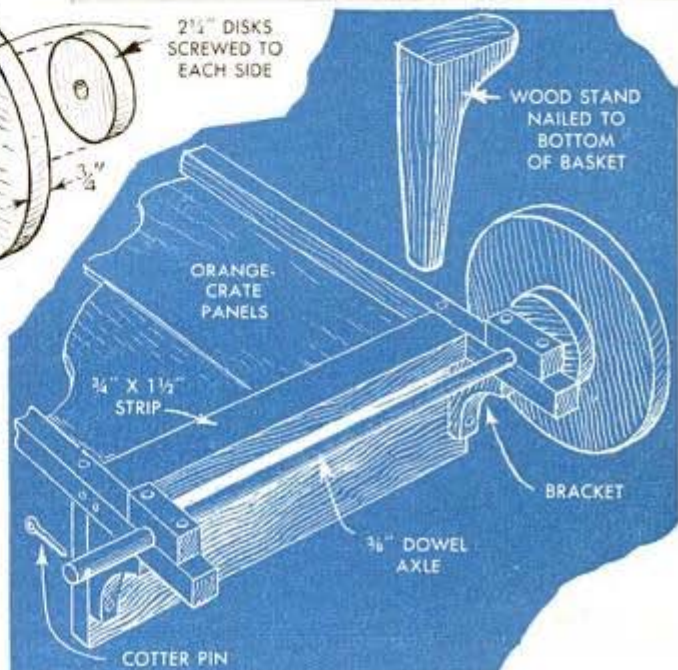
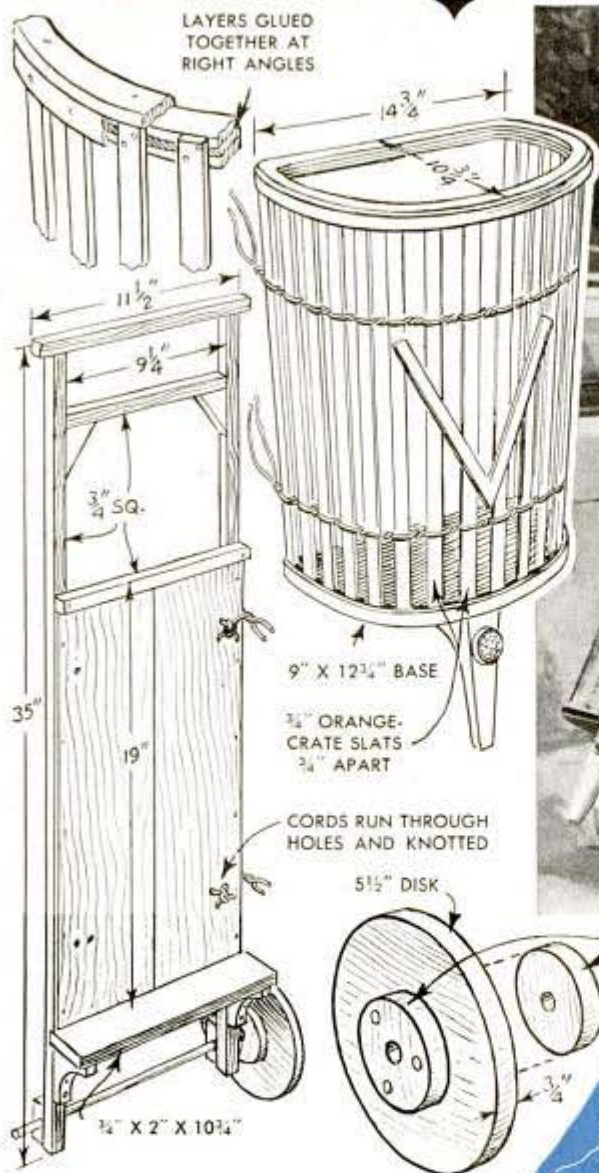


into the side of the porch to engage the spokes of one wheel as shown. This idea is especially useful if the carriage has no brakes, or if they are ineffective.

☛ To keep your bathroom tiles glistening, dip a soft cloth in kerosene and rub over them. Wash with warm water and dry.

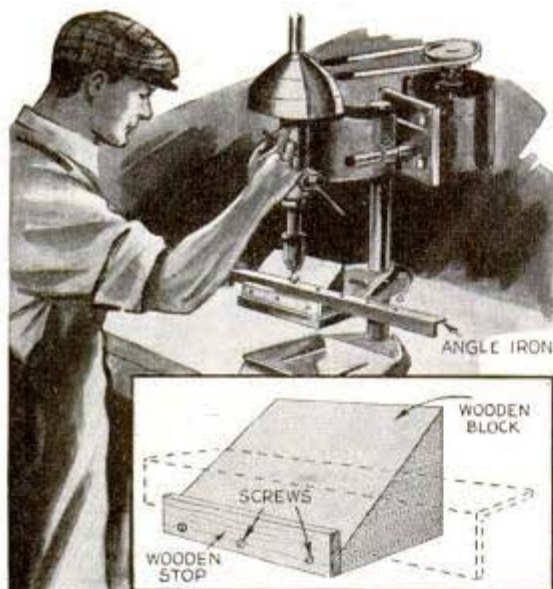
Economy "PUSHBASKET"

carries your groceries



Built almost entirely from orange crates at no cost, this pushbasket will carry up to 50 lbs., and rolls easily even when fully loaded. Two crates will supply sufficient material except for the two long frame members of scrap wood. Cross braces, wheels and basket base are cut from the crate ends, and the basket slats are ripped from the thin stock. The basket rim is glued up from the same material. Rigidity is added by weaving cords through the slats near the upper and lower ends

Block to Hold Angular Work On Drill-Press Table



When it is necessary to handle angular work, such as angle iron, on a drill press for drilling and countersinking holes where one side of the work must be kept in a flat, horizontal position, this block will be handy. Its long sloping side permits different sizes of work to be held in the correct position without making any changes.

Mud Stains on Clothes Removed By Serrated End of Hose

To remove dried mud stains from garments brought in for pressing, one tailor made an eraser for the end of his whisk-broom handle. The eraser consisted of a



short piece of rubber hose serrated at one end. The eraser is employed to loosen the dried mud, after which the broom is reversed to brush it from the fabric.

Nails Staggered in Roll Roofing To Prevent Loose Joints

One reason for loose joints and torn edges of roll roofing is that there is usually a tendency to drive closely spaced nails in line, which splits the board underneath. Hence, it's always a good idea to stagger the nails so that those in line are at least twice as far apart as they would be ordinarily. Better still, on roofs exposed to high winds, drive the two rows of nails in broken lines.



On roofs exposed to high winds, drive the two rows of nails in broken lines.

Pour "Spout" Cut in Paint Can

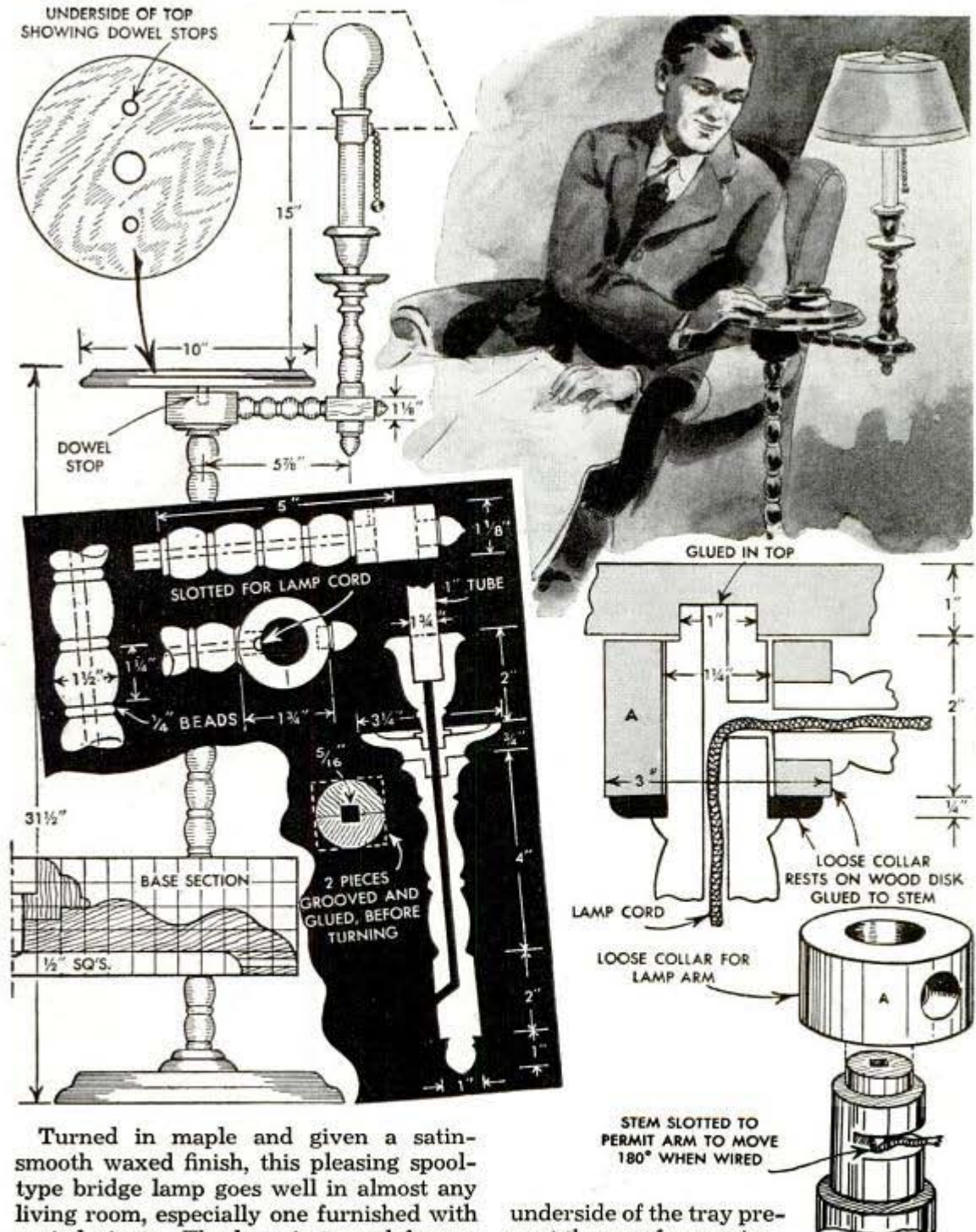


A beverage can opener of the type shown will enable you to solve the problem of removing all the paint from a can having a friction lid. Just punch a hole in the side of the can at the rim as indicated and every drop of the paint will drain out. Of course, this shouldn't be done when the entire contents of the can are not to be used at one time, as it would be difficult to seal the can after the hole has been punched in it.

WRITE FOR POPULAR MECHANICS!

Readers are paid cash for ideas printed on these pages. You too may know of a simpler, faster or better way to do some daily chore about the home, farm, office, shop or garage; an aid to amateur photographers, model makers, workshop fans, car owners, hobbyists, etc. Or, perhaps it's something of unusual juvenile appeal. Just send a short but complete description plus a sketch or photo to the Homecraft Editor of Popular Mechanics. Checks sent promptly for accepted ideas.

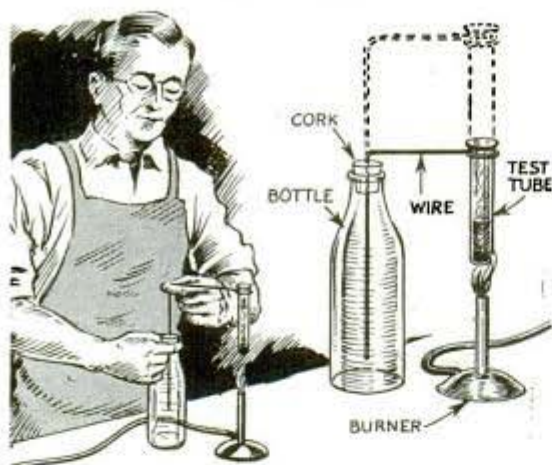
Bridge Lamp Has a Swing Top and Handy Tray



Turned in maple and given a satin-smooth waxed finish, this pleasing spool-type bridge lamp goes well in almost any living room, especially one furnished with period pieces. The base is turned from a block built up by gluing together two or three pieces of wood with the grain at right angles. Each of the spool-shaped parts that carry the lamp cord consists of two pieces which are grooved before they are glued together. The swinging arm is held on a wooden collar, detail A, that rotates on the standard and two stop pins on the

underside of the tray prevent the arm from swinging more than halfway around. To permit the cord to move inside the collar, the top end of the standard is slotted. A candle-type socket and shell can be obtained at most five-and-dime stores. To prevent easy tipping of the lamp, the base should be weighted by recessing it to take a piece of lead or other suitable weight.

Emergency Test-Tube Support From Wire and Bottle



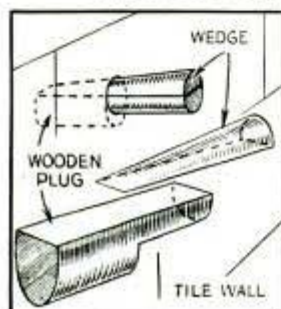
An emergency support to hold a test tube over a burner flame may be made by bending a length of wire to the shape indicated and inserting it through the cork of a tall bottle. The cork provides sufficient friction to hold the wire at any desired height.

Safe Holder for Pair of Scissors Fastened to Side of Drawer

A pair of scissors will not present any serious danger in a sewing-machine drawer if they are kept in a holder of the type shown. To make it, cut a piece from one end of a flat, telescoping curtain rod and tack this to the inside of the drawer. It may be necessary to bend the sides to fit the particular pair of scissors at hand.



Putting Wood Plug Permanently In Wall of Hollow Tile

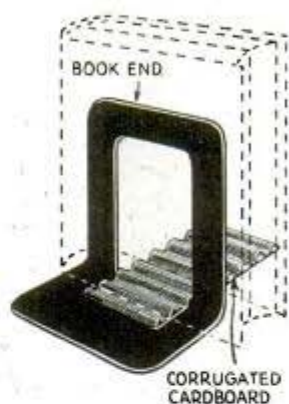


The next time you want to put wooden plugs in a hollow-tile wall for the attachment of a shelf or to hang a picture, try the method shown of installing the plug. First drill a

hole about 1 in. in diameter into the wall. Then make a shouldered plug like the one shown in the lower detail, and also a wedge. Insert the shouldered plug into the hole with the shoulder inside the tile and drive in the wedge. This will lock the assembly in place so it will not crack the tile, which often happens if a solid plug is used.

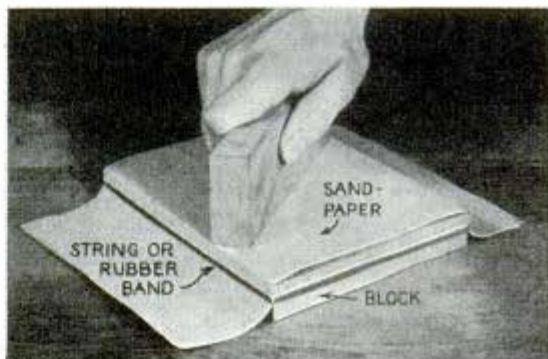
"Invisible" Supports Hold Books In Store-Window Display

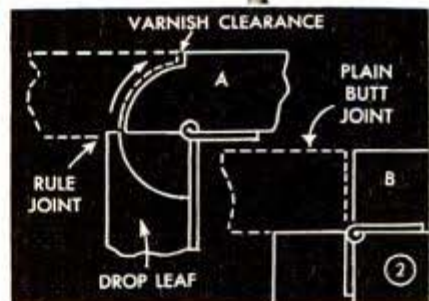
Where closed books are displayed individually in a store window, they can be held in a vertical position by "invisible" supports made from metal bookends of the type shown. To adapt such bookends for the purpose, pieces of corrugated cardboard are slipped through the openings in them, after which they are inserted between the pages of closed books. As the lower ends of the covers rest in grooves provided by the cardboard, the books are kept closed so they can be moved easily when arranging the display.



Sanding Block Attached to Bench Is Always at Hand

When you have a number of small parts to sand, screw a block of wood to the bench top or other convenient surface and fasten the sandpaper to it with a string or rubber band. In this way, both hands are left free to hold the work. And, as the block is attached permanently, it is always at hand and ready for use when needed.





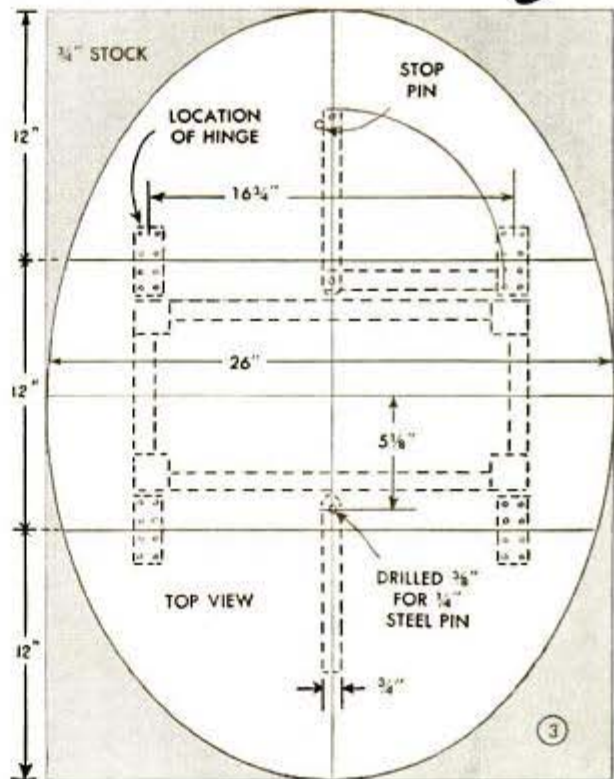
Maple

BUTTERFLY TABLE of Colonial Design

By W. B. Martin

PLACED at a chair or davenport, this table gives variable top space as it can be used with both leaves dropped down as shown in Fig. 1, or with only one leaf extended. And, when both leaves are extended, you have a serviceable coffee table. In keeping with the colonial design, maple is the best wood to use in making it, but it also looks well in other woods.

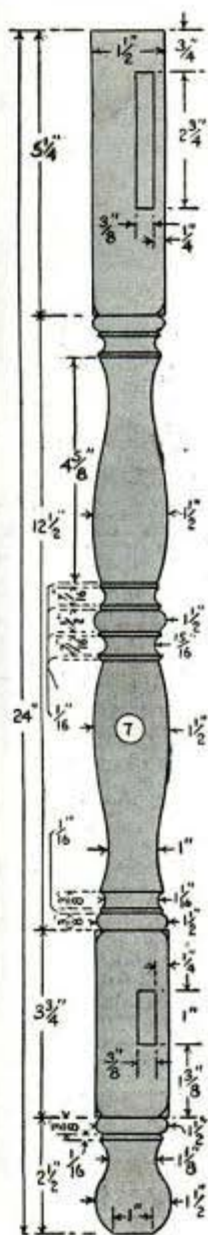
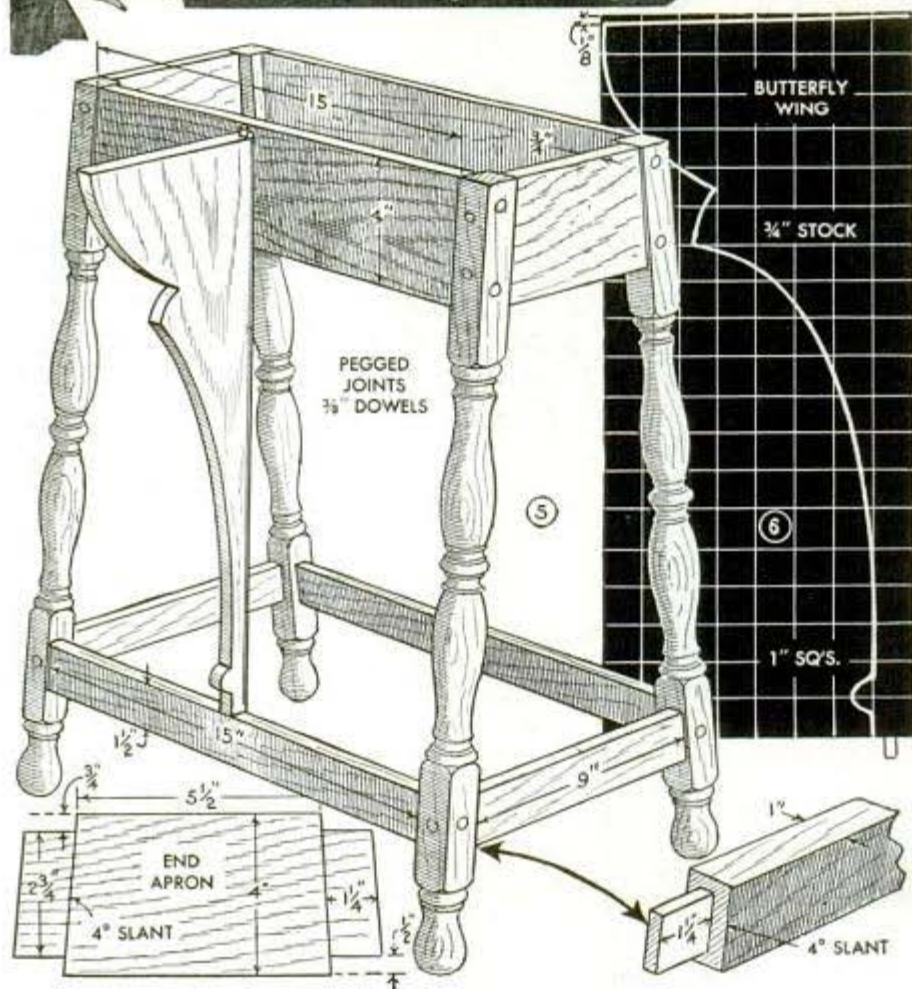
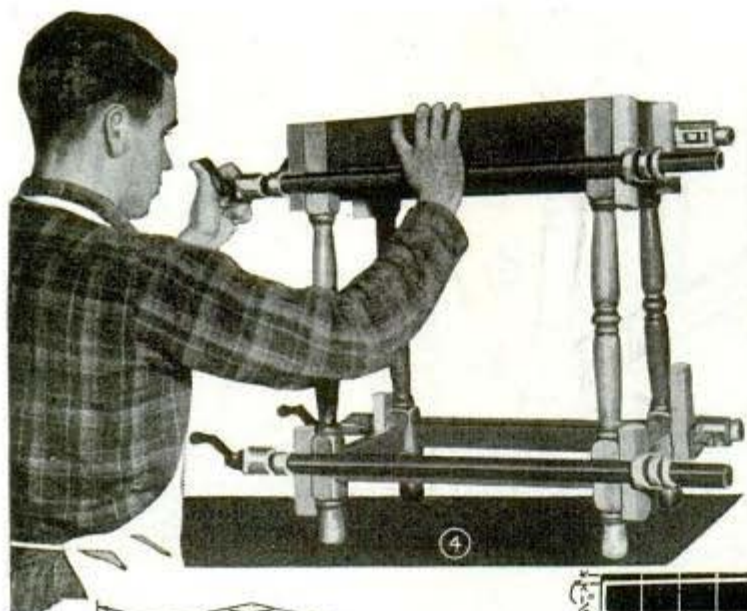
As with most tables, the legs are made first. These are cut from $1\frac{5}{8}$ -in. stock, squared to $1\frac{1}{2}$ in. and then turned to the dimensions given in Fig. 7. A jig like the one in Figs. 8 and 9 should be used in mortising the legs and cutting tenons on the rails and stretchers. It is made by fastening a block onto a square base $23\frac{1}{2}$ in. long. The block is 4 in. long and one surface is sloped $1\frac{1}{2}$ in. in 12 in. which corresponds to the angularity of the legs. Another block at the opposite end acts as a stop.



The rails and stretchers are cut to the dimensions given in Fig. 5. It is best to make the angular cuts for the end pieces with the aid of the jig. Rails should be cut first and then clamped with the tenons in the mortises of the legs. The length of the stretchers can then be checked against the

length shown in the drawings. When making the cuts with the jig, it will be necessary to lay a narrow piece between the jig and the work, as the blocks are not close enough to support the work. After all tenons have been cut, the table can be clamped together, Fig. 4, the legs marked and the top ends cut off flush with the top of the rails. These parts can then be glued and clamped permanently.

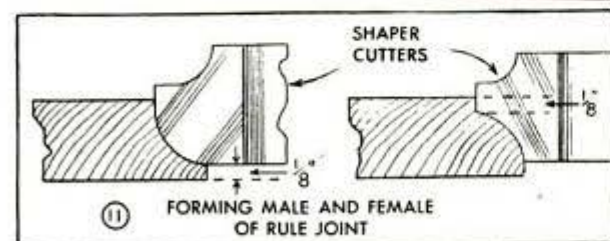
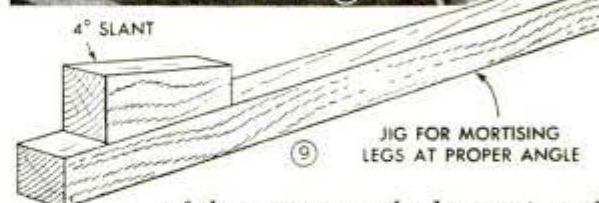
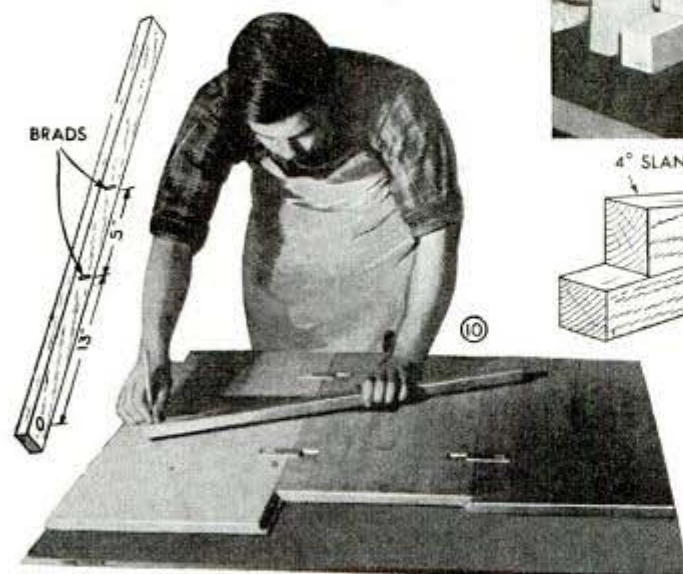
The table top is next, and consists of a center piece and two drop leaves. It is important that all the pieces be planed to the same thickness, otherwise difficulty



will be experienced in shaping the edges and in hinging the leaves to the center piece. You can use a plain butt joint between the leaves and center piece, or you can use a rule joint, Fig. 2, which is better looking but more difficult to make. The rule joint can be made best on a shaper as in Fig. 11, but don't forget to allow clearance for the thickness of varnish coats at the close-fitting upper edges.

After the joints have been completed, the hinges should be screwed in place and the top cut out to an oval as indicated in Fig. 3. The oval can be laid out with the aid of a marking stick as in Fig. 10. To make it, drill a hole $\frac{1}{2}$ in. from one end to take a lead pencil. Drive two brads into the stick, one 13 in., the other 18 in. from the pencil.

Lay out the axis on the underside of



the table top by drawing two centerlines to intersect in the center of the table and form four right angles. Place a large carpenter's square on the lines so that the outside edges are directly over the lines with the corner at the junction of the lines, and clamp it in this position. Then put the marking stick over the square so the brad, 13 in. from the pencil, is against the edge

of the square on the long axis and the other brad is against the edge on the short axis. By keeping the brads against the edges of the square as the pencil end of the stick is swung around, one quarter of the oval can be drawn. This same operation repeated four times, with the square moved to the other positions, will result in a perfect oval.

The wings or leaf supports are the last parts to be cut out as in Fig. 6. The wings are pivoted to the stretchers and top center piece with steel pins. The proper angle at the top edges of the supports can be determined with a sliding T-bevel and the wings cut to this angle. The table can be finished as desired. If a wax finish is used, it is advisable to raise the grain two or three times by wetting before the stain is applied, sanding after wetting the wood each time to remove the raised wood fibers. Wax, of course, must be applied in two or three applications and rubbed in thoroughly between coats.

Small Can Hinged Under Bench Is Handy Match Extinguisher



To avoid the possibility of fires from used matches thrown about the bench or floor, punch a hole in the lid of a tobacco can and nail it under the bench ledge. Then drill a hole through the bench top so that burned matches can be dropped into the can. The latter may be emptied from time to time by tipping it as indicated.

Bucksaw Blade on Straightedge Rough-Finishes Sloping Walk

When making a sloping sidewalk that should have a rough finish so that it will not be slick when wet or frosty, an old bucksaw blade nailed to a straightedge will enable you to roughen the concrete easily before it sets. The blade is moved back and forth while sliding the straightedge over the fresh concrete, leaving a rough but



neat design of grooves in the surface. Depth of the grooves is determined by the projection of the saw below the straightedge.

Mallet Used to Stretch Webbing

An emergency tool for stretching and holding strips of webbing on upholstery jobs can be made quickly by wrapping and tacking a sheet of sandpaper around the handle of a wooden mallet.



By placing the mallet head against the board to which the webbing is to be attached, and gripping the webbing against the sandpaper, it can be held firmly while stretching it tightly.

Rivet Heads Stuck to Metal Tube By Belt Dressing



Where two pieces of large-diameter tubing are riveted together, the difficulty of holding the rivets in place while slipping the pieces over a mandrel for peening can be overcome by scraping each rivet head over a stick of belt dressing. Thus, when the rivets are inserted through the holes, a little pressure will stick them to the metal while slipping the tubing over a mandrel.

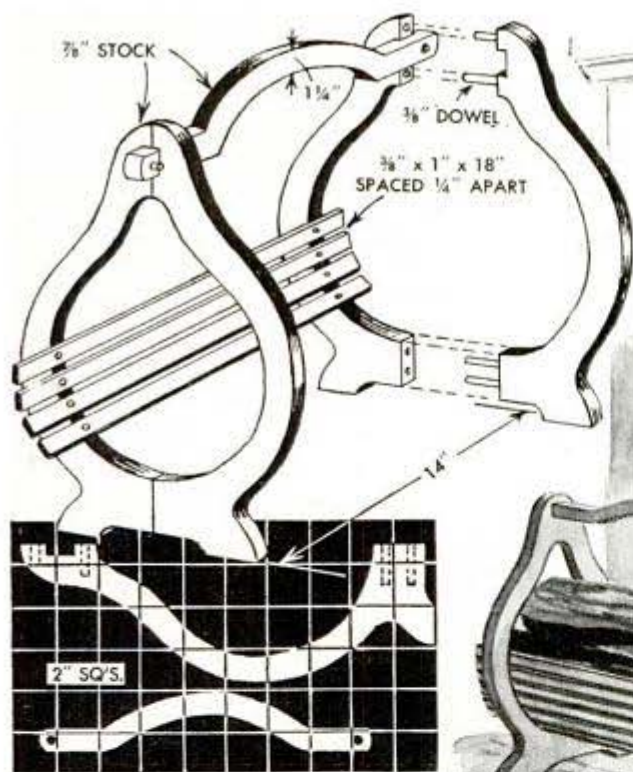
Windows in Metal Lunch Box Permit Quick Inspection

Disliking to remove the contents of his lunch box for inspection when entering the defense plant where he was employed, one workman put windows



in the box so that the inspector could see inside. The windows were made by cutting openings in the box and cementing celloid over them. The windows were cut in both sides and ends of the box.

An Attractive Wood Basket at Your Fireplace



Appropriate in size and shape for any fireplace, this wood basket consists of only five pieces glued and doweled together, and a number of slats that form the bottom. If spacing between the slats is not desired, they can be laid together snugly. An advantage of a handle running lengthwise is that the basket can be carried more conveniently than one having a handle crosswise. Although it can be painted, a natural oiled and waxed finish is popular, or the wood can be adzed and gouged for a rough-hewn

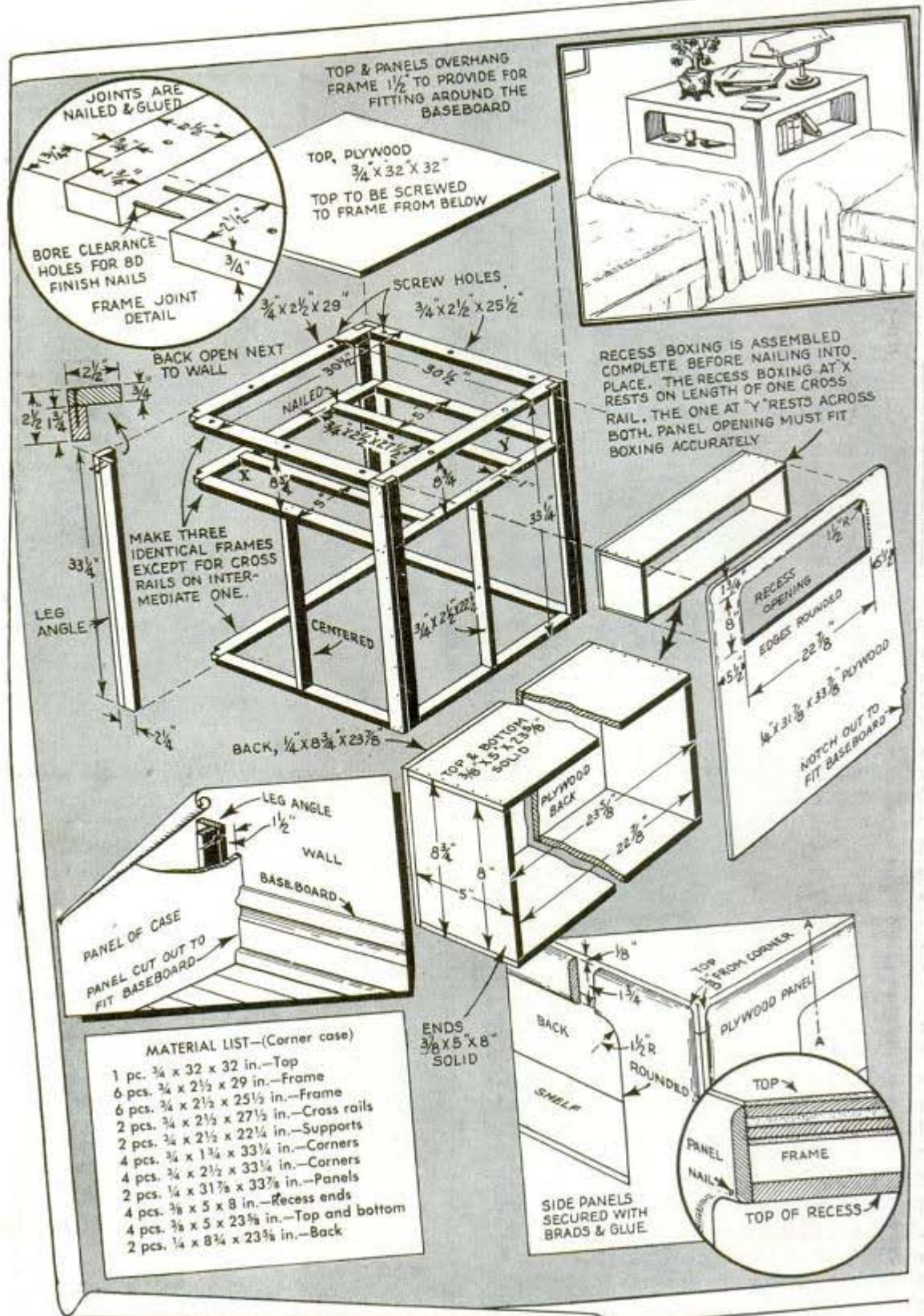
effect. Another finish is that of old hammered brass, obtained by tapping the surface with a ball-peen hammer, and then bronzing it, after which an antique effect is produced by applying a coat of dull black paint and then wiping it off.

Razor Blades Wiped on Cleansing Tissues to Save Towels

If the menfolk in your home sometimes accidentally cut face towels when using them to dry their razor blades, keep a cleansing tissue handy for them to use instead of a towel. A good way to do this is to attach a spring-type clothespin to the wall near one end of a towel rack to hold the tissue. This arrangement makes it easy to change a tissue when it becomes soiled. A couple of small screws through one leg of the pin will hold it. You will have to take the pin apart to drive the screws and then reassemble it.



HEADBOARD CASES *for*

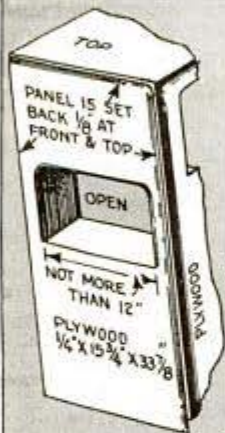


- MATERIAL LIST—(Corner case)**
- 1 pc. $\frac{3}{4}$ " x 32" x 32 in.—Top
 - 6 pcs. $\frac{3}{4}$ " x $2\frac{1}{2}$ " x 29 in.—Frame
 - 6 pcs. $\frac{3}{4}$ " x $2\frac{1}{2}$ " x $25\frac{1}{2}$ " in.—Frame
 - 2 pcs. $\frac{3}{4}$ " x $2\frac{1}{2}$ " x $27\frac{1}{2}$ " in.—Cross rails
 - 2 pcs. $\frac{3}{4}$ " x $2\frac{1}{2}$ " x $22\frac{1}{4}$ " in.—Supports
 - 4 pcs. $\frac{3}{4}$ " x $1\frac{1}{4}$ " x $33\frac{1}{4}$ " in.—Corners
 - 4 pcs. $\frac{3}{4}$ " x $2\frac{1}{2}$ " x $33\frac{1}{4}$ " in.—Corners
 - 2 pcs. $\frac{1}{4}$ " x $3\frac{1}{8}$ " x $33\frac{3}{8}$ " in.—Panels
 - 4 pcs. $\frac{3}{8}$ " x 5" x 8 in.—Recess ends
 - 4 pcs. $\frac{3}{8}$ " x 5" x $23\frac{3}{8}$ " in.—Top and bottom
 - 2 pcs. $\frac{1}{4}$ " x $8\frac{3}{4}$ " x $23\frac{3}{8}$ " in.—Back

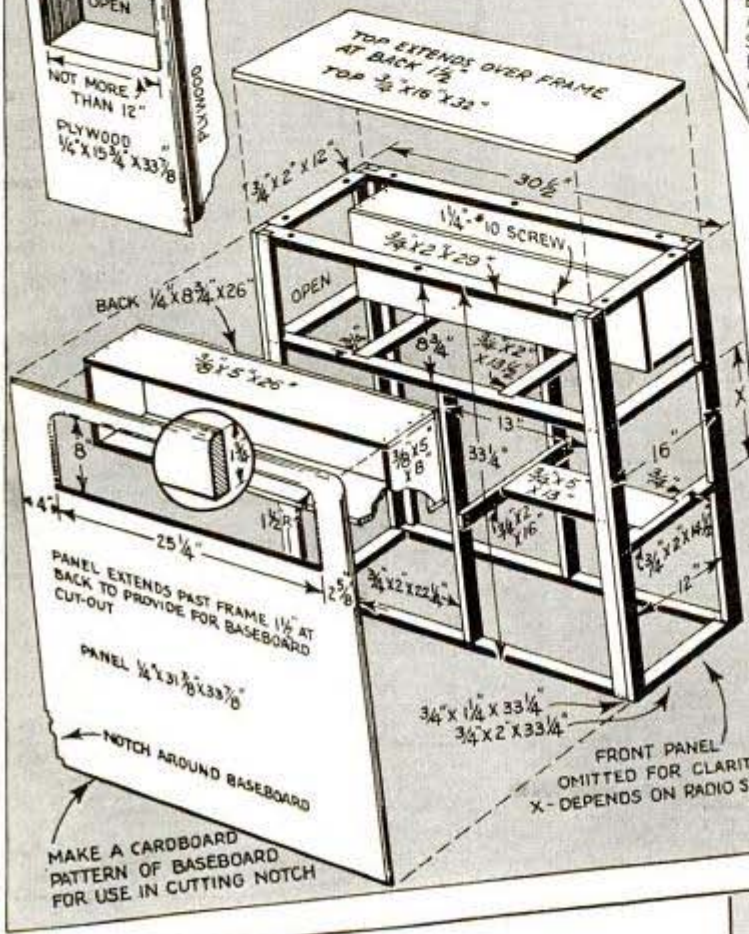
TWIN STUDIO BEDS

MATERIAL LIST—(Center case)

- 1 pc. $\frac{3}{4}$ x 16 x 32 in.—Top
 - 6 pcs. $\frac{3}{4}$ x 2 x 29 in.—Frame
 - 6 pcs. $\frac{3}{4}$ x 2 x 12 in.—Frame
 - 2 pcs. $\frac{3}{4}$ x 2 x 13 $\frac{1}{2}$ in.—Cross rails
 - 2 pcs. $\frac{3}{4}$ x 2 x 22 $\frac{1}{2}$ in.—Vertical supports
 - 1 pc. $\frac{3}{4}$ x 2 x 14 $\frac{1}{2}$ in.—Rail
 - 1 pc. $\frac{3}{4}$ x 2 x 16 in.—Rail
 - 1 pc. $\frac{3}{4}$ x 5 x 13 in.—Shelf
 - 4 pcs. $\frac{3}{4}$ x 2 x 33 $\frac{1}{4}$ in.—Corner posts
 - 4 pcs. $\frac{3}{4}$ x 1 $\frac{1}{4}$ x 33 $\frac{1}{4}$ in.—Recess ends
 - 4 pcs. $\frac{3}{8}$ x 5 x 8 in.—Recess ends
 - 4 pcs. $\frac{3}{8}$ x 5 x 26 in.—Recess top and bottom
 - 2 pcs. $\frac{1}{4}$ x 8 $\frac{3}{4}$ x 26 in.—Recess back
 - 1 pc. $\frac{1}{4}$ x 15 $\frac{3}{4}$ x 33 $\frac{3}{8}$ in.—Front panel
 - 2 pcs. $\frac{1}{4}$ x 31 $\frac{3}{8}$ x 33 $\frac{3}{8}$ in.—Side panels
- Note: Material for front recess is not listed



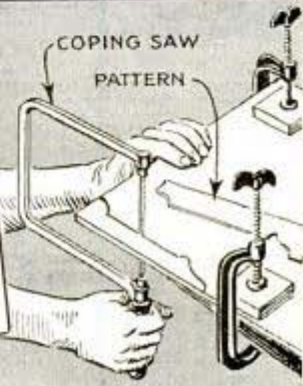
RECESS AT END TO BE MADE TO FIT YOUR RADIO. ELECTRICAL CONNECTIONS FOR RADIO SHOULD BE CARRIED INSIDE THE CABINET



BORE $\frac{1}{2}$ " HOLES AT CORNERS. START CUT WITH KEYHOLE SAW AND FINISH WITH PANEL SAW



COPING SAW PATTERN



PANELS ARE COPED OUT TO FIT BASE BOARD

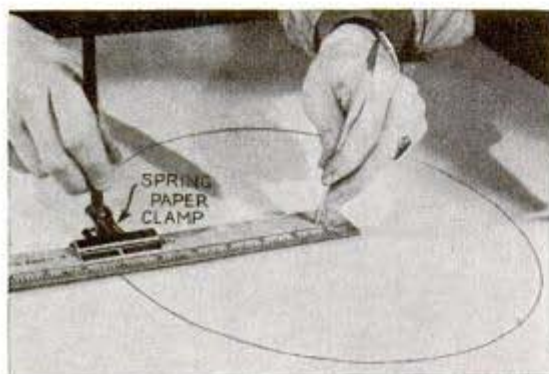
Table Drawer Provides Support For Small Sketching Board



If you occasionally have to use a small sketching board and wish to avoid the expense of purchasing an adjustable support for it, an improvised one can be provided by using a table or desk drawer. This is done by cutting the board so that the lower end will slide into the drawer vertically. Then, screws or nails are driven into opposite edges to slip into angle slots sawed into the drawer sides. When set in this position, the board is adjusted easily by resting it against the edge of the table top and moving the drawer in or out.

Handy Compass Assembled Easily From Ruler and Paper Clamp

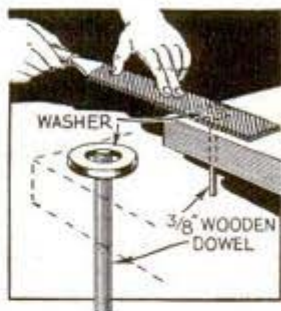
Ideal for drawing circles that do not have to be absolutely accurate, this improvised compass is assembled from a ruler with a hole near one end, a spring-type paper clamp and two pencils. In use, just insert the eraser end of one pencil in the ruler hole to form the axis, and slide the clamp along the ruler until it corresponds with



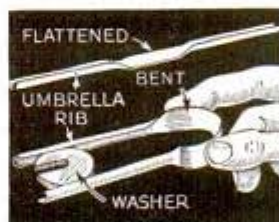
the desired radius. Then, drop the other pencil into the handle holes of the spring clamp. To help line up the clamp with ruler markings, a center mark should be painted or filed on one of the clamp jaws.

Dowel Stop in Workbench Top Holds Washers While Filing

When it is necessary to reduce the thickness of a few washers for use on certain kinds of jobs, drill a hole through your workbench to take a length of $\frac{3}{8}$ -in. dowel snugly. This may be driven up to the desired height to hold the washer. When not in use, the dowel is driven down flush with the bench surface.



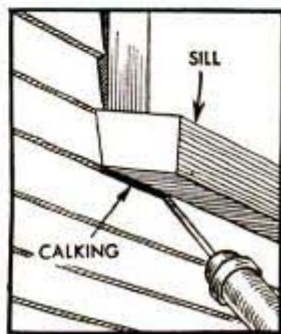
Tweezers Insert Valve Keepers In Hard-to-Reach Places



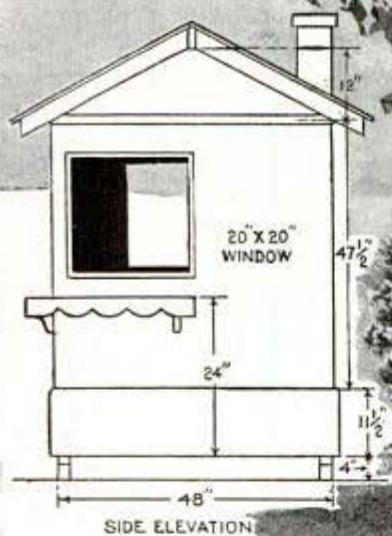
The job of inserting engine-valve keepers and other split washers in places that are hard to reach can be simplified by using a pair of tweezers like the ones shown. They are made from a length of umbrella rib, which is flattened in the center and then bent to the shape indicated. There is enough spring in the rib to hold a washer.

Calk Underneath Window Sills

When you calk a window, always run a line of compound underneath the sill as indicated. In older buildings shrinkage of siding and sheathing often opens a crack under the sill and allows cold air to come in around the lower part of the window frame.

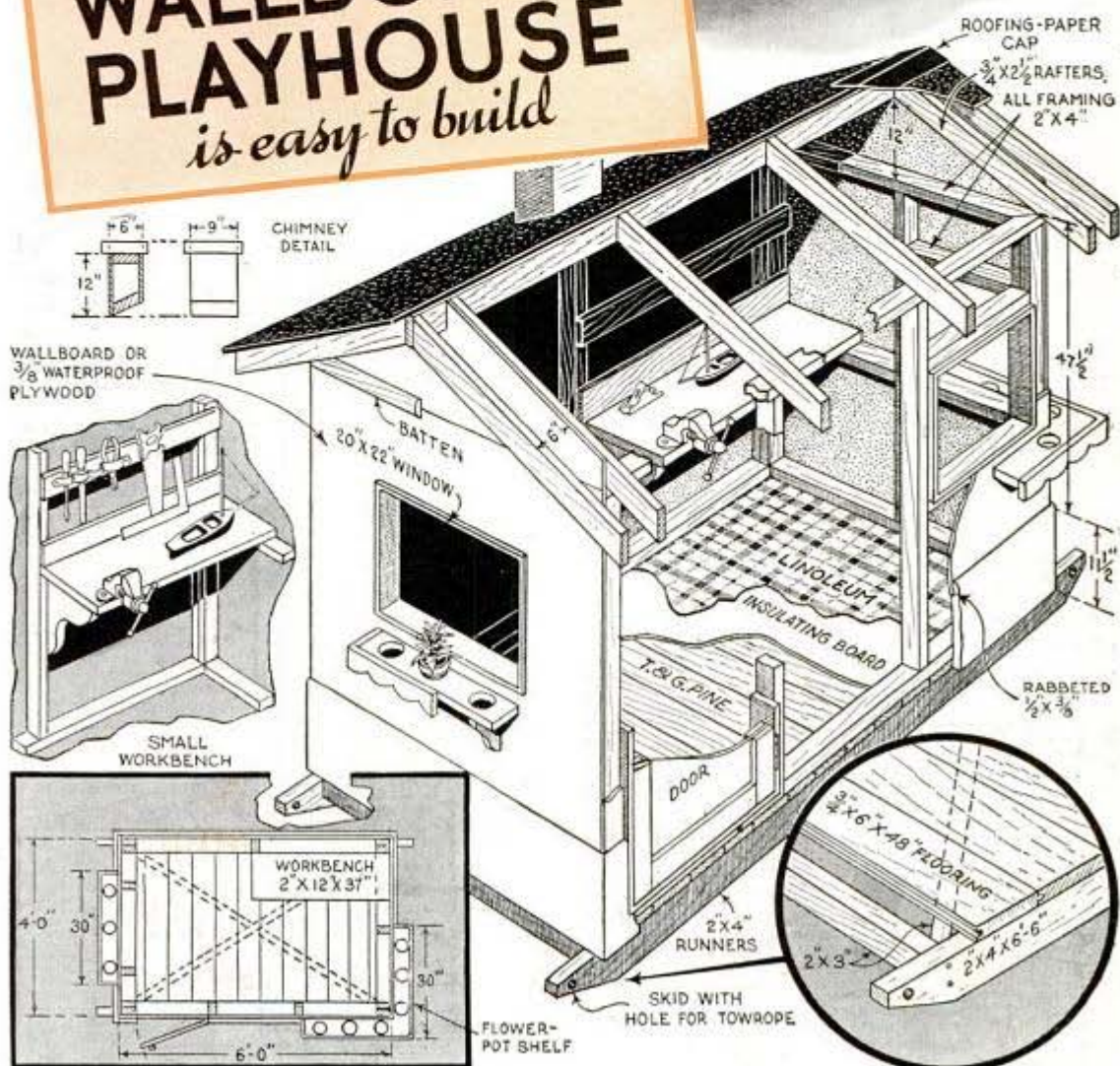


—W. C. Lammey, Sandwich, Ill.



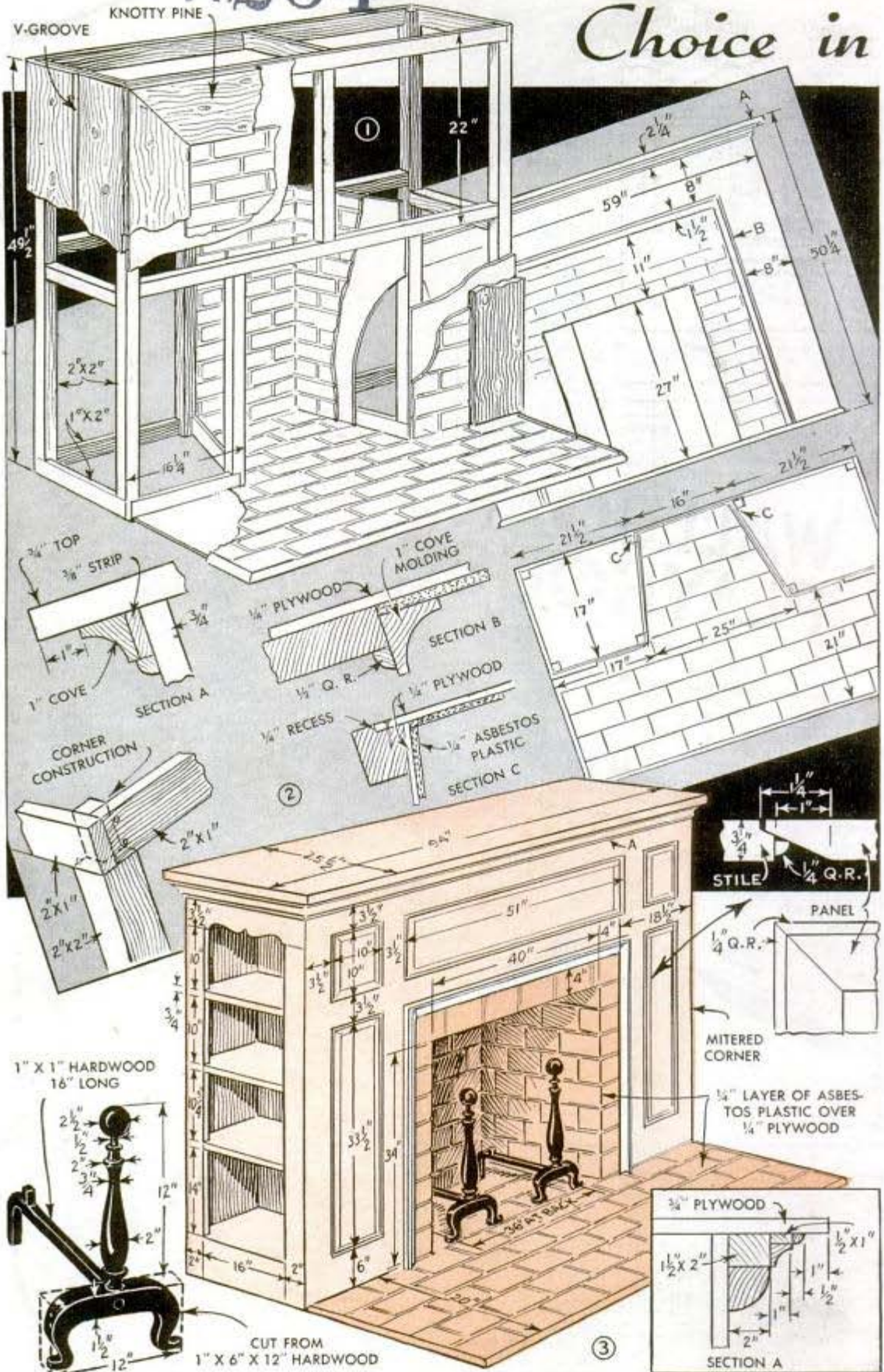
WALLBOARD PLAYHOUSE

is easy to build



X284

Choice in



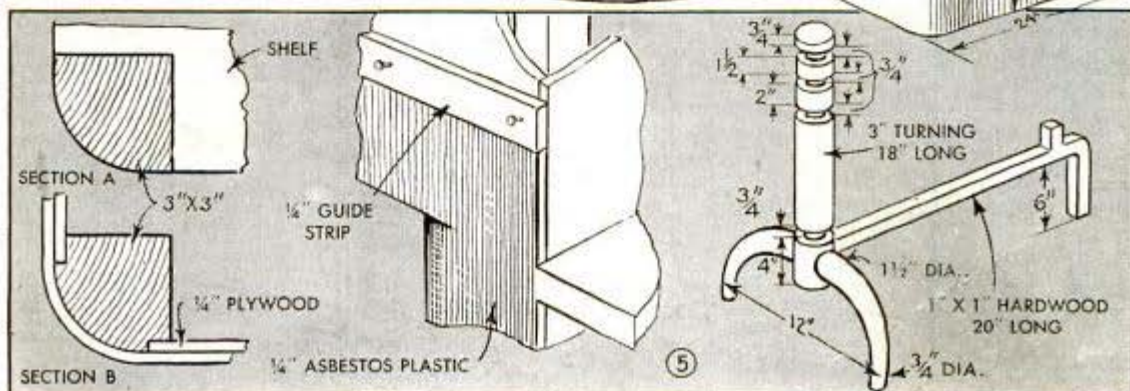
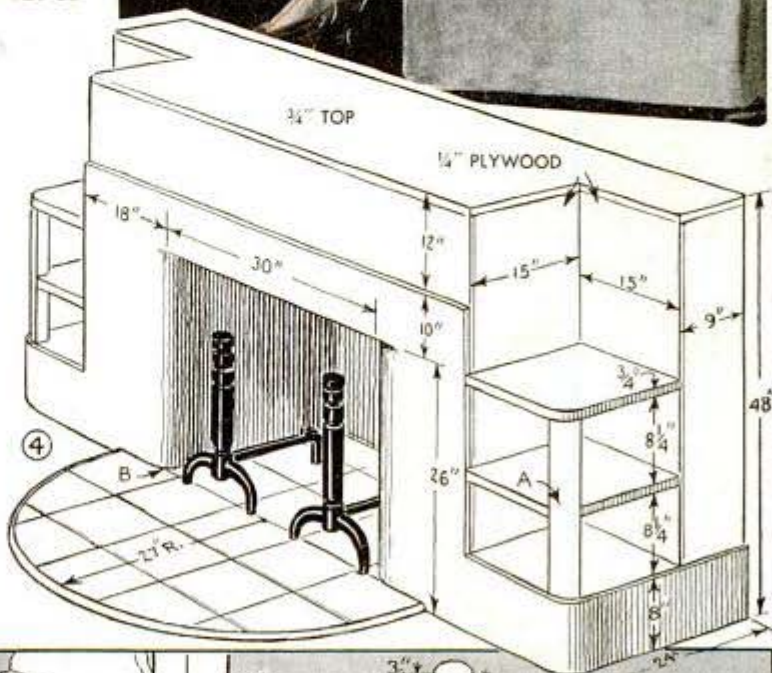
Imitation FIREPLACES

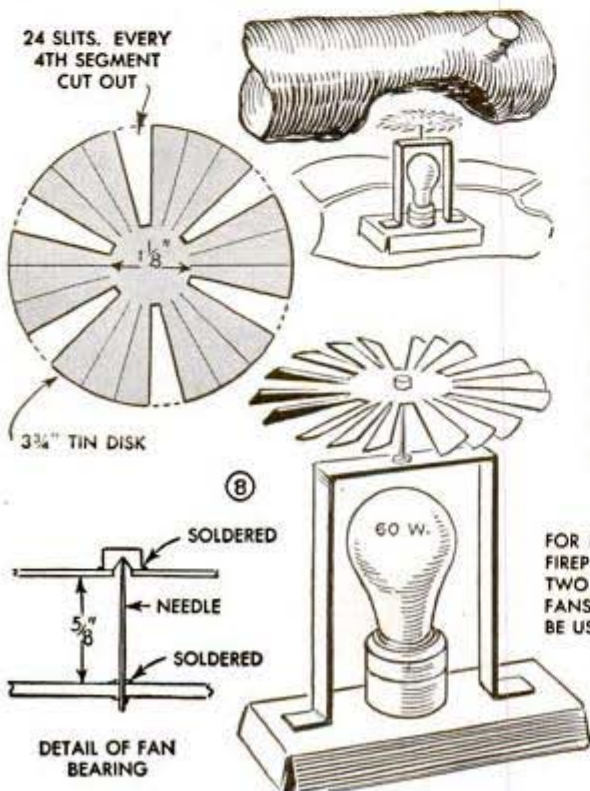
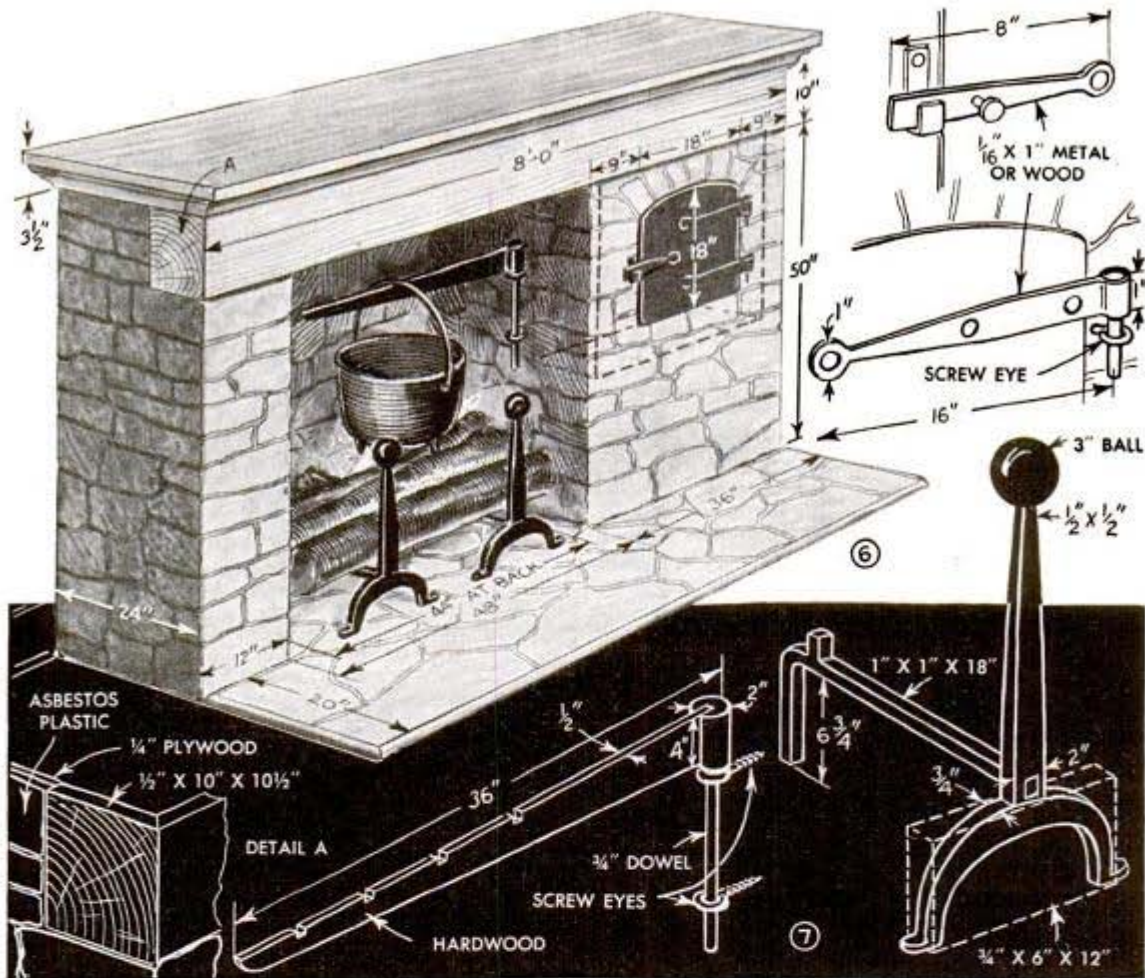
Four practical designs incorporating built-in book shelves and storage space. Plastic coating is applied and molded to imitate brick and stone

By Carl W. Bertsch

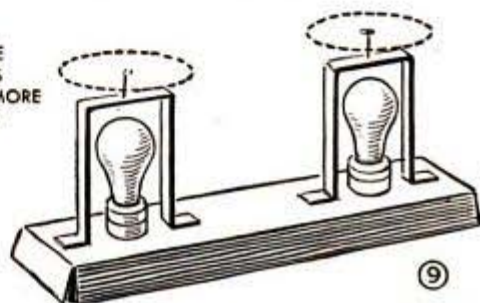
SO REALISTIC looking are these imitation fireplaces, you'll find it difficult to distinguish them from the real thing, especially when they are fitted with homemade wooden andirons and a "glowing" log. Among the four designs given there is one to suit practically any setting, from a modern living room to a den of knotty pine. The hearth of each is a separate unit from the rest of the fireplace for easy handling when moving.

Construction is basically the same for all, that is, a rough framework similar to the one shown in Fig. 1, is made first, which is covered with plywood before adding the finished trim and the imitation brick or stone. Slight variation of this procedure will be noted in the construction of the modern fireplace detailed in Figs. 4 and 5, as no inner plywood covering is necessary here. In case you are unable to obtain 1/4-in. plywood, some of the bet-



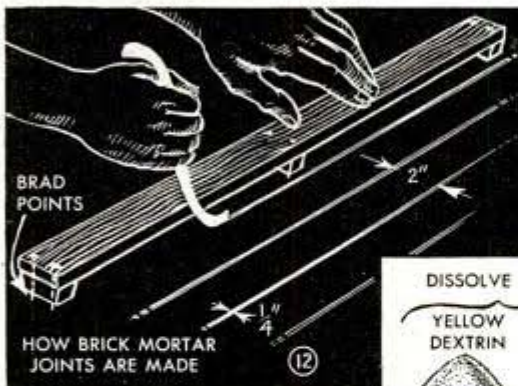


ter grades of wallboard, as well as hard-pressed board, will do. Figs. 1 and 2 detail a neat little fireplace that is especially suitable for apartment use, while the one in Fig. 3, being considerably larger, requires a more spacious setting. Plain stock, painted to match the woodwork, can be substituted for the knotty-pine trim suggested for the former. The trim on all should overhang the frame about 1 1/2 in. at the back, to have sufficient stock from which to cut out around the baseboard. To look well, the fireplace should fit as snugly to the wall as possible. A length of flat-wire solder will be found handy in obtaining

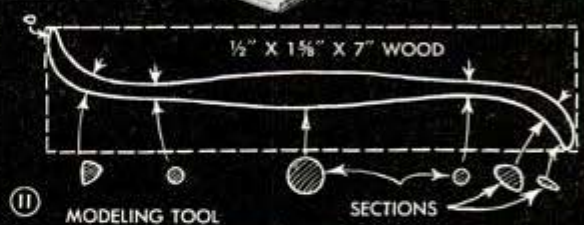


the shape of the baseboard for transferring to the end boards. Areas to be covered with plastic should have $\frac{1}{4}$ -in. wire mesh tacked to them to make it adhere. However, if you are unable to obtain this material, another way to key the plastic is to groove the plywood deeply with a sharp tool, undercutting the grooves thus made, then size the wood with a coat of shellac.

Now to mix and apply the plastic: The ingredients of this are listed in the formula given in Fig. 13. Weigh and measure these carefully, and when adding the asbestos-whiting mixture, stir constantly and finally knead with the hands. Be careful not to add more water than is specified. A pail is a good container in which to mix and store the plastic. It can be kept for as long as a



In "raking" brick mortar joints, divide the space evenly so that all courses will be a uniform width of about 2 in.



DISSOLVE		ADD		MIX	
YELLOW DEXTRIN	HOT WATER	SULPHONATED CASTOR OIL	GROUND ASBESTOS FIBER	WHITING	
1 PART. OR 16 OZ.	2 PARTS 32 OZ.	$\frac{1}{8}$ PART 2 $\frac{3}{4}$ OZ.	3 PARTS 48 OZ.	1 PART 16 OZ.	

FORMULA FOR ASBESTOS PLASTIC

month if covered with wet cloths to prevent it from drying out. Apply the plastic with the fingers or putty knife, pressing it into the wire-covered surface, and build up a layer about $\frac{1}{4}$ in. thick. Then smooth it lightly with a trowel dipped in water frequently. Avoid troweling the plastic too smoothly in order to have the texture resemble that of brickwork. To simulate stone as is used on the colonial fireplace detailed in Figs. 6 and 7, a wooden modeling tool like the one in Fig. 11 is needed to form the "mortar joints." This is used free-hand as in Fig. 10 to produce irregular joints, but it is run along a straightedge as shown in Fig. 12 for producing brickwork effects. Where a rough stone effect is wanted, build up the thickness of the plastic by adding a second layer. The plastic dries hard in 48 hrs., the same color as cement.

Artists' oil colors, thinned with turpen-

tine, are best to tint the plastic. Burnt sienna, Indian red or Venetian red, with or without lampblack added, will give practically any brick shade wanted. Apply a wash coat of this, leaving the mortar joints unpainted. Then tone individual bricks here and there a little darker than others. The back and sides of the fire pit should be given a coat of lampblack to make it look smoked. Stone surfaces require more care in coloring. Experiment with yellow, blue, green or orange colors mixed with sepia or raw umber to obtain the stone effect.

A log charred on the underside by applying a blowtorch or other flame to it, and placed over a hidden colored bulb as shown in Figs. 8 and 9, will give a flickering glow to further add realism. Also, by "peening" the wooden andirons and giving them a coat of flat-black paint, it will be hard to tell them from iron.

Shallow Pit at Front of Furnace Simplifies Cleaning Floor

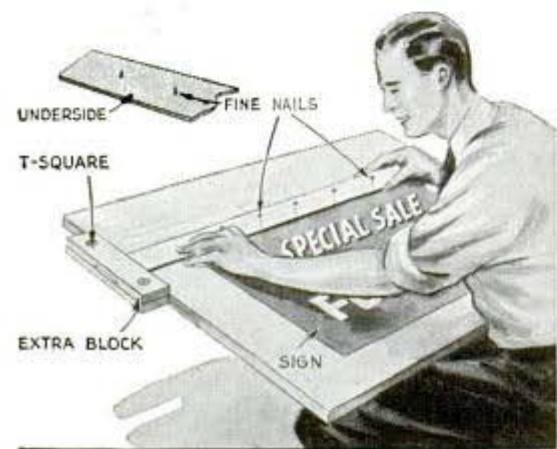


Sunken into the floor directly in front of the ashpit door of your heating plant, a pit of a size to take a pan or even a tub will make it easy to keep the floor clean around the heating plant. A grating is placed over the pit and is made flush with the top surface of the floor. In this way, spilled ashes, dust and bits of fuel can be swept into the pit and then removed easily when the pan or tub is filled.

—G. L. Armstrong, Sedalia, Ohio.

Brads in Tongue of T-Square Aid Sign Painter

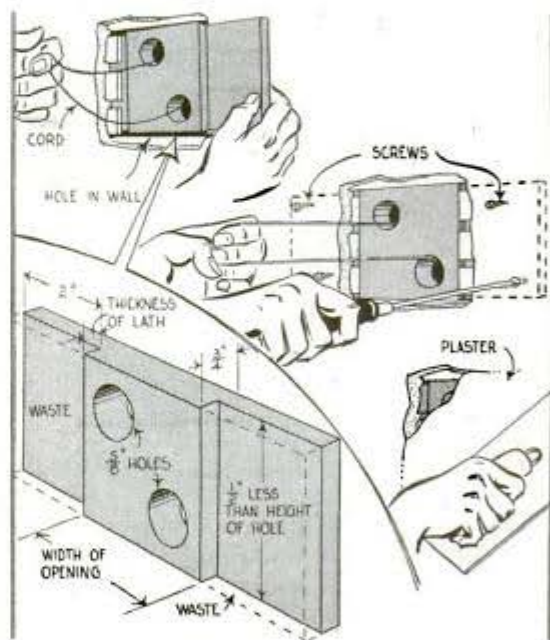
Five or six small brads driven through the tongue of a T-square and filed off so that they project slightly will save time for a sign painter in lining up and holding the cardboard on which the lettering is to be done. It may be necessary to add a thin



block to the head of the square to provide the necessary thickness. In use, the cardboard is placed on the drawing board, lined up by the T-square at the top and then the square is pressed down to force the brad ends into the cardboard and hold it in place. When the square is turned over so that the brad ends project upward, it can be used for its regular purposes.

Reinforcement for Patching Hole In a Plastered Wall

If you have an opening in the lath of a plastered wall that you want to fill with plaster, this reinforcing piece will enable you to do a good job. Cut a wooden block that is 1 in. thick. It should be 1 or 2 in. longer than the wall opening and about $\frac{1}{2}$ in. less in width than the height of the opening. Cut down the ends of the block

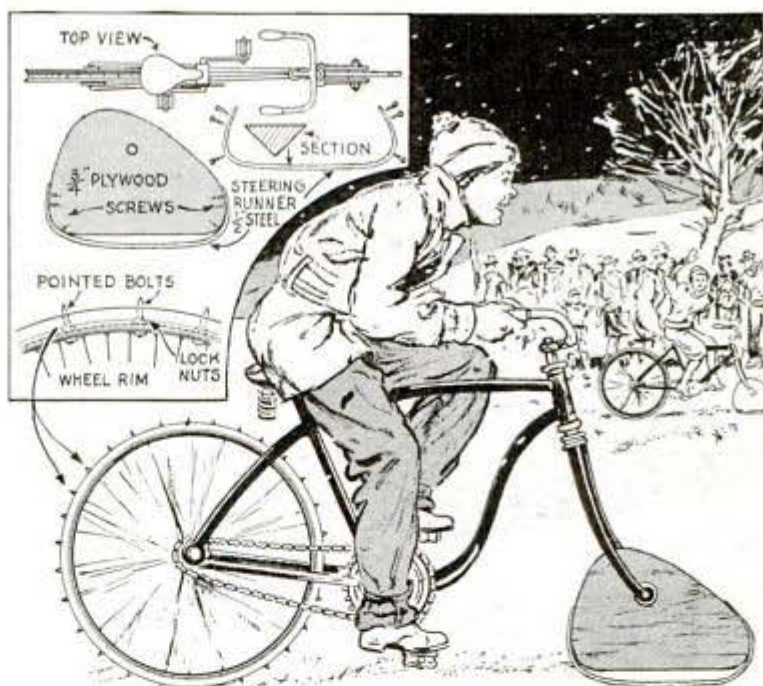


that project behind the lath so that the portion of the block that fills the opening will come flush with the outer surfaces of the lath. Now drill two large holes in the center of the block, run a string through them and work the block into the opening, using the string to hold it in position while screws are driven through the plaster and into the block to hold it in place. After this has been done, remove the string and apply the plaster. You will find that the patch is reinforced so that it cannot be knocked out accidentally.

—P. L. Brownell, Omaha, Nebr.

Snow Bike Gives You Thrilling Ride on the Ice

Besides providing fun on a skating pond, this runner-equipped bicycle can also be used on ice- and snow-covered streets. The runner and spiked wheel can be made interchangeable with the regular wheels of your bike. Use an old rear wheel and drill the rim to take a number of pointed bolts. These are held in place with nuts and lock washers, and the pointed ends should project $\frac{1}{2}$ in. beyond the edge of the rim. The runner is made of $\frac{3}{4}$ -in. stock and is pivoted to the front fork. A shoe of triangular steel is screwed to the runner. If attached as shown, it will absorb some road shocks. However, it can be bent around the lower edge of the run-



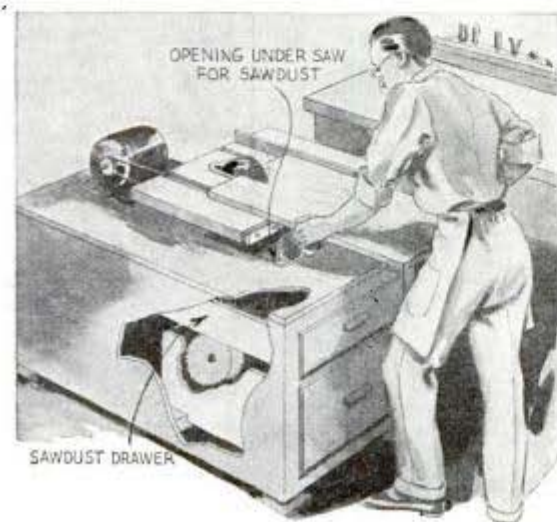
ner and screwed firmly in place if desired.
—L. B. Robbins, Harwich, Conn.

Drawer Section of Old Kneehole Desk Makes a Saw Stand

Power-tool stands that are strong and inexpensive can be obtained by using the drawer sections of an old kneehole desk. The drawers provide ample storage space for tool accessories and attachments and if openings are cut through the stand top under a circular saw and jointer, the upper drawer can be used as a shaving and sawdust catcher. When this is done, cleaning of the shop floor is required less frequently

and dust flying over the tools and benches is reduced to a minimum. If a couple of large casters are used at the rear end of the stand, it can be moved about easily by lifting the front to clear the floor. When casters are used, a couple of blocks screwed to the front corners will level the stand and keep it from "creeping" while operating the tools.

—Lewis L. Gibson, Jr., Vicksburg, Miss.



Salt Anchors Lantern to Ice

Warning lanterns placed around a hole in the ice of a skating pond, can be anchored securely by using salt. This is sprinkled around the base of each lantern, causing the metal to freeze firmly to the ice.





By Alexander Maxwell

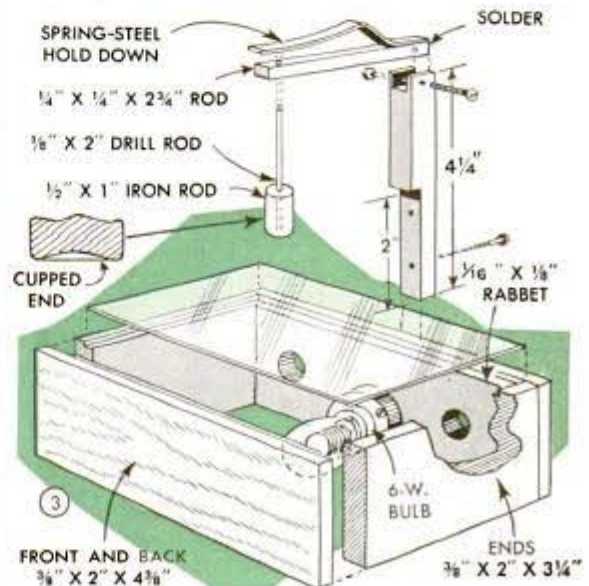
YOUR color transparencies will be safe from dust, moisture and scratches if you put them between glass hermetically sealed at the edges. This can be done with a special nonhardening cement that is just as easy to apply as cellulose tape customarily used to bind the edges. As the cement remains slightly tacky, slides can be taken



Safety-Sealed

out of a rack or box and inserted into the projector by pressing the thumb and index finger against the edges, instead of gripping the sides of the glass and getting fingerprints on it.

Mounting masks on transparencies is simplified by the use of a handy holder illustrated in Figs. 1 to 3. With this you can hold the transparency in position while using both hands to register the mask to the best advantage in regard to the angle of interest and composition. In using the holder, you first slip the dry mask, glued side down, up around the weight and let it rest on the arm as shown in Fig. 1. Next, you place the picture on the glass table of the holder and lower the weight on it. The weight is threaded or soldered to a $\frac{1}{8}$ -in. shank that passes through a hole drilled in the arm. A flat spring attached to the arm exerts pressure on the end of the shank so that there will be a positive clamping action of the weight on the picture as shown in Fig. 2. The base of the holder is a glass-covered box having a small light inside so that all details of the picture can be seen. See Fig. 3. When the picture has been placed under the weight, you moisten the inner edge of the glued surface on the mask with a small brush as in Fig. 1, taking care to avoid applying too much water as it will either get on the picture or will cause the mask to stick to the glass. After registering the mask exactly where wanted, press

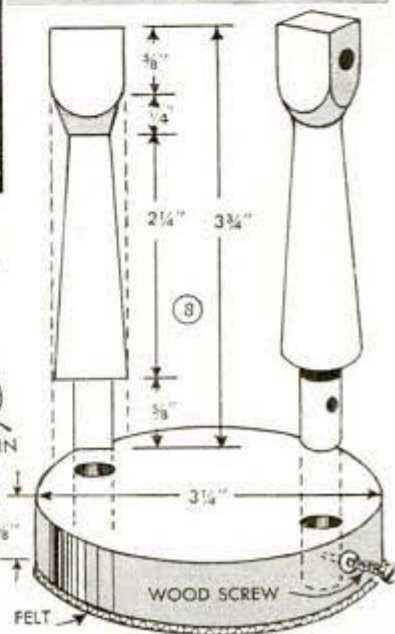
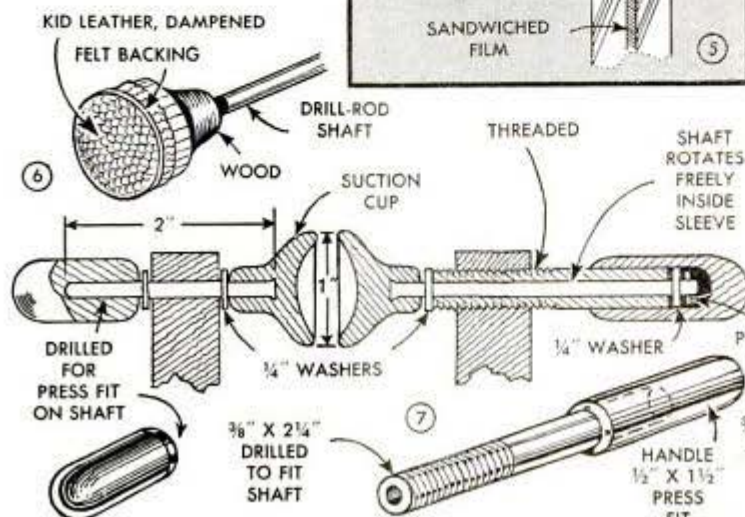
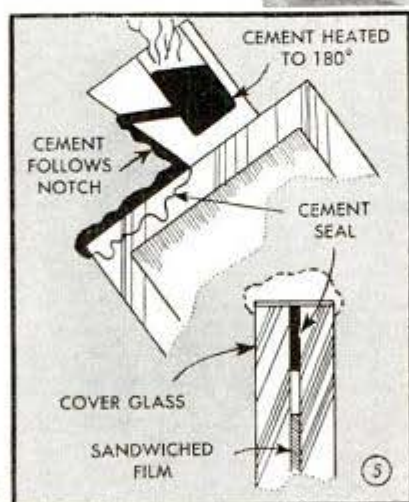
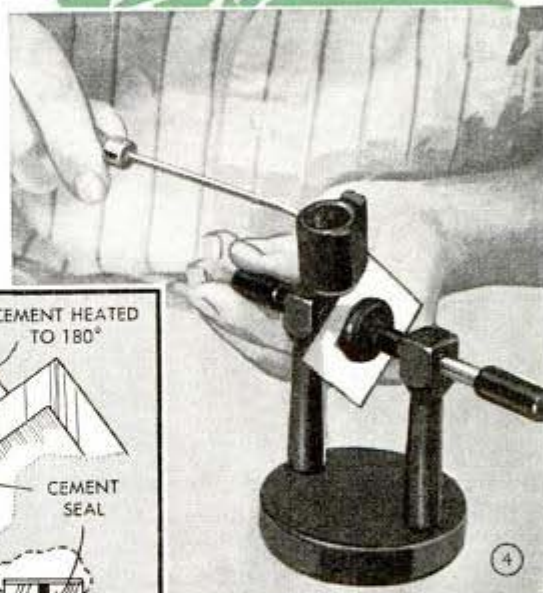
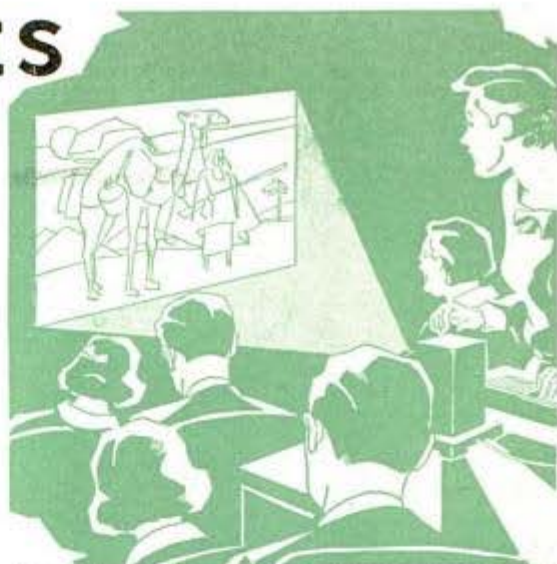


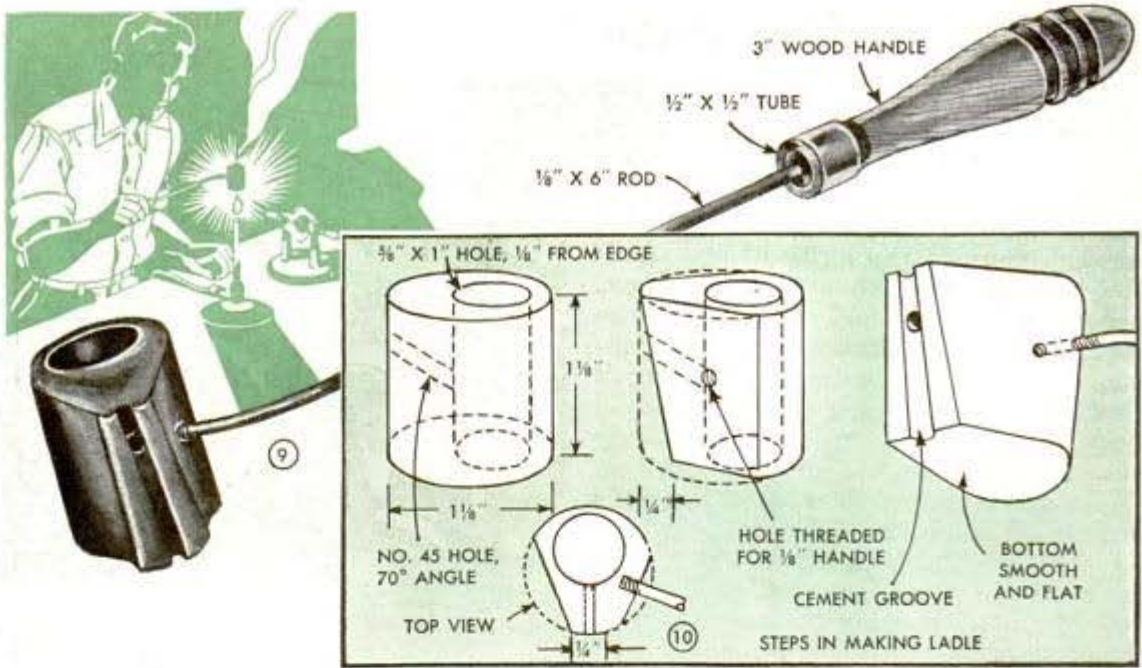
COLOR SLIDES

it down on the picture and hold it there until the glue sets, which will be from five to ten seconds. If further "cropping" of the picture is desired, after the mask has been applied, you can use strips of opaque or "silvered" paper along one or more edges.

Now, all lint and dust particles must be removed from the surface of the transparency, which can be done with a sable brush used dry. When clean, it is sandwiched between the cover glasses, previously cleaned and inspected for dust and lint. Cover glasses are washed in hot soapsuds and rinsed in a bath consisting of vinegar, one tablespoonful, in a quart of water. Water spots are wiped away with a chamois.

To facilitate pouring the cement along the edges of the glass covers, you will need a little slide vise such as shown in Fig. 4 and detailed in Figs. 6 to 8. It can be made of hardwood. Rubber suction cups are best for the jaws, but if not available, you can substitute wooden ones padded with felt disks and covered with kid leather or chamois as in Fig. 6. Both jaws are made to rotate on their shafts. One shaft fits a hole drilled in the corresponding post, but the other shaft fits inside a sleeve, threaded externally and pinned to a handle, which when turned, advances the



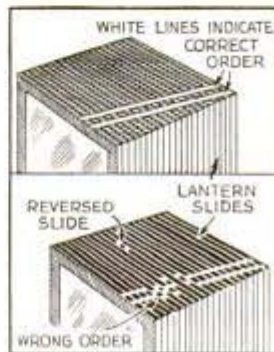


jaw. In use, a pair of cover glasses with a transparency between them, are held between the vise jaws and the threaded one brought against the glass to squeeze the assembly and hold it in position while pouring the cement.

The cement is made by melting beeswax and pitch together which is heated in a tiny ladle over a gas flame until a faint wisp of smoke rises when the ladle is removed from the flame, indicating the correct pouring temperature. Figs. 4 and 5 illustrate the method followed in applying the cement with the ladle. As the cement chills almost instantly, the bottom of the ladle is kept in contact with the edges of the glass while the cement is running down the groove, assuring some penetration of the cement between the glass. Steps in shaping the cup of the ladle from cold-rolled steel are given in Fig. 10. By leaving one side thicker than the other, sufficient stock will be had in which to thread the handle. A slight bend in the handle near the cup, as in Fig. 9, will facilitate pouring. The cement never gets hard and stretches as the glass expands and contracts. It can be purchased in sticks from scientific supply houses, or you can get it from discarded, old-style radio parts, where it was used to seal some coils and to impregnate condensers and power packs. Heated excessively, it is violently inflammable and becomes brittle upon cooling. It should not be heated beyond the stage of a thick syrup. After

each pouring, the bottom and lip should be wiped clean, and at the first sign of pitting or oxidation of these metal surfaces they should be polished bright and smooth. A ladle of the size given will hold enough cement for about six slides, but it is reheated after each pouring. Do not trim off the surplus cement until all the slides have been sealed. Then, with a razor blade, trim off the excess cement, taking care to avoid getting any of the chips on the slides as it is very difficult to remove. The trimmings can be collected, put back into the ladle and used again.

Lines on Edge of Lantern Slides Show When They Are in Order

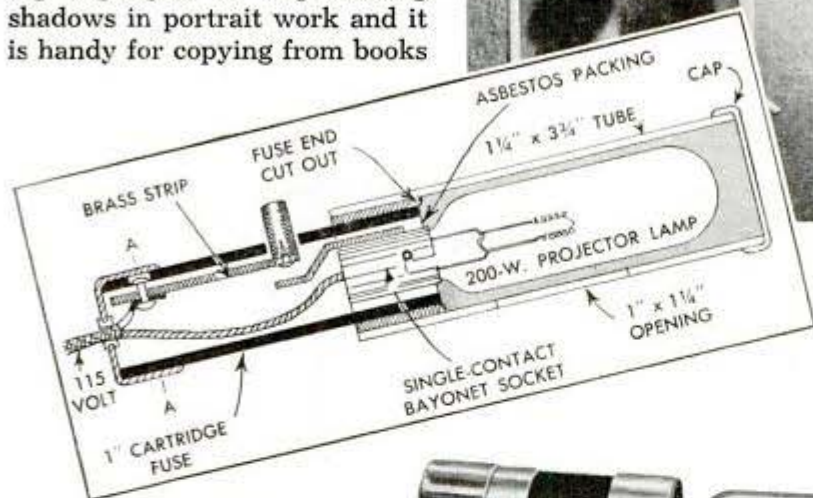


Looking at lantern slides individually to see whether or not they are in proper order for showing will not be necessary if two white lines are painted at a slight angle across the top of the pack. As

shown, both lines are unbroken when all slides are in order. If some of them are out of place, they can be located and shifted quickly so that the white marks match.

Pocket-Size Floodlight for Candid Camera Fans

Designed for taking candid photos at parties and other places where house current is available, this floodlight is no larger than an average size flashlight so that it can be carried in a pocket or camera kit. Also, it can be used as an auxiliary unit for producing highlights or lightening shadows in portrait work and it is handy for copying from books

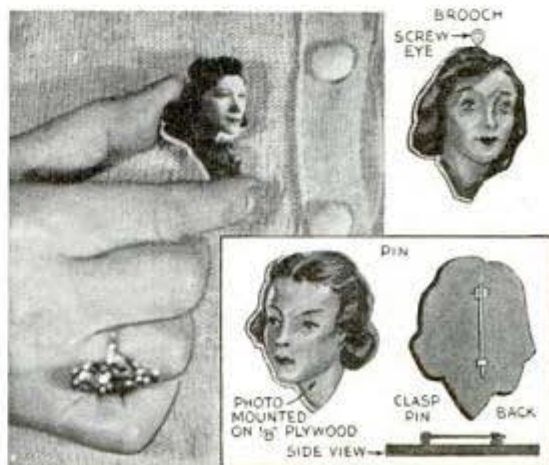


in a library. Being small, it also can be inserted into openings or concealed behind objects to light difficult parts of industrial subjects. The unit consists of a metal-tube reflector fitted with a handle of insulating, heat-resisting material, and a small 200-watt, bayonet-type projector lamp. In the

original unit, the handle was made from an old cartridge fuse 1 in. in diameter and was fitted with an improvised push switch as shown for operating the lamp. The reflector tube, which encloses the lamp, is capped at the outer end and has an opening 1 in. wide and 1 1/4 in. long for the escape of light. The lamp is turned on only long enough to make an exposure to avoid overheating.

Pins and Brooches Made From Your Favorite Photographs

These little photo pins and brooches are simple to make and are very attractive when worn on your garments. All you do is cut out the head portion of the photo and glue it to a piece of 1/8-in. plywood or hard-pressed board. The photo should not be more than 1 1/2 by 2 in. in size. Then with a scroll saw cut the board to the outline of the photo. Drive the parts of a clasp pin into the back of the wood or, if the pin is in one piece, it can be cemented in place. Such small photos can be worn around the neck on a chain or ribbon as a necklace, in which case a small ring is placed at the top as shown.—H. R. Wallin, New York City.



Coat Hanger Used as Towel Rack On Shower Curtain in School

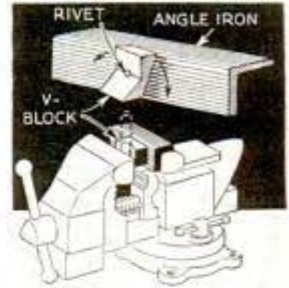


To keep towels handy on the shower curtains for students, the janitor of one school bent wire hangers, and inserted them through small slits in the curtains as indi-

cated. The hanger hooks slip over the hoops supporting the curtains and slide easily with the curtain rings.

Adjustable V-Block on Vise Jaw Holds Round Stock at Angle

When riveted loosely to a length of angle iron, a small V-block provides a handy means of holding round work in a vise. This arrangement is especially useful where it is advisable to hold the work at an angle, as the V-block can be adjusted quickly to suit any position desired.



In attaching the block, note that the rivet head should be countersunk slightly so that it will not interfere with gripping small diameter rods, pipes, etc.



Oak Leaf Whatnot Shelf—Plan No. 1085

Popular Mechanics Magazine,
200 E. Ontario St., Dept. 453, Chicago

Enclosed is.....for plans checked below.
(Uncancelled U. S. stamps or coin may be mailed if carefully wrapped)

- () Oak Leaf Whatnot Shelf, Plan No. 1085—25c
 () "Black Forest" Corner Shelf, Plan No. 1086—25c
 () New Plan Catalog—no charge

Name (use pencil)

Street

City and State

Full-Size Patterns on These Scroll-Sawed Shelves

With these patterns, there's no need of spending time to make enlarged drawings of the scrollwork. Just trace the designs on wood and start cutting. Besides the patterns, full details to assemble and finish these attractive corner shelves are given. Only tools required to make them are a hand or power scroll saw and a hammer. No experience in craftwork is necessary. Send 25 cents for either plan or 50 cents for both.



'Black Forest' Corner Shelf—Plan No. 1086



SHOP NOTES

Lathe CENTER TESTER

magnifies errors

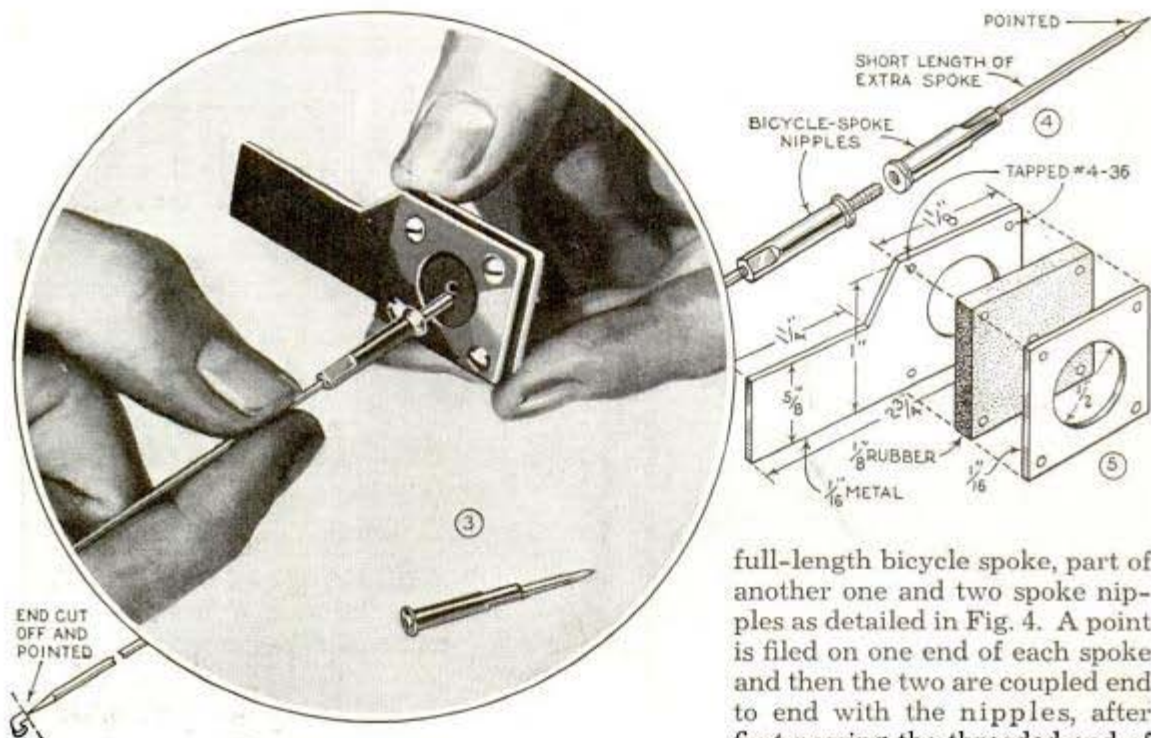
SIMPLIFIES CENTERING OF IRREGULARLY SHAPED WORK IN CHUCK. ALSO USEFUL TO TEST THE ACCURACY OF LATHE CENTERS



By
**RICHARD
HANSCOM**

THERE'S no guesswork in locating round or odd-shaped work centrally in a four-jaw chuck for recessing or counter-boring when you use this simple center tester, because the slightest eccentricity of the work is greatly exaggerated by the pointer, which then spins around the tail center in a circle and makes any error in

centering plainly evident. Rechucking of the work until the pointer revolves without any wobble and in line with the point of the tail center as shown in Fig. 1, assures you that the work is centered. A simplified universal joint makes this tool easy to make. Here, in place of a ball-and-socket arrangement, a small piece of rubber is



used to give universal movement to the pointer and sufficient lateral spring to hold the point of it against the work without being damaged. Fig. 5 shows how the rubber piece is sandwiched between two metal plates, one of which is shaped to fit the lathe cut-off tool holder as shown in Fig. 2. In drilling the plates, exact alignment of the holes can be had by spot-soldering the two metal pieces together at the edges.

The indicating pointer consists of one

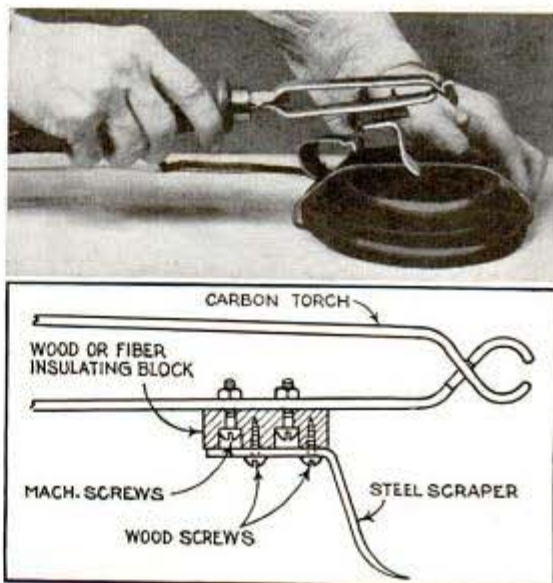
full-length bicycle spoke, part of another one and two spoke nipples as detailed in Fig. 4. A point is filed on one end of each spoke and then the two are coupled end to end with the nipples, after first passing the threaded end of

one through the rubber center of the universal joint as in Fig. 3. As no vertical adjustment of the universal joint itself is provided, the moon-shaped wedge of the tool post is used to align both ends of the pointer exactly with the points of the lathe centers. Aligning the tester with the lathe centers is done while the headstock center is still in the spindle. One hand is used to hold the pointer at the tail center and the other to adjust the tool post for height.

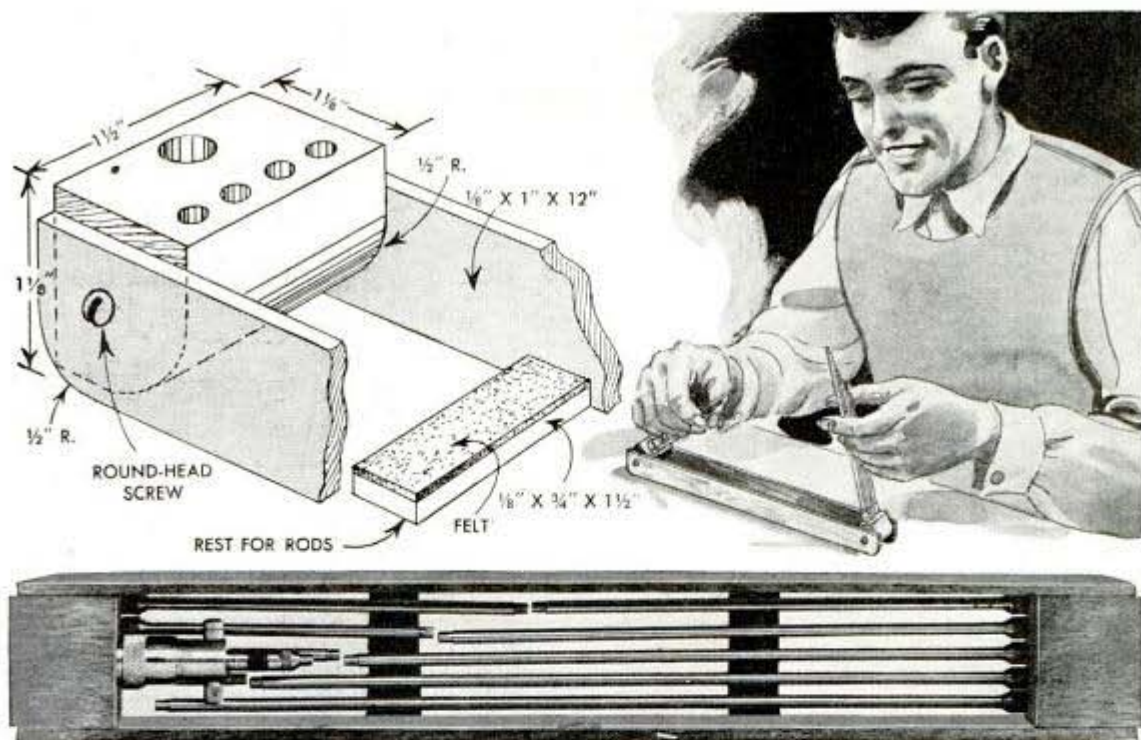
Scraper Attached to Handle of Welding Torch Saves Time

With a steel scraper blade like this one attached directly to the handle of your carbon welding torch, you won't have to stop and use another tool to remove rust, grease or other foreign matter from the work. It is mounted on the side of the torch as shown in the detail at the right, where it will not interfere when welding, and being insulated from the torch, it is not necessary to remove the ground clamp when you wish to use the scraper. The machine screws, which bolt the wood or fiber insulating block to the torch, must be well countersunk so that the heads do not make contact with the scraper blade. In fastening the scraper to the block, see that the screws do not touch the countersunk bolts. A piece of flat iron will do for the scraper.

—W. C. Wilhite, Carlinville, Ill.



Inside Micrometer Case Opens Like a Jackknife



Thin enough to fit into the shallowest drawer of a tool cabinet or box, this compact case affords ample protection for a set of inside micrometers, and it opens like a jackknife for instant removal or insertion of the parts. These fit snugly in holes drilled in end blocks, which are rounded at the lower, inside edges and pivoted to the

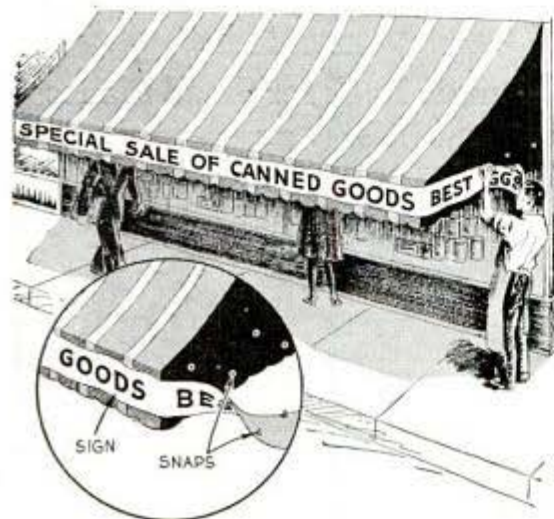
sides with screws. When the case is closed, the micrometer parts rest on felt-covered strips of wood glued and bradded in place across the bottom. Walnut or mahogany makes a neat looking case, although almost any kind of hardwood, varnished or rubbed with linseed oil, will do.

—Emil H. Lubitz, Beloit, Wis.

Oilcloth Signs Snapped to Awning Are Easy to Change

Attention-getting signs that are interchangeable, can be hung in prominent po-

sitions outside of stores and shops, where they are easily seen, by attaching them to the awning. Ordinary dress snaps are used to hold the signs and permit them to be changed with ease. Such signs should be painted on oilcloth or other suitable material that is weather resistant.



Salvaging Empty Paint Cans

Old paint containers in which the paint has hardened may be cleaned easily by pouring a small amount of kerosene into them and setting this afire. When the kerosene has burned the charred residue remaining in the container will be easy to remove with a scraper. This method is practical only on pressed metal containers. If used on containers that are soldered, the solder is likely to melt.

Level Fastened to a Straightedge Lines Up Concrete Forms



A contractor attaches a level to his straightedge when using it to line up concrete forms. This enables him to span the space between the forms and saves time in getting both sides of the forms to the same height. The level is attached by putting two short dowels in the straightedge for insertion into two holes drilled in the edge of the level.

Tar Dug From Pavement Joints With Ordinary Wheelhoe

An ordinary garden wheelhoe is used by the Porter County unit of the Indiana State Highway system to remove old tar from

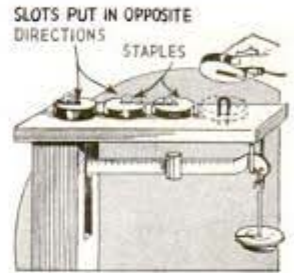


pavement expansion joints. The hoe saves much time and labor over the old method of digging out the tar with steel bars. The blade or shovel that removes the tar is shaped at the lower end so that the center portion projects into the joint, while the sides are cut back to ride on the edges of the joint, thus serving as depth stops.

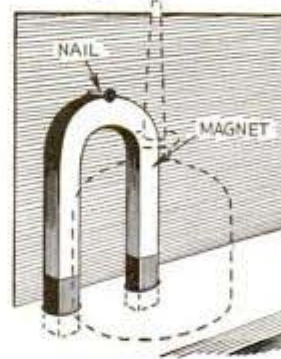
—George R. Harrison, Valparaiso, Ind.

Scale Weights Held in Place By Using Large Staples

One produce merchant kept the weights of his platform scales from falling off, when moving the latter about, by slipping the weights over large staples, which were driven into the arm of the scales. The slots in the weights were turned in opposite directions, as shown, so that they could not slip off the staples.



Magnet Holds Oilcan on Shelf

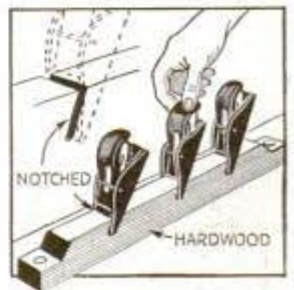


When a steel oilcan is used around machinery where there is considerable vibration, the can will remain on a shelf if a magnet is used as shown. Two or three nails will hold the magnet in place.

Simple Rack for Small Planes

In schools and shops where a number of small planes are used, this rack is just the thing for keeping them close at hand, and their cutting blades are well protected.

The rack, which is fastened to the bench, is nothing more than a wood strip notched at an angle to take the noses of the planes.

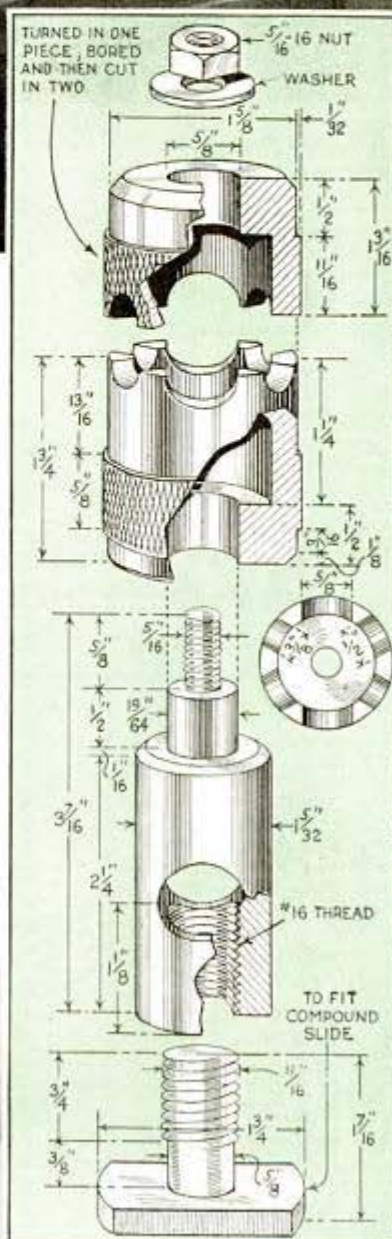


Triple BORING-BAR HOLDER



HERE'S a chance to use up some of those scrap pieces of steel that you have saved from past turning jobs and at the same time provide your lathe with an excellent three-size boring-bar holder. The dimensions given are for a 10-in. lathe, but sizes can be increased or decreased proportionately to suit. The important thing is to see that the cross holes in the holder are bored on a line with the center of the headstock spindle. It is best to turn the locking shell first. This is turned in one piece, knurled and bored crosswise before sawing it in two pieces through the center of the holes. Then the inside of the upper half is counterbored and the lower one is bored completely through to set down over the center column. The detail at the right shows this bored through part way from one end, after which it is chucked end for end and completed. The cross hole through the column should be bored slightly oversize so that the two halves of the shell will grip the boring bar solidly when the nut at the top is tightened.

—Walter T. Warde, San Francisco, Calif.



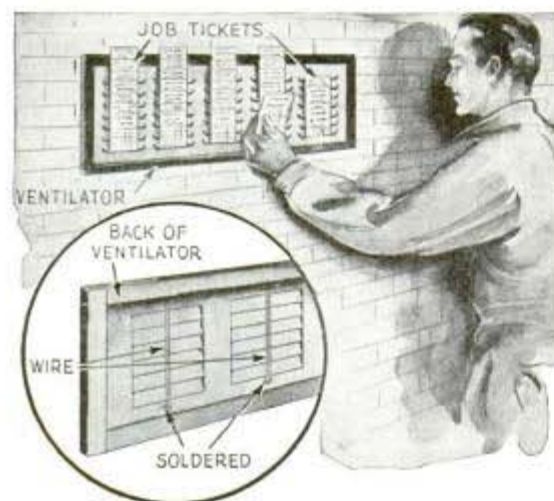
Extra Mileage From Worn Tires If Used Two on a Wheel



When you have old tires and driving your car is a necessity, here's a simple way to make a good tire by combining two that are worn badly. Just cut openings in the sidewalls of one as shown, leaving the bead and tread intact. Then slip this over another tire and cement the two together to reduce friction and heat. Inflating 6.00-16 tires to 40 lbs. when used in this way is recommended by one motorist who claims satisfactory service for 7,000 to 10,000 miles at low speeds.—G. Cominos, Columbia, Mo.

Ventilator Provides Ideal Holder For Garage Job Tickets

If you own a garage or repair shop where job tickets are used, an inexpensive holder for them can be made quickly from a metal



window ventilator of the type shown. All you need to do is solder a wire behind each row of louvers to prevent the tickets from sliding on through and then fasten the ventilator on the wall.

Chamois Kept in Hip Pocket With Aid of Cork Ball

To keep a chamois or cloth handy when servicing a car, one attendant pulls a corner of the fabric through a cork fishing float. By slipping the cork into his hip pocket, the cloth is held conveniently for use whenever needed.



If a cork isn't available, a wooden ball or similar object will serve the same purpose.

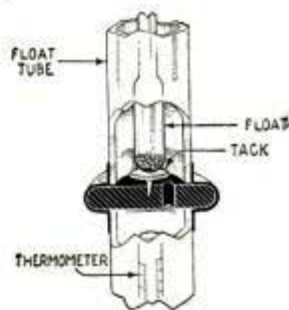
Ice-Coated Auto Fenders Thawed With Heated Sandbag



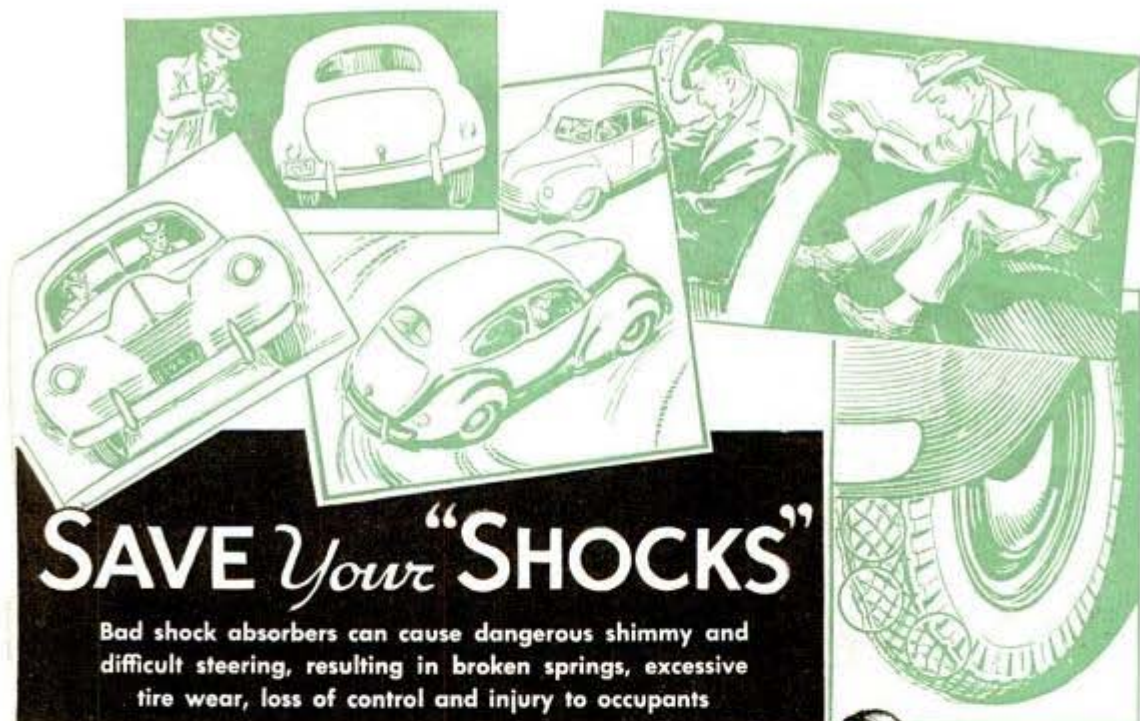
While working in a garage where considerable fender repair work was done on cold winter days, one mechanic found a heated sandbag ideal to thaw ice from the underside of fenders before starting on them. The bag was kept on a convenient radiator when not in use so that it would be ready for any rush jobs that might come in.

Sticking of Hydrometer Float Prevented by Thumbtack

Over a period of time some anti-freeze solutions tend to soften the rubber in the bottom of the glass testing hydrometer so that the float sticks. To avoid this, just insert a celluloid-covered thumbtack into the rubber where the float rests on it.



—Emil J. Novak, Omaha, Nebr.



SAVE Your "SHOCKS"

Bad shock absorbers can cause dangerous shimmy and difficult steering, resulting in broken springs, excessive tire wear, loss of control and injury to occupants

By C. E. Packer

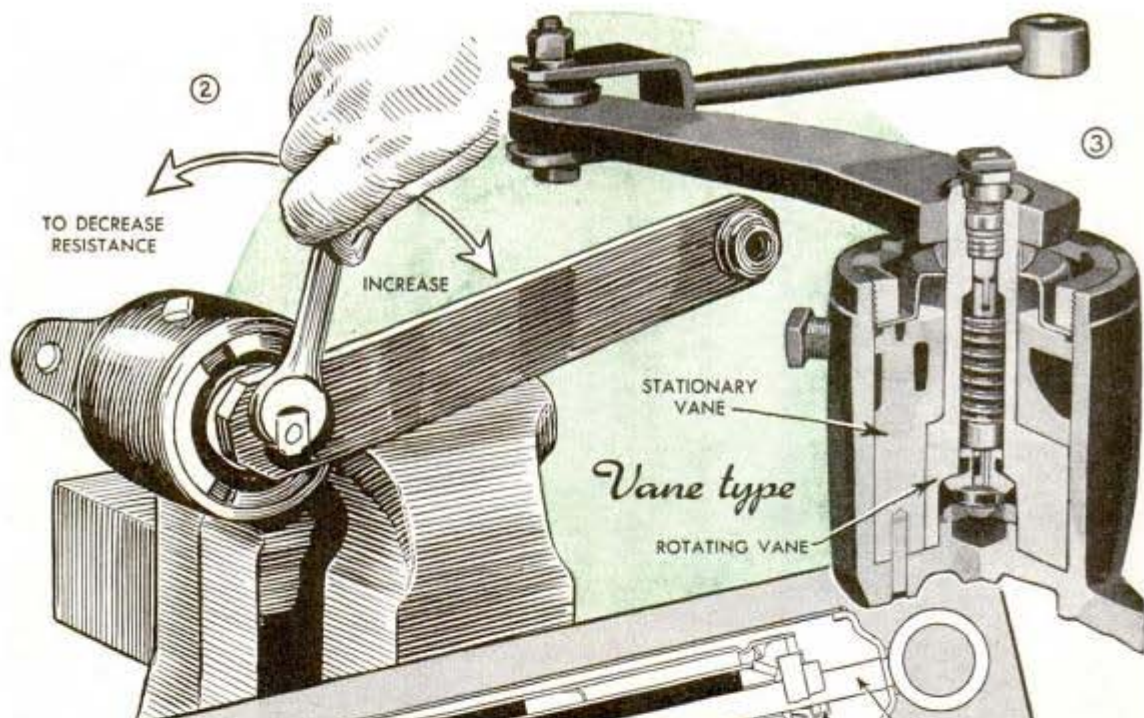
IT'S JUST as important to keep your shock absorbers correctly adjusted and properly filled with liquid as it is to keep oil in the motor crankcase. Shock absorbers that are not in good condition cause rough riding and may be the cause of an accident. When they permit a car to "bounce along," it is difficult for the driver to control the car, and at night the bobbing headlights may blind an oncoming motorist. Therefore, it is necessary that they be inspected at least every 5,000 miles to see if they are full of liquid, which also acts as a lubricant for the closely fitted parts that will wear rapidly beyond repair if the liquid gets too low. An easy occasional check is to stand on a bumper and bounce the car as in Fig. 1. If it rebounds two or three times after you jump off, the shock absorbers need attention. Such a check should be made at both ends of the car.

Most shock absorbers are similar in basic design and are of the vane type, Fig. 3, the plunger type, Figs. 4 and 5, or the piston type, Fig. 6. All depend on the resistance of a liquid being forced through orifices or valves, from one chamber to another, to control their action. The variation between shock absorbers is in the kind of liquid used, the type of valve or orifice, and the shape of the chambers. There are

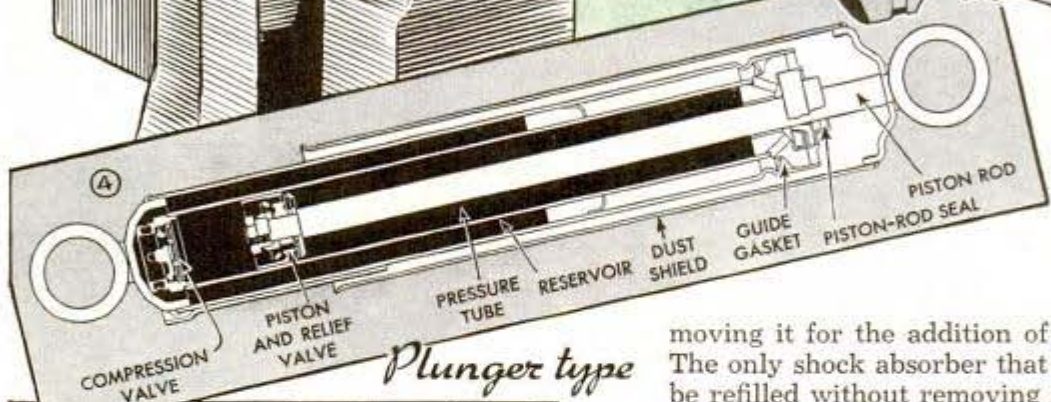


two kinds of liquids: One is an oil and the other is a liquid containing glycerin and alcohol. In all kinds, it is very important to use only a prepared liquid made especially for your particular shock absorbers. Any substitute is likely to cause serious damage, as the liquids, besides lubricating the parts, must maintain a nearly uniform viscosity over a wide range of temperature and must not foam or gum.

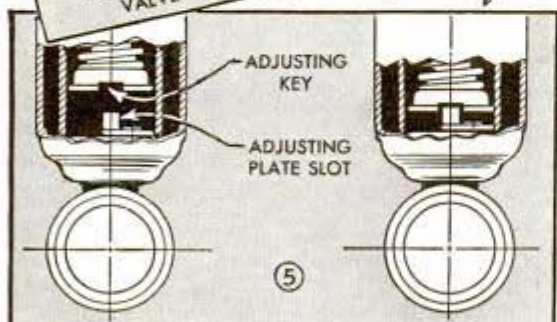
As any dirt that might enter the filler hole may clog a valve or orifice, or cause an abrasive action against the moving parts, it is important to remove all dirt and rust particles around a filler plug before re-



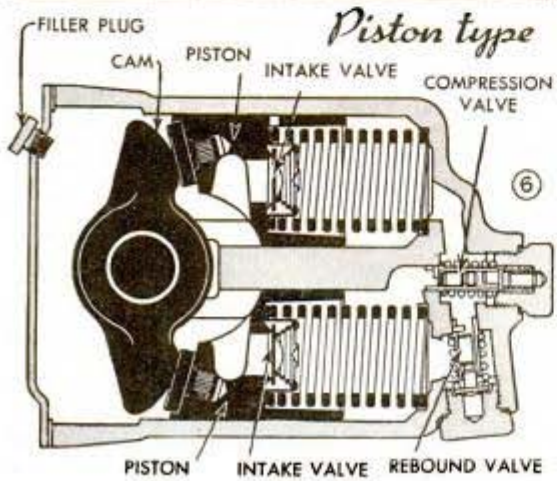
Vane type



Plunger type



Piston type

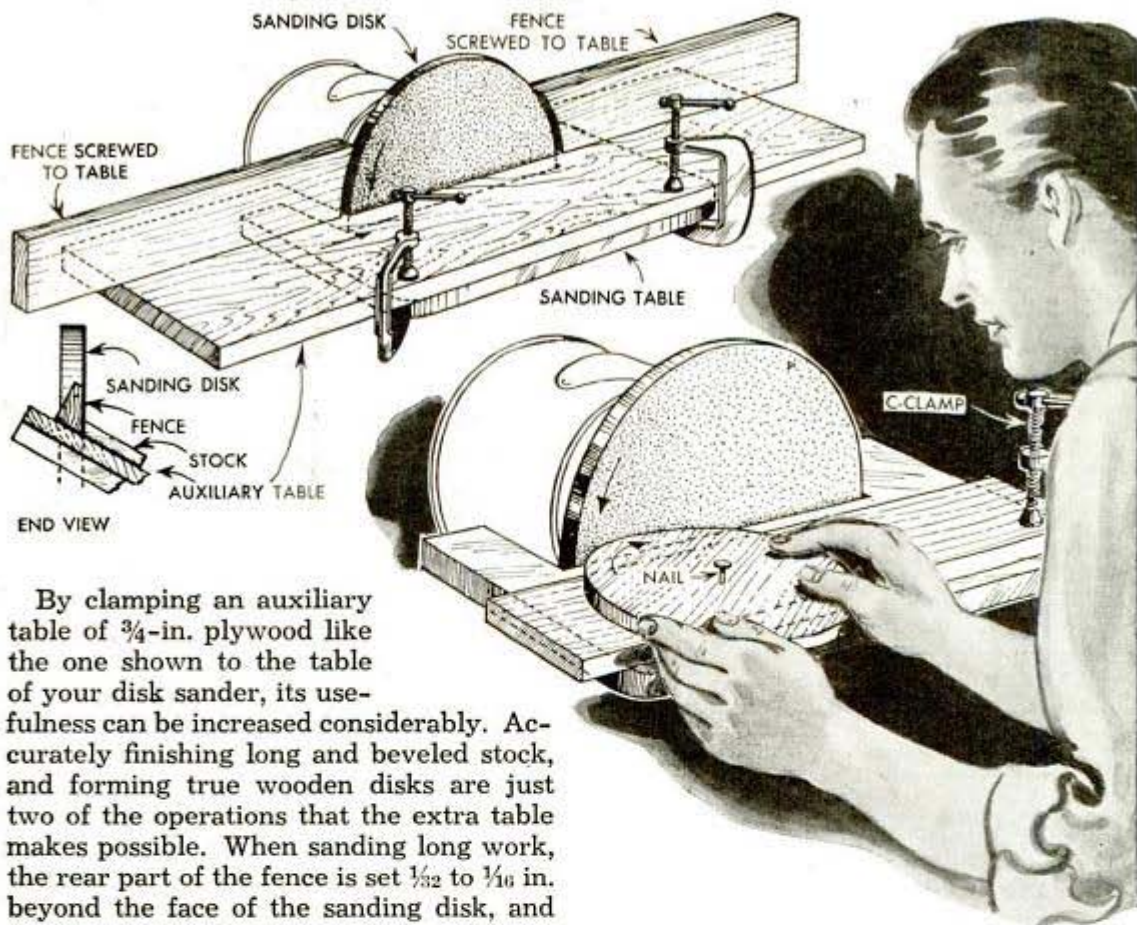


moving it for the addition of liquid. The only shock absorber that cannot be refilled without removing it from the car is the long direct-acting, plunger type.

Partially filled shock absorbers sometimes produce a sucking or thumping noise. But as noises of this nature are not always caused by the shock absorbers, it is a good idea to disconnect the arms and make a road test. If the noise is still present, the trouble is caused by some other part of the car. While disconnected, the shock absorbers should be operated by hand as a further check for noise and action.

Adjustment, or ride control, is made by turning the needle valve of the vane type as in Fig. 2. Piston-type shock absorbers may have replaceable valves in the piston heads, except some models having needle valves that can be adjusted externally. Long, direct-acting shock absorbers generally can be adjusted only by disassembling and replacing the valve parts. However, those on the American are disconnected at the bottom as in Fig. 5, pushed up to engage the adjusting plate and then are turned clockwise for more resistance or counterclockwise for less resistance.

Extra Table Makes Disk Sander More Useful



By clamping an auxiliary table of $\frac{3}{4}$ -in. plywood like the one shown to the table of your disk sander, its usefulness can be increased considerably. Accurately finishing long and beveled stock, and forming true wooden disks are just two of the operations that the extra table makes possible. When sanding long work, the rear part of the fence is set $\frac{1}{32}$ to $\frac{1}{16}$ in. beyond the face of the sanding disk, and the forward fence is set the same amount behind it to allow the work to pass across the disk at a slight angle and avoid being kicked up on the up stroke of the abrasive paper. For sanding beveled work, the table is the same as for long stock, but the face of the fence must have the same angle as the bevel to be sanded. In using the

table to make a true disk, first jigsaw the disk as closely to the desired shape and size as possible, then pivot it to the table with a nail through the center and turn it against the rotating sanding disk. Many other uses for the auxiliary table will become apparent once you make it.

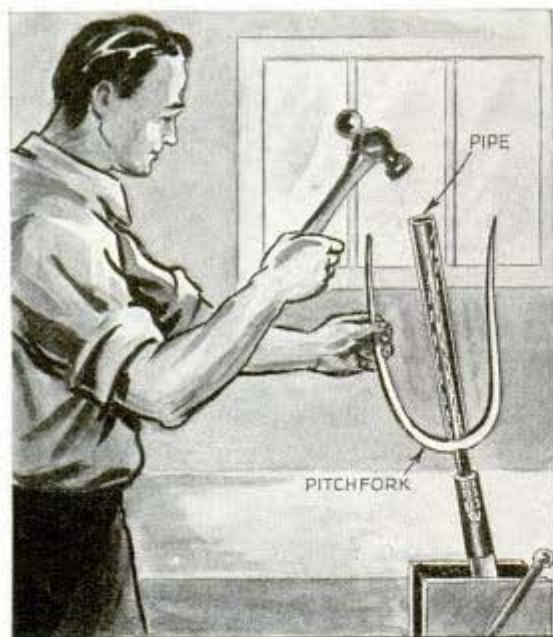
Marked Floor Plans on Wall to Locate Fire Extinguishers

To enable the occupants in a large office building to locate fire extinguishers in corridors without confusion and with the least possible loss of time in the event of a fire, one building manager placed floor plans at various points in the corridors. On each plan, its position in the corridor was clearly indicated by means of a large cross so that a person looking at it could determine immediately where the closest fire extinguisher could be found.

When the edge of a squeegee becomes irregular, a new edge that will be straight and true can be made with a paper trimmer.



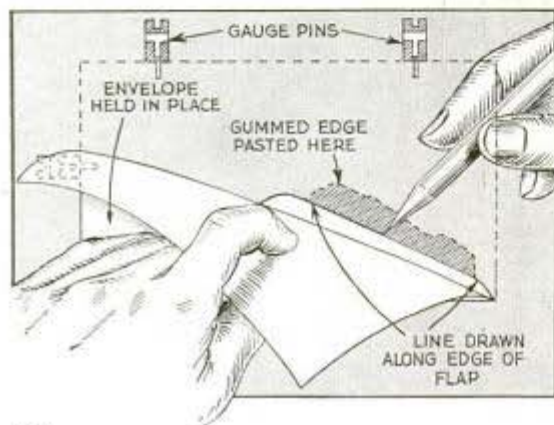
Pipe Aids in Driving Pitchfork Into Handle Ferrule



The job of putting a new handle on a pitchfork can be simplified by using a piece of pipe. This is slipped over the center tine so that a hammer can be used to drive the fork into the handle. The pipe must be long enough to project above the end of the tine to avoid breaking it.

Faster Makeready for Envelopes

To speed up the makeready on envelopes, I have found that the following method saves time on rush orders. After the envelope has been placed and the gauge pins set, press the fingers of the left hand down hard on top of the envelope directly over the flap. Then with the other hand, turn back the bottom part of the envelope until the gummed flap shows, taking care that the envelope does not slip. Now, draw

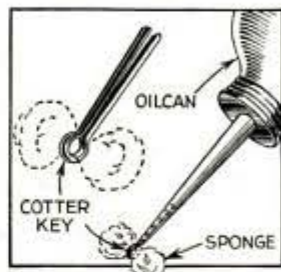


a pencil line along the edge of the flap, remove the envelope and tear off a piece of the gummed edge and paste it below the line as done ordinarily. This method is much faster than the usual one of holding the envelope up to the light in order to determine where to draw the line.

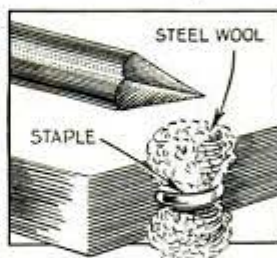
—C Mehigan, Jr., Clarksville, Tenn.

Sponge on Oilcan Used as Swab

When a swab is needed to apply oil to any work in the shop, force a small piece of sponge through the eye of a small cotter key and insert the key into the spout of your oilcan. This will make a handy applicator for many uses.



Steel Wool Stapled on Bench To Wipe Soldering Iron



A handy and easily renewed wiper for a soldering iron can be made by stapling a wad of steel wool to the end of your workbench. In this position the wiper

is out of the way, and the wool is renewed easily by pulling the staple for insertion of a new piece.

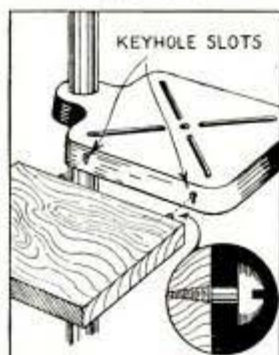
Binder Wheel Forms Rigid Stand To Support Feed Kettle

If you need a stand for a feed-cooking kettle, look around for an old implement wheel and make one from it. The grain wheel on a binder is about the right size for this purpose and it can be converted by cutting out all but three of the spokes. These are then heated near the rim and bent upward at an angle so that the kettle



will rest on the ends. Such a stand is not only rigid, but its round base permits it to be rolled wherever needed.

Slots in Edge of Drill-Press Table Hold Small-Parts Shelf

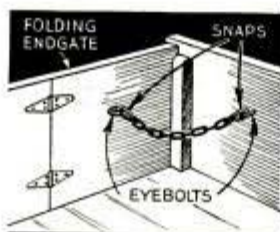


In order to have space on his drill-press table to hold small parts at hand for production work, one workman attached a wooden shelf to the table. This was done by drilling keyhole slots in the edge of the

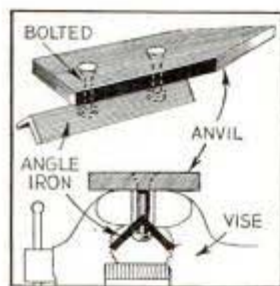
drill-press table to take the heads of screws projecting from the edge of the shelf. This method of attachment is strong enough for most work, and it makes the shelf easy to put on or take off.

Loss of Trailer Endgate Avoided By Detachable Corner Chains

After losing the folding endgate from his trailer, one farmer used a couple of corner chains as shown. These were attached to the endgate and to the sides of the trailer by means of eyebolts and harness snaps. The chains were long enough to permit slack so they would not interfere with loading or with dumping loads of small grain.



Anvil to Clamp in Bench Vise



The difficulty of holding a small anvil in a bench vise so that it will not loosen or tip may be avoided by bolting it to a short length of angle iron. When inserted in the vise as shown, the jaws clamp it securely. This idea is especially handy when working on the end of the anvil, as it cannot tip.

Butcher Keeps His Apron Clean By Using Removable Front



To keep his apron as clean as possible, one butcher fitted it so that extra fronts can be buttoned to it. This was done by sewing on four buttons to take extra pieces of cloth in the shape of napkins. Whenever one of these becomes soiled, it can be changed quickly for laundering, thus keeping the apron clean and reducing the cost considerably.

Cutting Force of Ax Is Reduced If Mounted Wrong on Handle

One woodsman claims that much of the labor of using an ax may be eliminated if the blade is hung correctly on the handle. To do this, place the ax on a flat surface with the end of the handle and the cutting edge in contact with the surface. When the blade is mounted correctly, the curved cutting edge should contact the surface about two thirds the distance back from the front. Any deviation from this point will reduce the cutting force of the blow in chopping.



Pointers in ARC WELDING



Based largely on simplified, fundamental information on arc-welding technique, vividly shown in a series of special training films in full color and sound, entitled "The Inside of Arc Welding," which are available to industry from the General Electric Company. The films were produced by the Raphael G. Wolff Studios of Hollywood under the technical supervision of the General Electric welding laboratories

By E. R. Haan

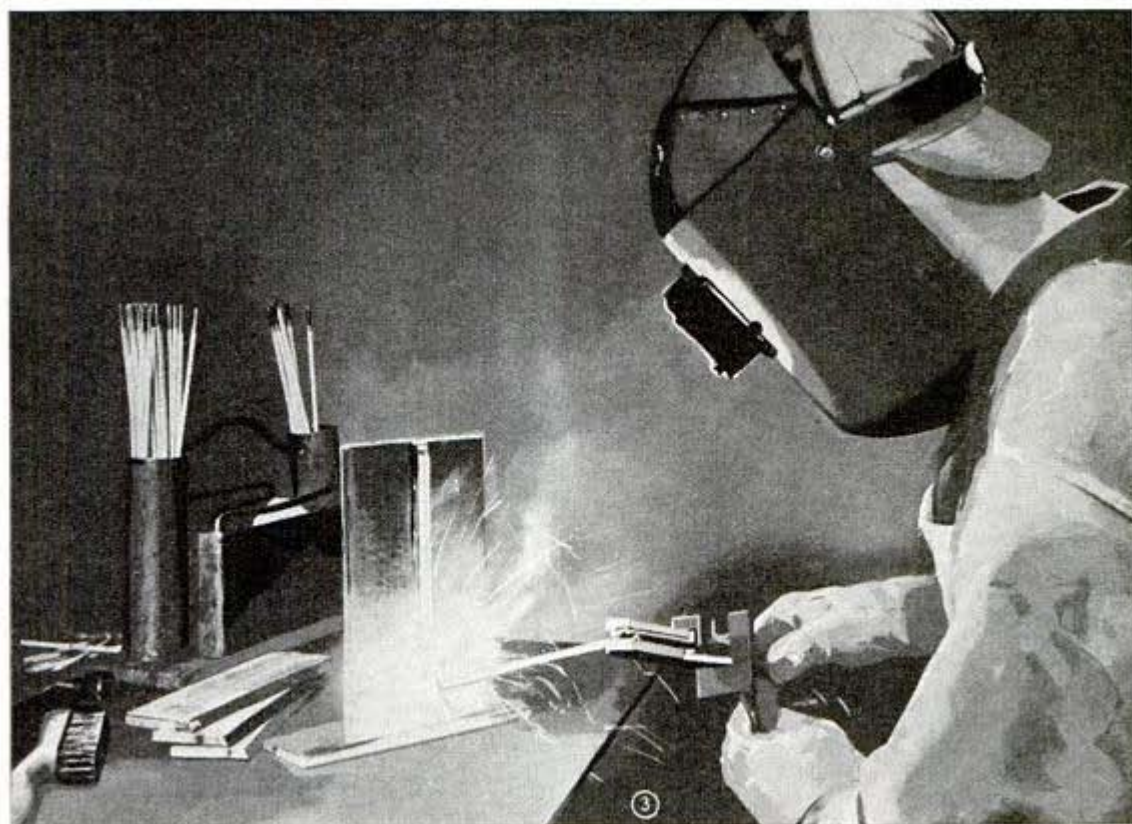
IN ARC WELDING, an electric arc is formed and maintained between the base metal to be welded and a bare or coated metal electrode. The intense heat of the arc, which is about 6,000 degrees Cent., forms a molten pool in the work, and melts metal from the tip of the electrode, which passes into the pool where it fuses with the base metal. For greatest efficiency, the work should be arranged so that welding can be done in a flat or horizontal position as shown in Fig. 1. However, it is possible to do welding in a vertical and even in an overhead position.

Metals and electrodes: Although metal arc welding is done mostly on mild steel, other ferrous and nonferrous alloys also may be welded readily. In the former class are rolled steel and cast steel. The latter group includes chrome steel, chromenickel steel, manganese steel, and bronze, brass, and aluminum, etc. Various alloys react differently under influence of the welding arc; therefore, a definite procedure must be set up for the particular metal to be welded. In addition, an electrode usually of the same composition as the base material must be used. There are two general types of electrodes: the "bare" or lightly coated type and the heavily coated type. The latter has a heavy coating of material which acts to shield the molten metal from oxidation or contamination by



the surrounding atmosphere, and also helps to stabilize the arc. Where the ductility, impact resistance, etc., obtained with heavily coated electrodes are not required, the bare or lightly coated electrodes are economical, but the user must base the choice on the results obtained.

Welding generator and its controls: A commonly used source of power is a single operator, direct-current generator having two controls for adjusting the current, Fig. 2. The open-circuit voltage (voltage when no welding is being done) ranges from 55 to 90 volts. The operating voltage across the arc varies from 15 to 26 volts when using bare electrodes, and from 20 to 40 volts when using heavily coated electrodes. The open-circuit voltage has no effect on arc voltage. When the arc is established, the voltage drops to a point governed by the length of the arc, and the current (in



amperes on the ammeter) will rise to a point fixed by the generator controls. On machines having dual control, both controls regulate the current. One is a coarse control and the other is a fine adjustment for filling in between the settings of the coarse control. The proper arc voltage and amount of current to be used depend on the size and type of the electrode used. Any variation in the length of the arc will vary the operating voltage and amperage. Lengthening the arc causes the voltage to rise and the amperage to drop. Shortening the arc causes the opposite. Obviously, the maintenance of correct arc length within a narrow range is essential to good results.

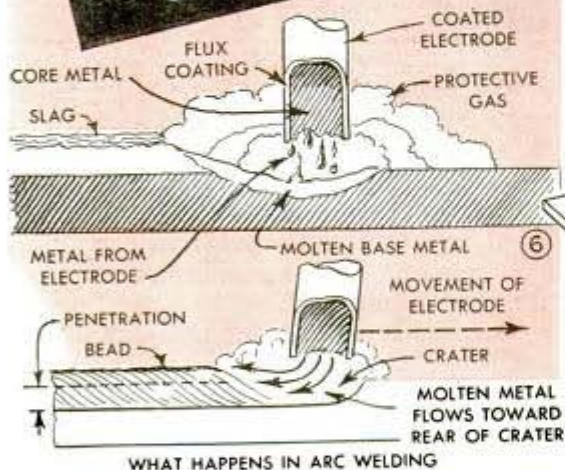
Polarity: To complete an electrical circuit between the welding machine and the work, two cables of adequate length and current-carrying capacity are required. Usually in d.c. welding with bare electrodes, the cable from the positive terminal of the generator is connected to the work by means of a suitable clamp, while the other or negative cable is connected to the electrode holder. This arrangement is known as "straight polarity." However, if the positive cable is connected to the electrode holder and the negative cable to the work, we have a condition called "reversed polarity."

Welder's equipment: To protect the skin and eyes from the ultraviolet and infrared rays emitted from the arc, as well as from the hot particles, the operator's face and neck must be covered by a suitable helmet fitted with a special protective glass as shown in Fig. 3. One should never look at the arc without such protection. Goggles also should be worn when chipping, cleaning slag, etc., when the helmet is raised as shown in Fig. 4. To protect the hands and arms, the operator should wear gauntlets of leather, asbestos, or other fireproof material. An apron or suit of nonflammable material also is desirable to cover his clothes. A welder should have one or more suitable holders of sufficient size and current-carrying capacity for the electrodes used. These are available with or without insulated jaws, and with soldered or solderless connections to the cable. Where welders are working in close proximity to each other, screens should be used to provide protection against eye injury and "sunburn." Such screens may be portable or they may be booths of permanent construction.

Cleanliness of work: Surfaces to be welded must be free of dirt, slag, rust, oil, etc., to prevent undue contamination of the weld metal. Slag, scale, rust, etc., may be



④ *Striking the arc*

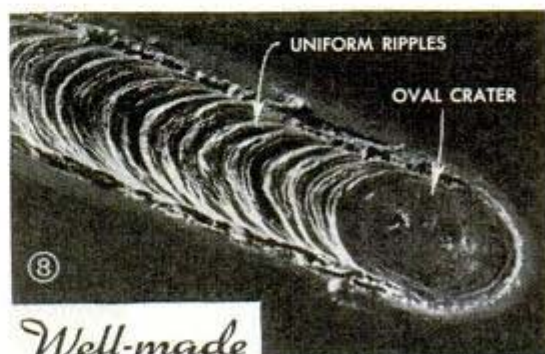
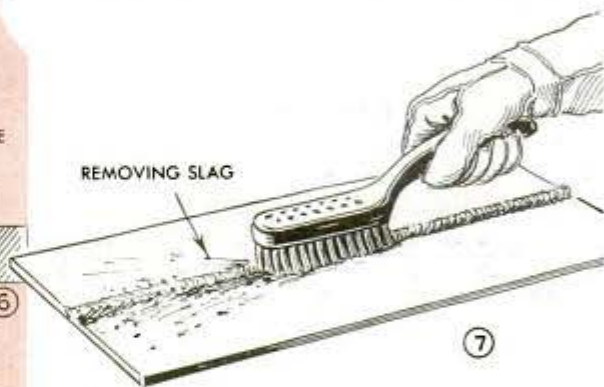


removed with a steel scratch brush or by chipping. To remove grease and oil, trisodium-phosphate cleaners are safe, but the shop in which the welder is employed usually has its own particular cleaning procedure. After a weld has been made with heavily coated electrodes, the slag over its surface is removed for the sake of appearance and examination of the weld. Where several layers of weld are made, as in multiple-pass joints, the slag covering each layer must be removed before starting another layer to prevent contamination of the weld metal.

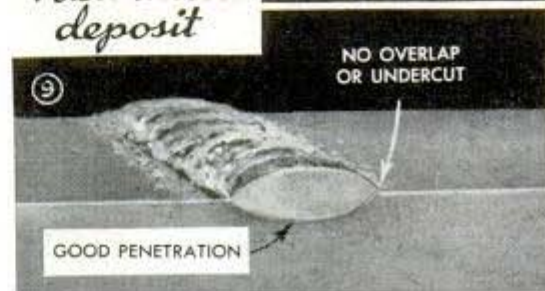
Striking an arc: The arc is struck by swinging the electrode down, scratching the tip against the surface of the work to

make electrical contact, and then drawing the electrode away from the work about $\frac{1}{4}$ inch. After holding this position momentarily, the electrode is returned slowly toward the work to the correct arc length. The arc length usually is equal to the diameter of the electrode used. Guiding facts on arc lengths are given in a subsequent paragraph. While beginners may use a gradual swinging movement to contact the work, the more experienced operator uses a straight up-and-down movement as indicated by the dotted lines in Fig. 5. When the arc is struck, it starts melting the base metal and that at the tip of the electrode. Metal from the electrode crosses the arc and mixes with the melted base metal forming a pool, called the arc crater.

How metal is deposited: The force of the arc causes the metal to pile up at the rear of the crater as indicated in the lower detail of Fig. 6, where the metal cools and forms a "bead" as the electrode slowly

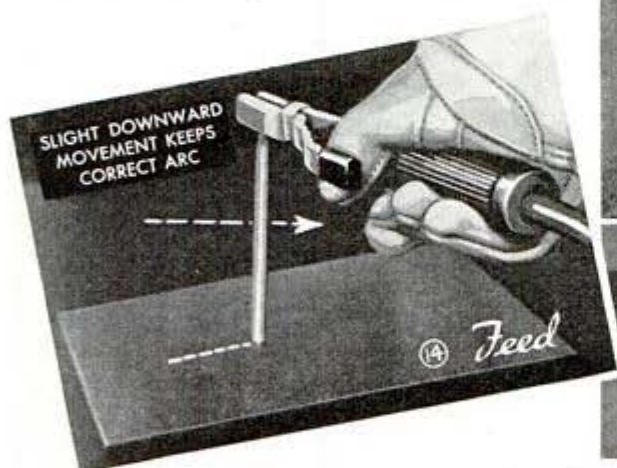


Well-made deposit



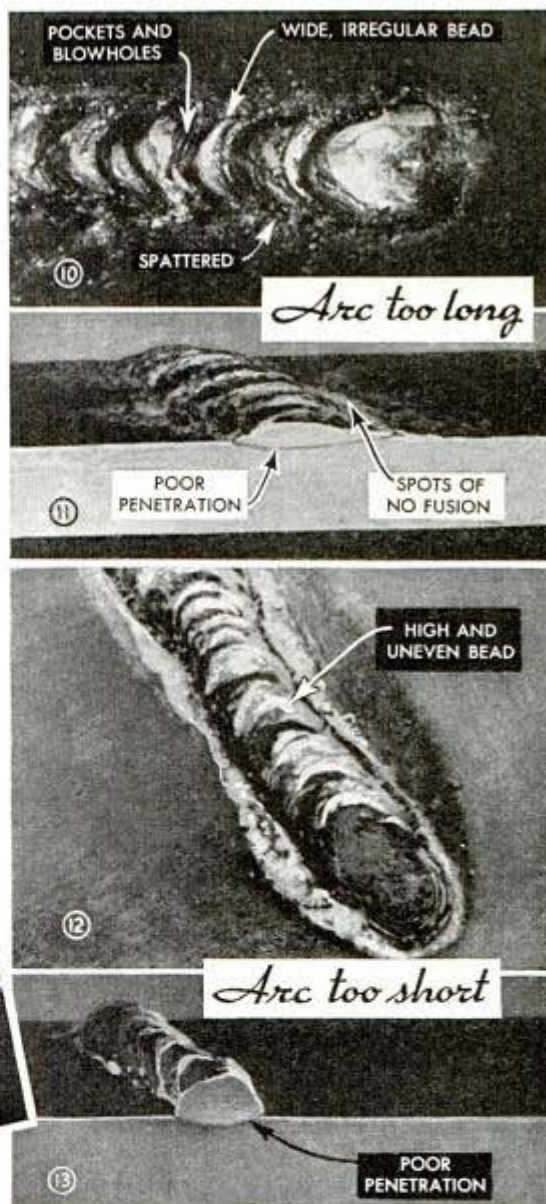
travels over the work in the opposite direction. While the metal is melting, the electrode coating is being consumed. As shown in the upper detail of Fig. 6, a gas is formed, which surrounds the arc with a protective shield, preventing the exposure of the molten metal to the air, and avoiding the absorption of oxygen and nitrogen, which is detrimental to the quality of the weld. The covering contains fluxing and slagging ingredients, which combine with the impurities in the molten pool, float to the top to form a coating of slag over the bead. The slag protects the molten metal and causes it to cool more slowly. As the electrode is being consumed, a cuplike condition at the tip of the electrode tends to shield the arc and helps direct the flow of weld metal.

Quality of a weld: Besides the sound that a correct arc produces—a steady frying and crackling sound—the shape of the molten pool and the movement of the metal at the rear of the pool serve as a guide in



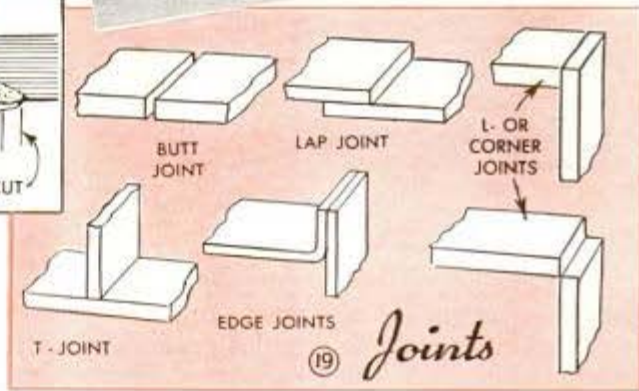
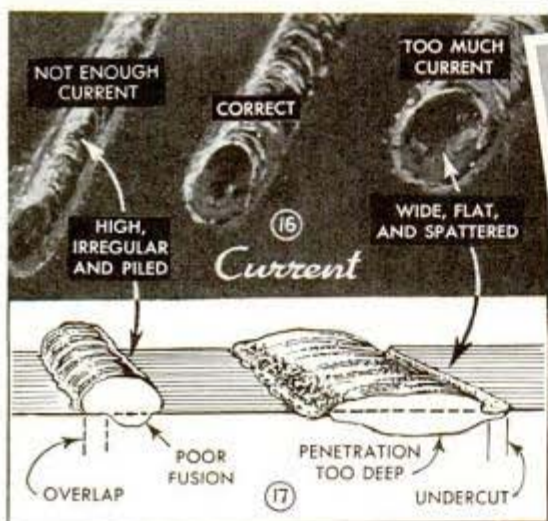
checking the quality of a weld. In a correctly made deposit, the ripples produced on the bead, which can be observed after the slag has been loosened and then removed as in Fig. 7, will be uniform, and the bead will be fairly smooth as shown in Fig. 8. The bead will join the plate with no overlap or undercut; it will have complete fusion and good penetration, as shown in the cross-sectional view of the weld, Fig. 9.

Arc too long or too short: If the arc is too long, the metal melts off the electrode in large globules, which wobble from side to side as the arc wavers. The result is a wide, spattered and irregular bead as shown in Fig. 10. Much weld metal in the form of spatter is left on top of the plate, there is poor fusion between base and de-



posited metals and there are slag inclusions. See Fig. 11. When the arc is too short, there is insufficient heat to melt the base material properly, and the electrode may stick to the work, in which case it can be broken loose, often by a quick twist or bend. Results of an arc that is too short are a high, uneven bead having irregular ripples. The fusion will be poor and there will be slag and gas inclusions. See Figs. 12 and 13. To maintain the proper arc length, the operator must feed the electrode to the work as fast as it melts off, as indicated in Fig. 14.

Angle to hold electrode: Besides its distance from the work, the angle at which the electrode is held, which normally should be nearly vertical to the surface of flat



work, affects the control of the molten metal because the arc has a definite directional force. Correct and incorrect angles in relation to the line of travel on flat work are shown in Fig. 15. Too low an angle is likely to produce a distorted bead and if the electrode is tilted too far toward either side, a lopsided and crooked bead results. However, in some types of welding, this directional force is sometimes used to advantage. When welding a T-joint the electrode is held at a 45-degree angle as shown in Fig. 21.

Arc blow: A condition is sometimes encountered where the arc tends to waver from its intended path. This is known as arc blow and is noticeable especially when welding with direct current and with bare electrodes. The waver is caused by mag-

netic fields set up around the work and the electrodes. It may be counteracted generally by changing the position of the electrode in relation to the work, or by changing the position of the ground in relation to the work, or by welding away from the ground.

Results of incorrect current: If the current setting on the machine is too high, the electrode will melt too rapidly and the molten pool will be too large to control properly. The resulting bead will be wide and flat, with considerable spatter as shown in Figs. 16 and 17. Penetration will be deeper than necessary and there will be an undercut on both sides. When the current setting is too low, there is insufficient heat to melt the base metal properly and the

molten pool will be too small for good control. The bead will be piled up and irregular, and there will be poor fusion.

Travel speed of electrode: When this is too fast, the metal does not stay molten long enough, which results in impurities being trapped and forming gas pockets. Then the bead will be narrow and the ripples pointed. The penetration will be irregular with undercut on each side. When the speed is too slow, the molten metal piles up, the bead will be high and wide, with a rather straight ripple. Also, with too slow speed, there will be considerable overlap and the

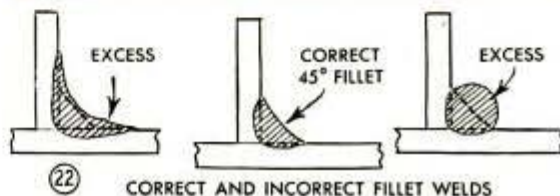
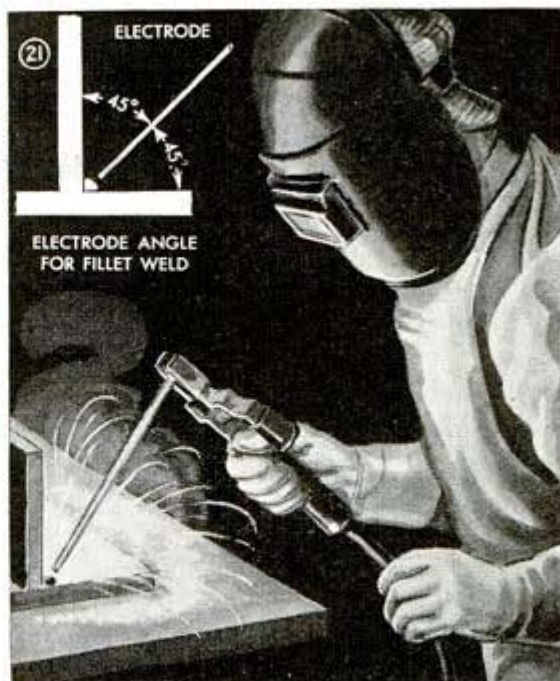
20 HOW METAL OF VARIOUS THICKNESSES IS PREPARED FOR WELDING

SIZE	BUTT JOINTS	T- JOINTS	L- OR CORNER JOINTS
1/8"			
1/4"			
OVER 1/4"			

penetration may be deeper than necessary.

Multiple passes: When a weld is built up by a number of consecutive passes, it is termed a multiple-pass weld. Where thin stock may require only a single pass to provide a good joint, thick stock requires multiple-pass welds in order to obtain proportional strength. See Fig. 18. When making multiple-layer welds the width of the weld should not exceed three times the electrode core diameter. Where it is necessary to make wider welds, two or more passes should be used.

Types of joints: In welding metals there are five commonly used methods of joining the pieces, as shown in Fig. 19. Butt and T-joints may be either open or closed. On thick metal, adjacent edges may have to be beveled by flame cutting, grinding, or chipping. Various cuts for joining edges on stock are shown in Fig. 20. There are four general types of welds, namely: bead (for building up surfaces), fillet (in corners as on T, L, and lap joints), groove, and plug welds. The size of a correct fillet weld is the leg length of the largest 45-degree right

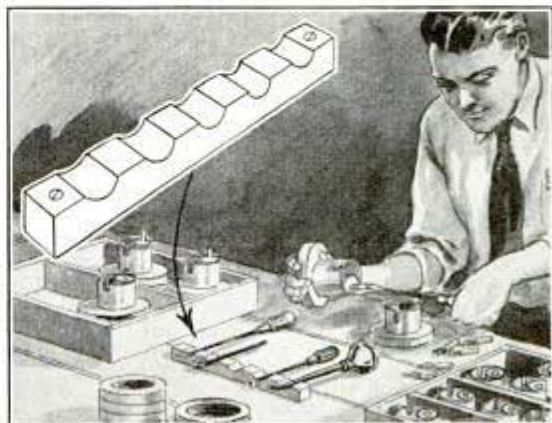


triangle that fits inside the cross section of the weld as indicated in Fig. 22.

With the rudiments of arc-welding practice as outlined in this article, the beginner should be able to advance quickly. To become an expert he should study the subject thoroughly from all angles, including various current adjustments for different types and sizes of electrodes, expansion and contraction problems, methods of counteracting distortion, physical properties of welds, and other related matter.

This Tool Holder Speeds Up Work on a Factory Production Line

Where it is necessary to use the same hand tools repeatedly in various operations, such as on a production line, this holder will enable you to work faster by keeping the tools positioned so they can be selected instantly. And, after using it a day or two, you will even be able to select a tool without looking at the rack because, after placing a tool in a particular spot a few times, the natural impulse is to pick it up from the same place. The holder is made as shown from 1-in. stock, and is screwed to the workbench in the most convenient position.—Allen Fiske, Chicago.



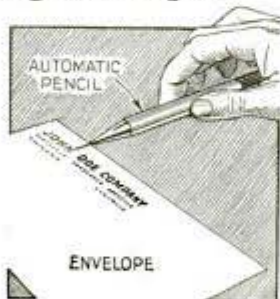
Coil Spring on Pressing Table Cleans Whisk Broom



Fastened to the underside of a tailor's steam-pressing table, a screen-door spring served as a comb to remove lint and pieces of thread from a whisk broom, which was used to brush out heavy fabrics. The spring was nailed in place with the coils stretched slightly. In use, the broom is pulled across the spring so that the straws pass between the open coils which remove the lint.

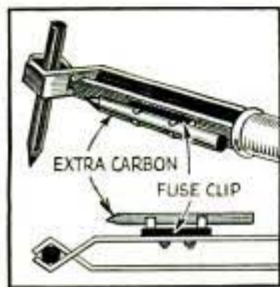
Automatic Pencil Used as Gauge When Printing Envelopes

When setting the gauge pins to print corner cards of envelopes, on a job press, one printer uses his automatic pencil as a measuring gauge. The lead is propelled or repelled to measure the distance of the printed line from the top of the envelope and the gauge pins are then set accordingly.



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Extra Carbon Carried on Torch Of Low-Voltage Welder



Attached to one side of the torch of a low-voltage electric welder, a couple of fuse clips provide a good means of carrying an extra carbon. If you carry the

welder in a tool kit for use outside the shop, the clips are handy to keep the carbon with the torch instead of having it clamped in place where there would be a possibility of breaking it. If desired, short lengths of welding or brazing rod may be carried in the clips.—W. C. Wilhite, Carlinville, Ill.

Barrel Bolt on Door Is Altered To Prevent Sawing It

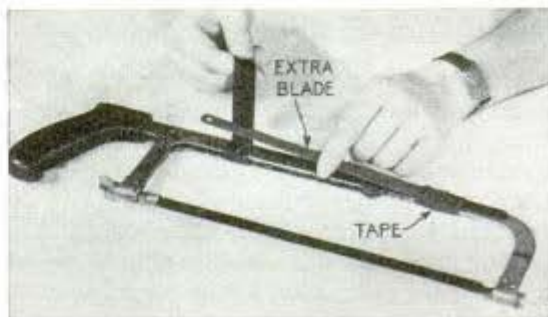
After his garage had been entered a couple of times by someone cutting off the bolt with a hacksaw run between the door and the casing, one owner altered the bolt so this could not be done. A piece of small pipe or tubing was substituted for the regular bolt, after which a steel rod was inserted inside the pipe and the ends of the latter peened slightly to keep the rod in place. If a saw is used with this arrangement, the pipe can be cut but when the saw reaches the pin the latter rolls so that it cannot be cut.



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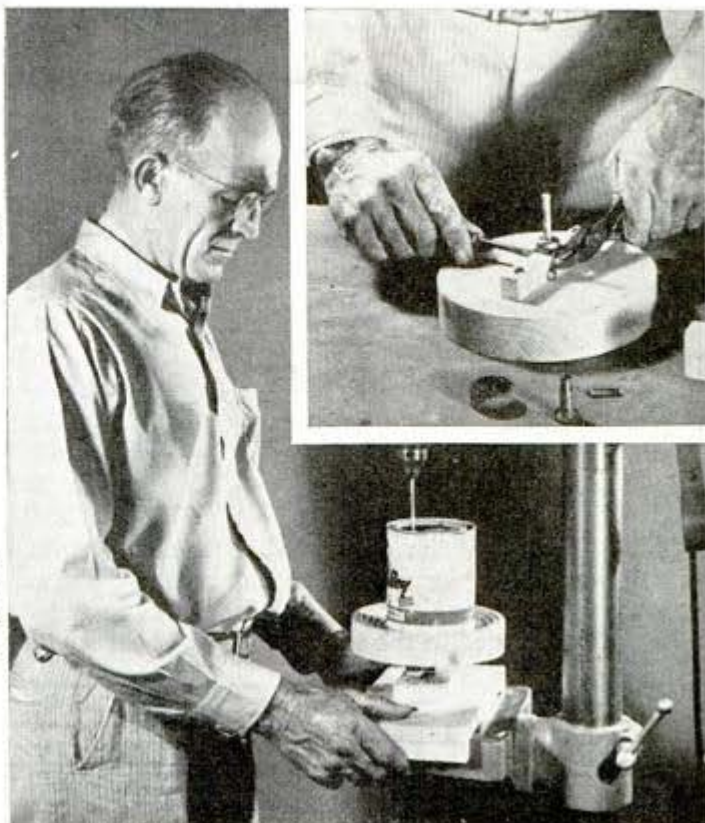
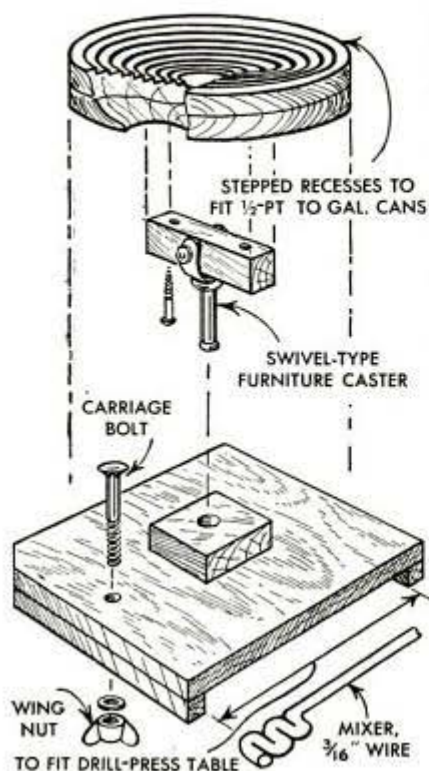
Spare Hacksaw Blades Carried By Taping Them to Frame

Tape an extra blade or two to the frame of your hacksaw and you won't have to worry about replacing a broken one when



working on jobs away from the shop. In this position, the extra blades do not interfere with regular operation of the saw and they can be removed to replace broken ones.—Opie Read, Jr., Chicago.

Paint Cans Rotated While Stirring in Drill Press



Stirring paint with a drill press is done more thoroughly and in less time if the paint can is set on a rotating disk. The disk has a number of stepped recesses turned in the top surface to fit cans of various sizes. A furniture-caster shank and a wood block pivot the disk to a base, which is cleated along two sides to straddle the drill-press

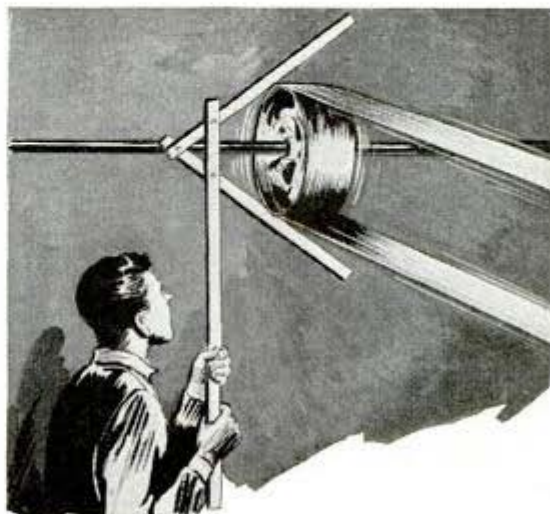
table where the base is held by a single bolt. A stirring rod can be made by bending a length of wire as indicated. Rotating speed of the disk is controlled by the position of the mixing rod inside the paint can. The nearer it is to the center of the can the slower will be the rotation.

—Frank Hegemeyer, Monterey Park, Calif.

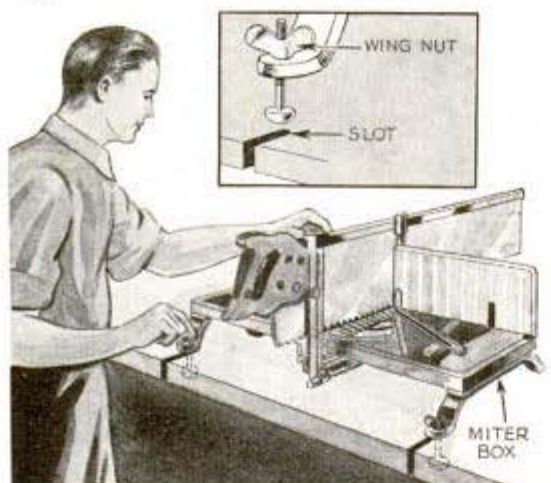
Diameters of Overhead Pulleys Measured With V-Stick

Having to measure diameters of several pulleys on an overhead shaft without stopping the machines driven by them, one mechanic used a V-stick, which was made by nailing three laths together as indicated. In use, the vertical lath was rested against the pulley shaft while the two shaped like a V were pressed against the rim of the rotating pulley. This marked the laths so that by measuring the distance between the marks the pulley diameter was found quickly. A piece of sandpaper erased the marks to measure other pulleys.

☛ Store honey in a warm, dry place. If kept in a cellar or other damp place, it is likely to absorb moisture and ferment.



Slots in Top of Workbench Permit Quick Attachment of Miter Box

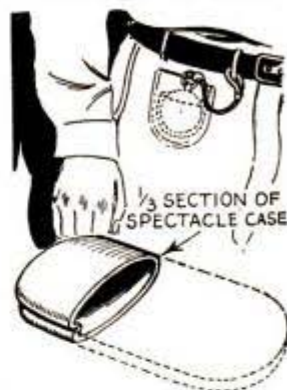


Two slots cut in the edge of the bench top as shown will permit quick attachment or removal of a miter box. Bolts fitted with wing nuts are used in the two front feet of

the box to slip into the slots and anchor the box when the nuts are tightened. Anchorage of the rear feet of the box is unnecessary for ordinary work.

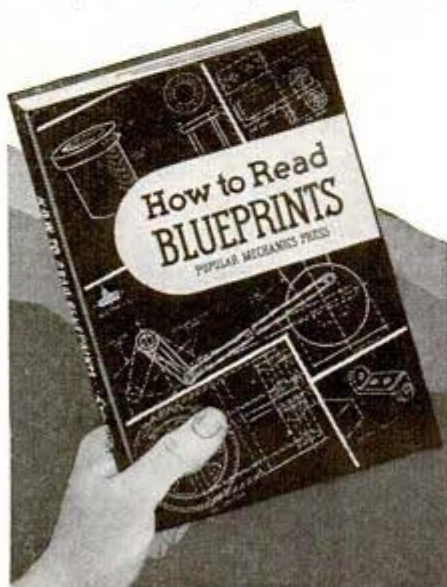
Spectacle Case Protects Watch

Mechanics and other workers who often have to carry heavy objects against their bodies in such a position that there might be danger of damaging their pocket watches, can protect the latter by using a section of a steel spectacle case. The case is cut off as indicated and is inserted into the pocket to receive the watch.



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Radio

First Aid for Home Sets

PART X

YOU may have an old receiver stored in the attic or basement that you discarded for a new one because you tired of the cabinet style or you purchased a new one because you wanted one with push buttons and other interesting gadgets. That old set may not sound as good as the new one but it is still useful as a standby when the new one develops trouble and no serviceman is immediately available.

If the old set was noisy, probably all that it needed was a new tube, volume control or a thorough cleaning. Dust filters into any receiver, and it often contains minute metallic particles that work their way between the rotor and stationary plates of the variable condensers, causing crackling and rasping noises as you tune over the band. Ordinary pipe cleaners can be used for cleaning between these condenser plates. Before beginning the cleaning op-



CLEANING UP THE OLD SET CHASSIS

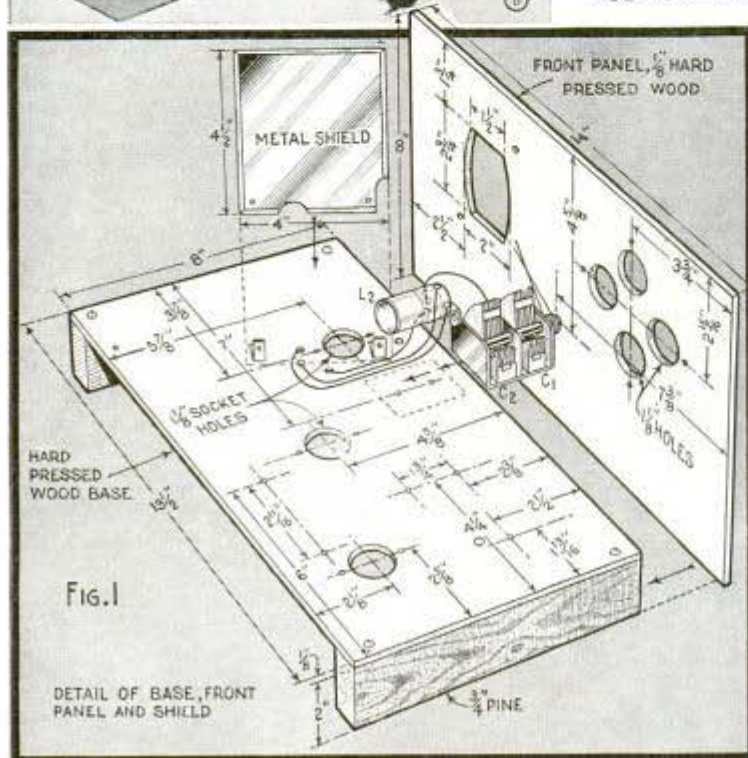
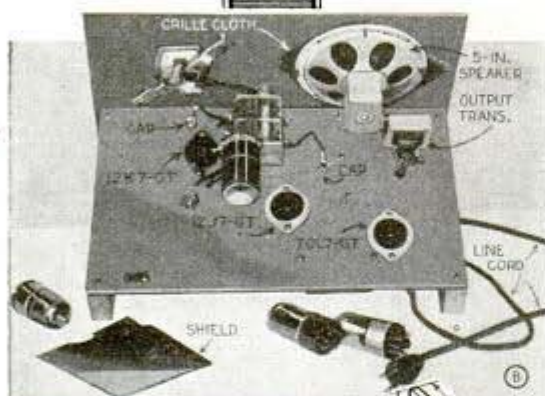
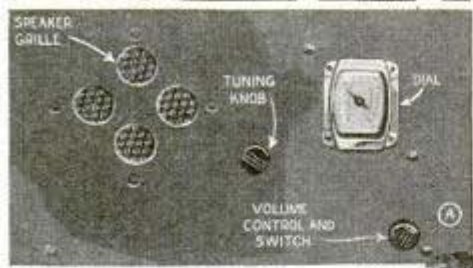


FIRST AID TROUBLE SHOOTING

eration be sure that the set is not plugged in. When plugged in to test for defective controls, touch nothing but the insulated knobs. Look for simple common troubles at the points indicated in the lower photo: (1) loose grid caps, (2) burned out dial lights, (3) slipping dial cord, (4) loose shaft setscrews, (5) dirty contacts on wave-change switch, (6) and (7) defective tone and volume controls, (8) electrolytic condensers loose on base, (9) bent rotor plates, (10) transformer for loose laminations, (11) defective cord, (12) "gassy" power tube.

(To be continued)

LITTLE GIANT THREE



MANY radio operators now in the service can trace their first interest in radio to certain outstanding student models of practical broadcast-band sets designed for home construction. The Little Giant a.c.-d.c. receiver that appears in each March issue of Popular Mechanics Magazine is an up-to-date simplified "sure-fire" beginners' set of this description. This "wartime" Little Giant for 1943 demonstrates a practical 3-tube tuned-radio-frequency circuit that can be built from odds and ends of parts. The coils are home-made, being wound on cardboard cases removed from discarded standard flashlight battery cells.

The straightforward TRF circuit is surprisingly sensitive; the original model pulled in stations 1,000 miles away at night with only a 15-foot wire for an antenna, and it is selective enough to be used in a city which has a number of powerful local stations. Assembled on a simple easily worked hard pressed wood base and panel, the only shielding required was provided by a flat piece of tin cut from a fruit can and the edges folded over, all details for which appear in Fig. 1. A simplified wiring diagram appears in Fig. 2 and this shows every

connection completed to each part below and above the base. It will be noted that the r.f. coil (L_2) is mounted directly on the frame of the 2-gang variable condenser by means of a small angle bracket; the frame of the variable con-

R. M. A. COLOR CODE FOR RESISTORS AND FIXED CONDENSERS

For Resistors		Unit: — Ohm	
Body Color	End Color	End Color	Dot Color
For Condensers Unit: — Micro-microfarad			
First Dot	Second Dot	Third Dot	
Black 0	Black 0	Black 0	Black 0
Brown 1	Brown 1	Brown 0	Brown 0
Red 2	Red 2	Red 00	Red 00
Orange 3	Orange 3	Orange 000	Orange 000
Yellow 4	Yellow 4	Yellow 0000	Yellow 0000
Green 5	Green 5	Green 00000	Green 00000
Blue 6	Blue 6	Blue 000000	Blue 000000
Purple 7	Purple 7	Purple 0000000	Purple 0000000
Grey 8	Grey 8	Grey 00000000	Grey 00000000
White 9	White 9	White 000000000	White 000000000

Note: In determining the capacity of a condenser from its color code, the dots are read from left to right with the condenser held so that the Trademark is in a normal reading position.

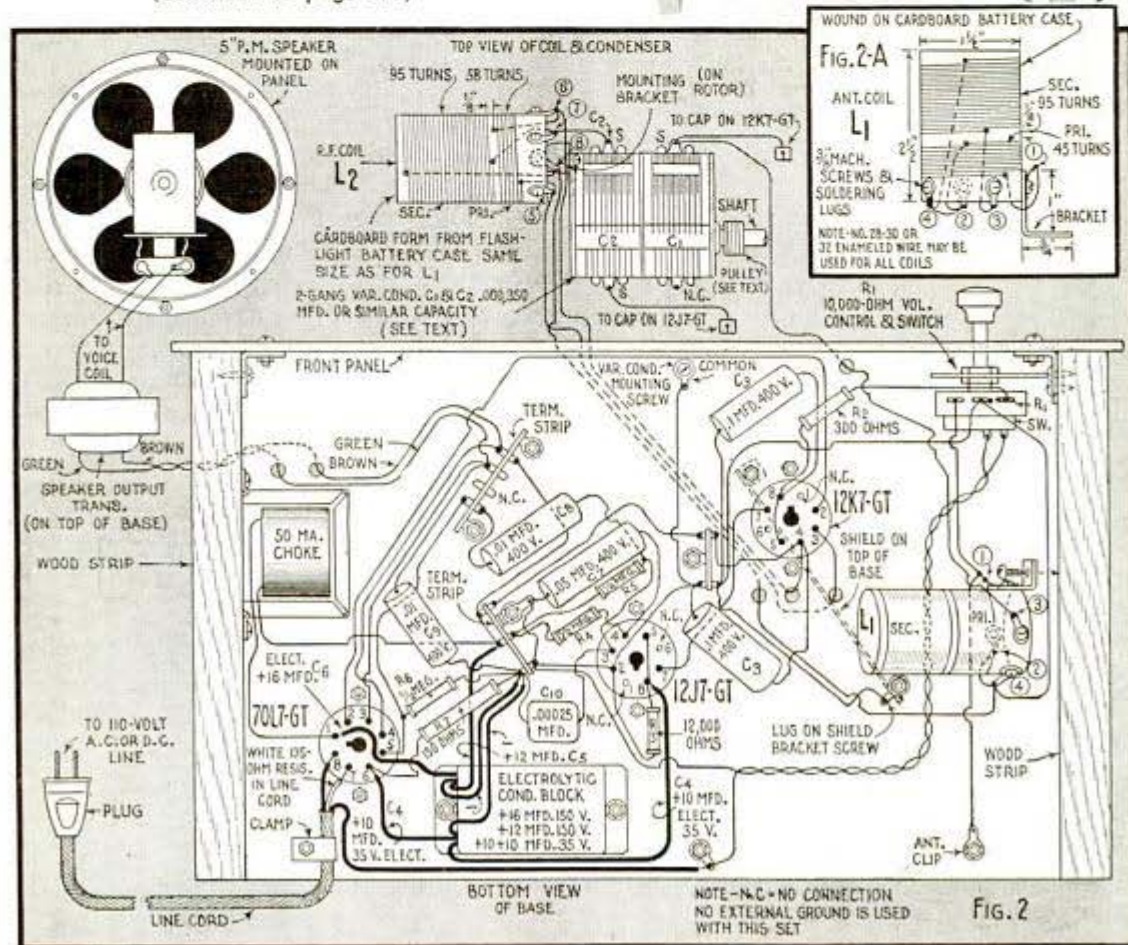
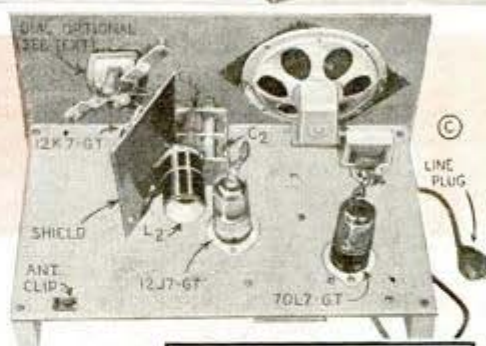
T.R.F. SET FOR BEGINNERS

HAND-WOUND COILS AND "JUNK-BOX" PARTS ARE USED IN THIS 1943 A.C.-D.C. T.R.F. SET FOR STUDENTS

denser being common with the rotor plates. The schematic circuit diagram appears in Fig. 3. Please note that no external ground is used on this a.c.-d.c. receiver. The single layer r.f. and antenna coils are both close-wound in the same direction; anchor each lead by "sewing" it through two small holes punched in the cardboard form and solder the leads to the soldering lugs in the manner shown and keyed by the mounting bracket which is lug number 1 on (L₁) and number 8 on coil (L₂). Check each lead in wiring with both the simplified and schematic diagrams.

A type 12K7-GT tube is used for the r.f. amplifier, and the 12J7-GT is the detector; a 70L7-GT tube is employed as a beam-

(Continued to page 172)



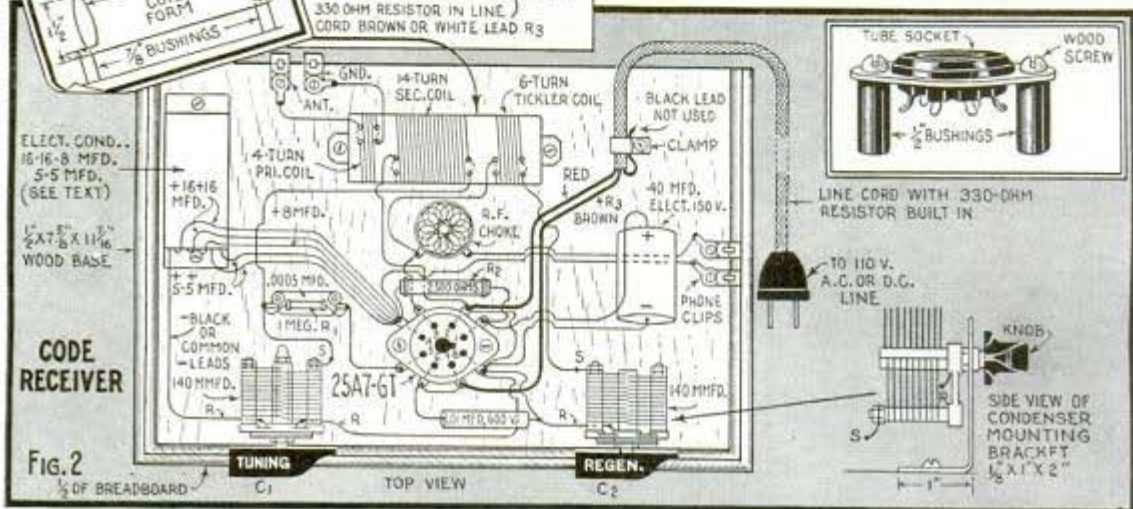
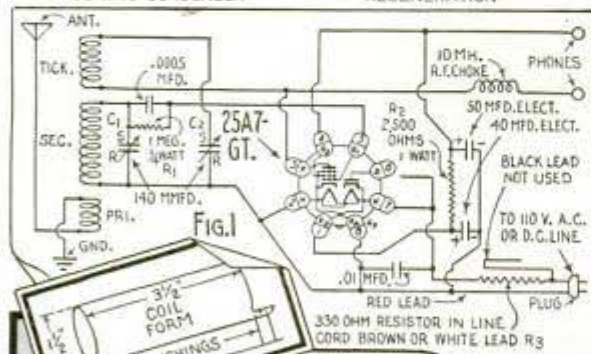
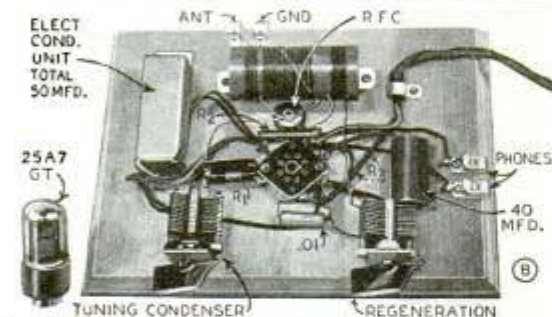
"Breadboard" S-W Receiver for Code Practice



DESIGNED as a companion article to the "Safety" Code Oscillator for radio students that appeared in the January, 1943, issue, this a.c.-d.c. short-wave receiver employs the same safety feature and uses the same tube for listening in on actual code transmissions on the air. Once some code efficiency is obtained, listening in on actual code signals is the best way to increase your code receiving speed and learn real message-handling procedure that will be of help in service training. Blueprint R-313 covers both code units, if you do not have a copy of the back issue.

The receiver is assembled on one-half of an ordinary breadboard, the other half being used for the oscillator. Actual frequency coverage is optional with the builder and depends upon the number of turns used on the secondary coil. With the coil used in the model, stations from 6 megacycles to 11 megacycles may be heard. The coil is wound with No. 18-28 magnet wire on the cardboard core from a toilet roll and measures 1½ in. in diameter. The 14-turn secondary winding was space-wound to occupy a length of 1½ in. on the form. Space-wind the shorter primary and tickler turns in similar manner; coat form with coil dope. The schematic circuit diagram appears in Fig. 1. Mount the various parts as shown in the photo and simplified wiring diagram Fig. 2, so that the grid and plate leads are as short as possible. Parts values are not critical and may vary within reasonable limits, with the exception of the line cord resis-

(Continued to page 173)

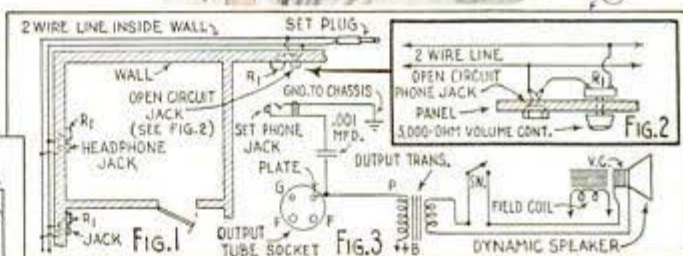
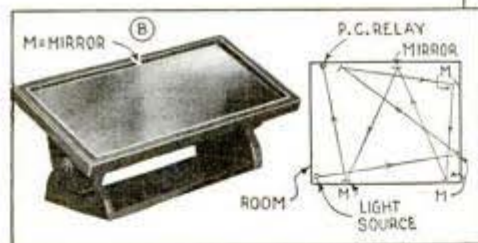


Helpful RADIO SUGGESTIONS

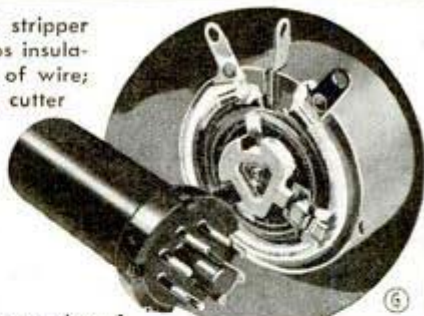
(A) Plug-in bedside headphone installation for the home serves up to 4 rooms. Ordinary twisted lampcord or similar insulated wire is run in conduit through the walls or along the baseboards to the various rooms where Bakelite wall outlet panels are provided as shown in Fig. 1. An open-circuit phone jack and a 5,000-ohm variable resistor, for volume control, are mounted on each panel and connected in series across the line as indicated in Fig. 2. A phone jack is installed in the receiver as shown in Fig. 3



(B) Adjustable mirrors used to reflect an infrared "black light" beam across a room to a photocell-relay burglar alarm for increased protection range. (C) Cloth holder for items needed during air raid blackouts fits over portable receiver; also serves to cover any light from front or rear of set. (D) Handy pull-out handle, for tube-base plug-in coils, made from small tool handle; permits removal of coil without damage to coil windings



(E) Automatic wire stripper which instantly strips insulation from all types of wire; also acts as wire cutter



(F) Pilot light saver for a.c.-d.c. sets. Connect a 1-watt wire-wound resistor (R) across the leads to the pilot light socket. The resistance value required depends upon the color of small bead in bulb as indicated in the table. Only a slight drop in illumination will be noticed, and bulb will last much longer. (G) Compact extra-heavy-duty power rheostat, only slightly larger than a tube. Contact is insulated from shaft by a center ceramic insulator. (H) Old headphone as code practice buzzer. Scrape edge of diaphragm and solder to one magnet lead; also scrape center of diaphragm bright. (I) "Ferrule" type resistors for quick replacement

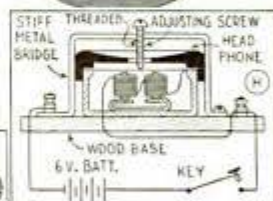


(F) PILOT LIGHT

BRACKET

BEAD COLOR IN BULB	R IN OHMS
BROWN	150
GREEN	30
BLUE	100

SEE TABLE TO SET CIRCUIT



Spring Action Phono Needle



This large scale model was used to demonstrate the spring action of a new concert phonograph needle that is claimed to play a year in the average home phonograph. The tip of the actual needle is made of a special alloy which reduces abrasive effects and is permanently welded to the "spring action" shank.

Soldering Iron Heat Control

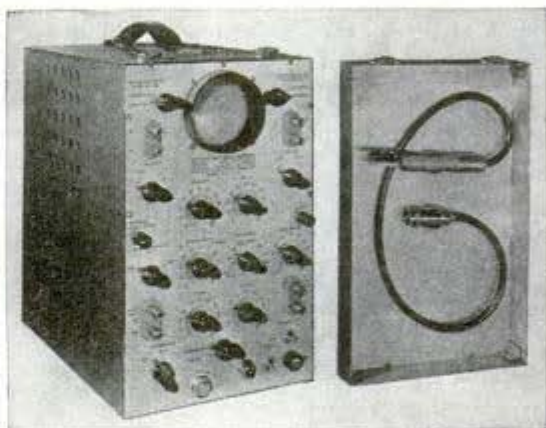
Rheostat control of soldering irons enables the worker to determine the correct



operating heat and maintain it at all times. This results in better work and effects important savings in production and maintenance costs. Correct heat saves on tinning, soldering tips last longer and the life of the element is prolonged. Rheostat control is also a power saver as irons are kept hot for standby and may be quickly adjusted to meet the job. The unit illustrated is supplied in a perforated metal cage, with knob, dial, series plug and cord. This control is also used with solder and glue pots.

Oscilloscope Has Wide Range

Critical wartime requirements are responsible for a new type of cathode-ray oscilloscope having a greatly extended frequency range, easier handling of applied signals, and a special pick-up means whereby input capacitance is reduced and stray pickup eliminated. The removable front cover protects the panel, controls and tube screen, and also holds the shielded



cable test probe when the instrument is not in use. In addition to conventional amplifier connections, signals can be applied directly to the deflection plates of the 3-in. cathode-ray tube, when desired, by means of terminals on the front panel.

Blueprints covering simplified radio construction articles in this and past issues are available for 25c each. Many popular tested circuits for beginners, students and experimenters may be built with used parts. Detailed material lists can be obtained from Popular Mechanics Radio Department upon receipt of postage.

NEXT MONTH—Homemade Universal Testing Bridge Measures Unmarked Radio Parts. This simple and highly efficient unit is capable of measuring salvaged resistors, condensers and chokes without the use of a meter. Also—**A 7-Tube Classroom Demonstrator Receiver, for Civilian, Army, Navy and Aircraft Radio Students.**

You may worry
about getting
to work on time



but here is one worry you can avoid

UNCLE SAM needs YOU in your war-job . . . whatever it may be. Equally important, he needs you on the job *all day, every day.*

That means you've got to keep your *car* on the job too . . . ready to get you to work on schedule! So stop car troubles *before* they start. Avoid excess chassis wear with Marfak lubrication.

Marfak helps add miles to your car's life by *cushioning* king pins, tie rods, drag links and other vital friction points. Marfak especially resists the washing-out effect of snow, slush and rain. It's super-tough. It "stays put."

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Never say "grease-job." Insist on genuine Marfak 40-point Lubrication Service. At Texaco and other good dealers everywhere.

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On the air every Sunday night, Columbia Network.



METROPOLITAN OPERA: Complete broadcasts of great operas every Saturday afternoon, Blue Network.



You're Welcome at **TEXACO DEALERS**

Tornado in a Bombshell

(Continued from page 95)

try cannot build in a day or a month the tremendous factory additions required to fix nitrogen in the quantities now needed—quantities wholly unprecedented and unprovided for in our peacetime planning.

Natural nitrates, such as Chile saltpeter, furnished practically all of the nitrogen used by the Allies in World War I. Germany likewise used natural nitrates during the early years of the war, but before the conflict was over began extracting nitrogen from the atmosphere by a process invented just before that war started. After the war private industries in the United States developed atmospheric nitrogen fixation on a large scale and during the last 12 years or more these industries have supplied all industrial and practically all agricultural demands.

The first step in the fixation of nitrogen by direct synthesis is the manufacture of ammonia, which consists of one atom of nitrogen and three of hydrogen. While this sounds simple, the process is actually rather long and involved. To begin with, coke, the almost pure carbon left after certain gases and tars have been driven from coal, is poured into six-story-high gas generators and ignited. Air is blown in at the bottom, which raises the coke to a white heat, and oxygen from the air unites with carbon to form carbon monoxide and carbon dioxide. Trapped with these gases at the top of the generator is nitrogen, which makes up about four-fifths of the air.

The air is then turned off and steam is turned on. The white hot carbon (coke) splits the molecules of steam, combines with oxygen to form carbon monoxide and sets the hydrogen free. The alternate blowing of steam and air through the coke goes on continuously, 24 hours a day. Fresh coke is added at the top of the generator.

To obtain nitrogen and hydrogen in pure form from this gaseous mixture, the carbon monoxide and carbon dioxide gases must be removed. This is done in a rapid-fire succession of chemical and physical punishments including pressures up to that in the breach of a large cannon at the moment of firing. The mixture is "scrubbed" with water which carries off the carbon dioxide in solution, leaving the less soluble nitrogen and hydrogen behind.

Finally, the hydrogen and nitrogen atoms

find themselves alone. With a metal catalyst acting as the chemical parson, they are wedded and you have ammonia.

For the making of explosives the ammonia is converted into nitric acid. This is done by burning the ammonia in air at a very high temperature and in the presence of another chemical parson, whereby oxides of nitrogen are formed. The wedding this time is between the nitrogen part of the ammonia and its old friend, the oxygen of the air, from which it had been physically separated back in the ammonia factory. The resulting oxides of nitrogen combine with water to form nitric acid, ready to be mixed with sulphuric acid for the final steps in the manufacture of TNT and other explosives.

At a time when bullets, bombs, shells and torpedoes take up a large share of the day's news, the average citizen gets the impression that all the explosives in the world are going into munitions. This is far from the truth.

Most important of the hard-working industrial explosives is dynamite. In peace, the United States uses about a million pounds of it every day—350,000,000 pounds a year. In this war year, America will use about 450,000,000 pounds. Dynamite is helping produce more steel, more coal, more copper. It helps speed cantonments and airports, excavations and harbors. On one island outpost dynamite is quarrying 20,000,000 yards of rock for a single giant air base. At one navy ammunition storage dump it's helping build 3,000 "igloos," each of which stores a quarter of a million pounds of ammunition.

Dynamite helped cut and surface the Alaska highway. It has helped to bring power to our war industries from the great new dams—Norris, Grand Coulee, Shasta and others. It helps mine iron ore and this year is doing the biggest job in history in the iron lands of Lake Superior. American cities, railroads and vast industries have grown up in a roar of exploding dynamite.

Dynamite is to the industrial field what TNT is to the battlefield. Both are essential to the successful and efficient prosecution of the job in hand.

¶To learn where to buy commercial products described in these pages, see the index.

KEEP 'EM
SLUGGING

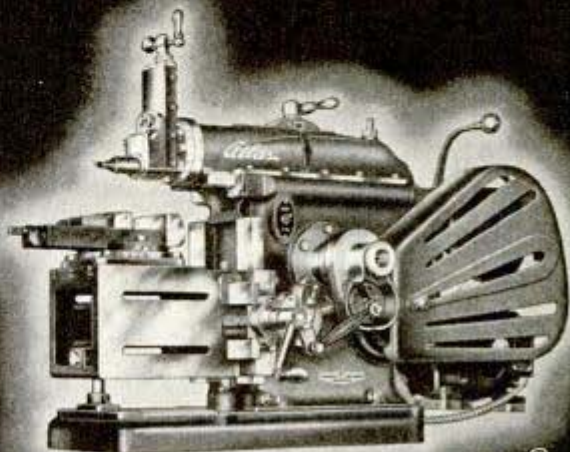
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WAR BONDS

Atlas "FIGHTING TOOLS"



Milling Machines

Under engineering development for two years, this compact Milling Machine was ready for active work when Uncle Sam's industry began tooling up for planes, guns, ships, and tanks. It handles the complete range of milling—from slabbing and facing cuts to end milling, keyways, finishing and layout work. Operates from 1/3 HP 1740 RPM motor. Precision ground table is 4½" x 18".



Shapers

These are great time and money savers in the victory program. They relieve larger machines of all work within a 7" stroke. Work set ups are faster, cost is low, motor required is but 1/2 HP. Features include crank-type bull-gear drive, 4 speeds, 5 automatic cross feeds, complete V-belt drive. Atlas Shapers are steady reliable producers in key war plants and serve important military units.



ASK the men of the army and navy maintenance forces . . . ask the men on America's fastest production lines . . . they'll tell you a most familiar trademark today is "ATLAS." They see it on Atlas Lathes, Drill Presses, Milling Machines, and Shapers. They see it everywhere behind the lines because Atlas Tools are in great demand and Atlas production has won the coveted Army-Navy "E" Award. As a potential Atlas buyer you can be glad Atlas is producing "fighting tools." It means the Atlas equipment you want after the war is proving its precision and rugged strength in the toughest test of the ages. Atlas Press Co., 343 N. Pitcher St., Kalamazoo, Mich.



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WILLIAMS

SUPERIOR DROP-FORGED TOOLS

Back Seat Driver in a Bomber

(Continued from page 43)

a signal to ground stations which determine from their findings his exact position and radio it back to him. This is called a "fix."

Recently, a bomber crew sank a supply ship and wanted to be sure about the location. The pilot radioed his base stations:

"Just sank enemy ship. Get me a 'fix.' Am not sure where I am."

The operator called back:

"You're at the top of the class."

If the operator had radioed his position, the listening enemy might have sent out some swift fighter planes to intercept the bomber. As it was, the enemy had as good a chance of making a "fix" on the bomber as the radio operators at his base. That is why much of radio navigation must be ruled out for military operations.

Because of the telltale nature of radio, the navigation cadet spends 34 percent of his training time star gazing. Celestial navigation, used by mariners for centuries, is both simple and accurate. However, "shooting" the stars from a fast-moving airplane is much different from carrying out the same operation on board a ship. The Pan American Airways Communications Department pioneered in adapting the instruments and methods of calculation of celestial navigation to aeronautical uses.

The cadet learns the names and positions of the stars and planets. Before he gets his wings, Polaris, Ursa Major, Arcturus, Venus and Jupiter are as familiar to him as the red and green traffic signals in his home town.

Under average flying conditions, the navigator on an ocean flight of thousands of miles can determine the position of his plane within five or 10 miles. With his sextant, which the navigator considers almost as a third hand, he takes his position from a star directly along the line of flight or directly to the right or left of the plane. He makes at least nine shots and takes the average. His guideposts are 52 trustworthy stars that don't choke off their "beams" when the air raid sirens sound.

The navigator is taught to play safe by directing his ship to a point perhaps 15 miles to the north of his destination. When he reaches that point he cuts south and finds the city, tiny island or whatever his

destination happens to be. This is known as "landfall." Many navigators believe Amelia Earhart was lost because of a landfall made on the wrong side of a Pacific island.

Aside from the sextant, the five fundamental instruments with which the bomber navigator works his magic are a clock or watch, altimeter, compass, air speed indicator and drift sight. The uses of the first three are obvious. The clock, set to the second with Greenwich Civil Time, enables him to plot accurately the charted course in units of time; the altimeter takes care of the third dimension of air travel, and the compass points the course. The needle of the air speed indicator affords information regarding departures from level flights.

The gyroscopic drift sight combats the principal complicating factor in all forms of air navigation—the wind. Immediately after a takeoff, and whenever he deems it advisable en route, the navigator takes a drift reading. While the pilot flies a straight course, the navigator peers down through the indicator with its field of vision crossed by straight and parallel lines. In taking a "double drift," the pilot is directed to fly off the course and back onto it forming a right triangle with the actual course making the hypotenuse. This enables the navigator to calculate wind directions, velocity and ground speed.

The navigation cadet learns to work with these instruments and many others in actual flight. For every five hours in his classroom on the ground, he spends one hour in the air and the average cadet flies about 15,000 miles. His flying schoolhouse, usually a twin-motored plane, has a cabin equipped with three desks where the cadets work under the close supervision of an instructor. The cadets take turns in navigating a single flight by pilotage, dead reckoning, radio and celestial navigation, for all the navigational methods are used with each other.

Inscribed on world maps on classroom walls are the words of President Roosevelt:

"We shall carry the attack to the enemy. We shall hit him and hit him again, wherever and whenever we can reach him."

The aerial navigator is playing a mighty role in helping the United Nations "reach him."



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My Boys Shoot Down Zeros

(Continued from page 25)

them back to safe landings. It is dangerous to go behind a mountain and overlap wings with your messmate. You will be washed right out of the school.

Washouts and blackouts and redouts are all dangerous. A washout is the end of your piloting career. We eliminate any man from this advanced training school who shows a lack of coordination. In his first nine weeks in civilian pilot training school he should have learned to fly "by the seat of his pants." In nine more weeks at an army flying school he should have mastered flying by instruments, formations, night flying and navigation. If in the next nine weeks at Basic School or the final nine weeks at Advanced School he still skids or slips in a turn, he is through as a pilot, although there may be room for him in some other branch of the Air Corps.

Blackouts are one of the little unpleasantries of power diving, but the first is the worst. As is well known, the blackout results from the draining of blood from the head by centrifugal force as a plane pulls out of its dive. It may be even more pronounced in a steep bank. Temporary anemia of the brain occurs until circulation is restored. By raising his feet and bending his head down between the legs a pilot can avoid a blackout to some degree. Through experience most of us acquire an automatic resistance to the blackout which I cannot explain. Fortunately the flier does not relax his grip on the stick while semiconscious, and it is still back, holding the plane in a climbing attitude, when he recovers.

The redout, less known, is far more serious. This occurs under certain conditions when flying inverted, such as an outside loop, the blood being forced into the brain. Then the blood vessels may literally explode in the brain. A pilot may endure a blackout pressure equal to seven "G's"—seven times gravity—but a redout of three G's would be fatal.

A blackout is not the only hazard to consider when you're diving. Remember, before you toboggan past the 2,000-foot level, that it takes between 4,000 and 5,000 feet to pull out of a dive at 400 miles an hour.

If you sign up as a flying student today, you may be just 11 or 12 months from Hawaii or the Bomber Command in England or Africa. You start with five weeks

of hardening and drill, then two months of flight training at a civilian school. Then to an Army Basic school for navigation, Link trainer, blind flying, instruments and the beginning of specialization. There are nine months in training centers, then two or three months of transitional training. At each school you solo all over again, and about the time you hit an advanced school like that where I teach multi-motor piloting you are elected to a special career.

Bomber or fighter? You can say which, although your field commander will decide. If you're the sort of fellow who loves to sweep swallows off the telegraph wires with his wing tip you probably will be made into a fighter pilot, unless the instructor catches you at it. If you're the steadier sort, you'll probably head into the Bomber Command, or perhaps become an instructor. My job may be less glamorous, but the bottleneck is in instructors. I have orders to recommend the steadiest, most promising among my pupils for training as instructors. We miss the thrills of battle, but we are instructors by official order, and we realize we're doing a vital job. We know that every student's combat ability relates directly to his instructors. And we do get a vicarious kick when some of the youngsters we've graduated in the last few months come back and account to us for the Zeros they've knocked down.

One boy came back recently with the story of his part at Midway. One incident was particularly interesting to us, who teach bomber pilots. Bombers, you know, are supposed to bomb and avoid fights. The Japanese Zeros learned early in the war not to molest our Flying Fortresses, and they let the B-17's alone pretty religiously. But a squadron of Zeros was tearing into one of our medium bombers when a Fortress, flying high, observed the scrap and dived to protect the twin-engine bomber. The Zeros scurried for their kennels as soon as they saw the Fortress.

The Fortress wasn't built as a fighter but it fills in very nicely on occasion. Conversely our fighters weren't built for bombing, but they've toted small bombs on occasion. However, every plane is designed for a specific job, and we have more specialized types than any other air force. We

(Continued to page 168)

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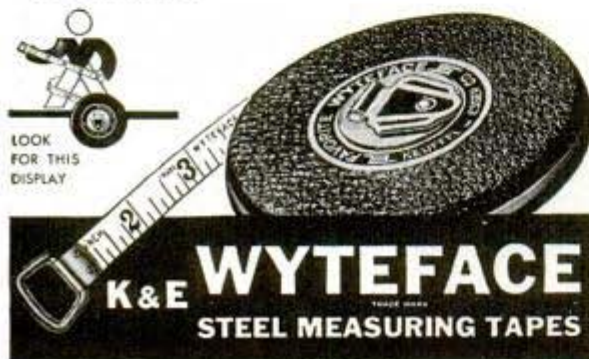
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teach bomber crews to keep after their objective and ignore any alluring targets they find along the way. As an example, a flight of American bombers over Europe once sighted a beautiful target—a German division arrayed along a highway inviting an attack from the air. The Yanks in the Fortresses would have loved to strafe those troops, but passed up the privilege, called the home base to report the position, and continued to their assigned objective.

To our bombers and those of the R.A.F., an objective is never just a city. It is a particular war factory or railroad yard, sometimes even a particular spot in a factory. I know of at least one occasion when a bomber squadron planted its eggs on a known vital spot in a factory which would put the entire plant out of operation—let's say it was an assembly line or a power room—and, having demolished that vital spot, wasted no bombs on the rest of the plant. The Allied bombardiers set their sights on the key; the Germans just try to plaster a downtown section indiscriminately. Our Fortresses, the least vulnerable bombers, are given the day shift for precision bombing from high altitudes; the British bombers, less fit for accuracy at extreme altitudes and less well protected, take the night shift over Europe.

When the boys come up here to "finishing school," each instructor is assigned five students to take through the nine weeks course. Precision navigating is an important part of the curriculum. Celestial navigation comes in a still more advanced school. Here we teach pilotage—navigation by landmarks—and dead reckoning, which is plotting a course by time, air and ground speed and wind drift. We turn this tough mathematical work into a sort of glorified "cops and robbers" game. You might call it Yanks and Zeros. I'll tell my students that a certain railway train left Salt Lake City at a certain hour. They have maps of the railroad. They are to leave singly at various assigned times and intercept the train. They know the winds in the neighborhood of the field, and must estimate the train speed and their own and plot a course to meet the train. I'll be there to see that they do. Or I'll send each of my five students by different routes with orders to rendezvous at a certain town at a specified minute. Or they'll be sent on a

(Continued to page 170)



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triangular course; they know that I shall be leaving a city 112 miles from here at 2:37 p.m., headed for home at 162 miles an hour, and each is to meet me at a specified point and time. There's plenty of mathematics to spoil their aerial sightseeing on that trip. They are allowed an error of one minute in meeting me, for I'm not going to sit up there and wait. Eventually they make the rendezvous to the second.

Young man, you have a busy day here. Up at 5:30, fifteen minutes to dress, 20 minutes of calisthenics, 30 minutes for breakfast, 25 minutes to police your room, then inspection. Three hours in ground school follow, then an hour of military drill, an hour of athletic games or swimming, and lunch. After lunch you're on the flight line; 15 minutes of conference with your instructor, three hours in the air, and an hour off before supper at 6. Time for recreation until 7:30 p.m., then two hours of home work, and in bed at 10. If you behave you get one afternoon off each week, besides Saturday afternoon and Sunday.

Nor is your instructor idle. Besides having to put you through your paces on the ground and in the air, I have to put in 100 hours a month flying, plus hours of studying code, marksmanship, and the Link trainer. We have, in addition to weekend leaves, seven days off every four months. That's more than you got when you were a teller at the First National Bank.

From here you'll go on to a more advanced school for medium or heavy bombers. For a transitional month you will get acquainted with your first real bombing planes. Then you will be assigned your own crew and your own ship, and they will be yours for the war. You'll paint a pet name on your ship and you'll get to know its personality and its idiosyncracies just as you knew the feel of your old car. You'll work with the same crew until you are a team, thinking alike, knowing precisely what every teammate is doing and anticipating what he is going to do next. In your second month you will engage in combat practice, bombing runs, laying real eggs on real targets and more precision interception. Then, for a final month, you will fly your ship and navigate it all over the United States. It's sort of a triumphal tour for your winning team, and a good look at the country you'll be fighting for. In another month you may be in there slugging.

Preparing for the Worst

(Continued from page 53)

"Improvements in technique make possible gas attacks on a far wider scale than any seen in the first World War. Fleets of airplanes equipped with chemical tanks make it possible to spray large areas with vesicant (blistering) liquids, not only on military personnel, but upon the civilian population as well. That a gas attack is considered possible at any time is evidenced by the fact that all of the belligerent nations have equipped their armies with gas masks. General staffs do not require soldiers to carry three or four pounds of extra weight just for fun.

"Mussolini, besieged by the sanctions of 52 nations, did not hesitate to use mustard gas on the unprotected Ethiopians to bring to a sudden end the first Abyssinian campaign. We have the testimony of Haile Selassie himself that mustard gas was the final blow which lost his war. Neither Hitler nor Mussolini has forgotten this."

Of the vesicant liquids, mustard gas has the odor of horse radish, irritates the lungs and causes delayed blisters, and Lewisite smells like geraniums and burns the eyes, lungs and skin. Mustard gas persists in its deadly effects from three to 20 days. During that time, anyone entering the gassed area not properly protected will suffer its effects. Lewisite persists one to seven days.

Two other lung-irritating gases are chlorine, a heavy yellow-green gas with a highly pungent odor, and phosgene, which is colorless and smells like fresh hay ensilage. Chlorine irritates the lungs, while phosgene burns the throat and eyes and causes coughing and choking. Both persist usually less than ten minutes.

Adamsite is an irritant smoke, with the smell of coal smoke, which causes headache, nausea and violent sneezing. Diphenyl-Chlorasine belongs to the same family, having the odor of shoe polish. A white-gray cloud of smoke, it causes a temporary mental depression.

Vast supplies of chemical agents will be necessary if the United Nations are forced into the use of gas. The Chemical Warfare Service has taken the steps to provide these supplies. America's enemies would do well to think seriously before launching the gas warfare that some authorities feel certain will come before the struggle ends.

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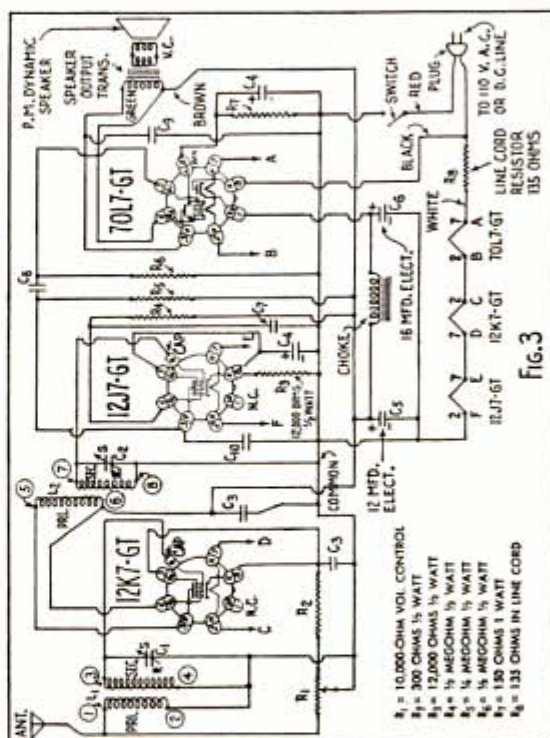
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Little Giant Three for Beginners

(Continued from page 157)

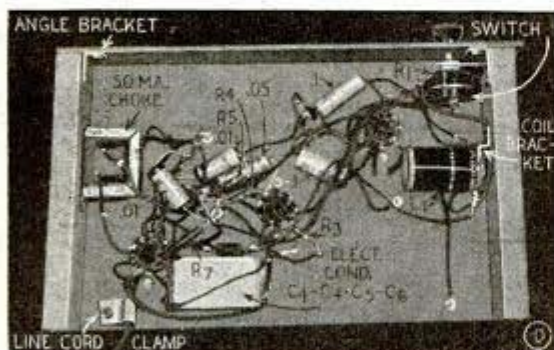
power amplifier and rectifier, making the set equivalent to a 4-tuber. The dial is a common broadcast type salvaged from an old set, the pointer being operated by means of a small wooden pulley cemented to the tuning condenser shaft, and driven with a "fishline" belt with a small take-up spring. The dial arrangement is optional and depends upon whatever the builder has on hand. A common flat dial plate may be mounted directly over the shaft on the front panel and a pointer knob used if pre-



ferred. Any small permanent magnet dynamic speaker with a matching output transformer may be used. This transformer can be mounted either on top of the base near the speaker or directly on the speaker. Photos A, B, C and D show various views of the completed set. The R.M.A. color code chart is given as an aid to the builder in identifying the values of standard fixed resistors and condensers. A detailed list of the non-critical materials used in the original model can be obtained from Popular Mechanics Magazine radio department without charge, if desired.

To test the set, use a short indoor antenna for local stations, and a good outdoor

antenna for distant stations. Line up the set by tuning in a station at the high frequency end of the band (with the rotor plates of the tuning condenser almost open) then adjust the trimmers on the tuning condenser sections C_1 and C_2 for the strongest signal from that station, making



slight adjustments of the trimmers and re-tuning the station each time. If a whistle occurs when tuning over the band, readjust the trimmers until all signals are clear. A No. 40 pilot light may be connected in series with the tubes in the (white) lead from R_8 to A_7 , see Fig. 3, if desired. The blueprint number is R-312.

"Breadboard" S-W Receiver

(Continued from page 158)

tor. The tuning and regeneration control condensers are both 140 mmfd. A smaller tuning condenser may be used but the frequency coverage will be less. A larger tuning condenser will crowd the stations. The regeneration condenser may be larger by 50 percent, but the number of turns on the tickler coil should be reduced in this case.

Either single or sectional type electrolytic filter condensers may be used and their voltage rating may be as low as 25 volts. A 5-section type with all sections paralleled was used to obtain a total of 50 mfd. The tuning condenser locates the station and the regeneration control adjusts oscillation. The receiver must be oscillating to receive most code stations. To remove line voltage from exposed parts of the set, polarize and mark the line cord plug by means of a 110-volt lamp in a porcelain screw-type socket with two 5-in. leads. Touch one wire to the ground clip and the other to the rotor plates of one of the variable condensers. If the lamp lights, reverse the plug in the wall socket.



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Sharp Shooting With 'Hand Irons'

(Continued from page 37)

working on a new revolver that has far greater range, hits harder, and is easier to aim than the handguns now in use. Miller is one of the gunsmiths leading in the development of the new super high velocity bullets. Some of his high speed .22 caliber rifle bullets do more damage at long range than do Army rifles.

Miller is testing a .22 caliber revolver bullet that has a muzzle velocity of around 3,000 feet per second, using a big charge of powder in a short shell that is necked down to hold the small .22 caliber bullet. Fired from a revolver with a 6-inch barrel, the bullet has an almost straight-line trajectory for 100 yards and is effective up to ranges of around 200 yards, four times the range of conventional revolvers. The usual recoil or muzzle lift is almost entirely lacking because of the light weight of the bullet. The bullet hits where it is pointed and because of its high rotational speed has a stopping power far in excess of ordinary police handgun ammunition. Ordinary lead slugs won't stand this velocity, so the high speed ammunition is jacketed.

Aside from being an improved weapon for police and peace officers, such a revolver may be equipped with a telescope and used in place of a rifle for hunting game. A two-hand rest at a sitting position makes the revolver about as steady as a rifle. Deer and other game are ordinarily killed at ranges of from 100 to 200 yards, well within the range of the high speed .22 revolver bullet. Not yet on the market, the new type of bullet and gun are also adaptable for riot gun use and for small one-shot "personal protection" guns.

Many of the hair-raising stories that have been told about the shooting exploits of old frontiersmen are sheer fiction or, at best, greatly exaggerated. New high speed revolvers such as Miller's may make some of these old stories possible for the first time, but not even such guns as these will make possible the exploit that one old-timer claimed he used to do. This quick-draw artist claimed that in his prime he could put five shots through the neck of a bottle, pointed toward him from across the road, so quickly that the last shot had entered the neck before the first shot went through the bottom of the bottle!



ask the boys from the Aleutians!

THE storm-swept roadsteads of the Aleutians were never made for "happy landings". No placid harbors here, no capacious wharves or rippling beaches! So, crashing through gale-lashed breakers, the dories, skiffs and work boats go . . . landing on craggy coastlines . . . handling ton-by-ton the precious cargoes of men and materials, food and supplies, that must be safely ferried from ships to shore.

It's a "destruction test" for small boats — and for hundreds of rugged Evinrudes that help drive them. At many a tough spot, a few short weeks is long life for battered boats . . . but salvaged motors drive *on and on* . . . peacetime products proving their stamina in grim and relentless wartime service.

Today, new Evinrudes are being built for only one purpose . . . *to help win the war*. When that need is past . . . and you're thinking of buying a new motor again . . . just "ask the boys from the Aleutians" — and from many another front! Ask *them* what they learned about motors, out there where the going really gets tough!



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The Longest Road in the World

(Continued from page 31)

Are there sufficient supplies and service facilities in South America for large-scale, long-haul trucking? There is oil in Venezuela, Colombia, Peru and Argentina; Venezuela is the second largest oil producer in the world. There are large quantities of asphalt in Venezuela and Peru for highway building. There is rubber in Brazil, Colombia, Ecuador, Peru and Venezuela.

South America has a population of approximately 90 million with a vast pool of labor available to maintain a fleet of trucks and thousands of miles of highway.

Materials vital to war production are available in many parts of South America: chromium, manganese, cocconut shell char, mica, nickel, quartz crystal, quinine, rubber, tin, tungsten, magnesite, graphite, diamonds, and vegetable oils. Long distance overland transportation of these may be several times as costly as peacetime shipping, but the safety of lives, ships and cargoes and the greater dependability of delivery during wartime might well justify the higher costs of trucking over the Pan American Highway.

As a partial solution of the shipping bottleneck, critical materials could be trucked from Argentina and southern Brazil westward to Chile and northward through Bolivia, Peru, Ecuador, Colombia and Venezuela to seaports on the Caribbean Sea or to the port of Buenaventura on the Pacific coast of Colombia. From these "ports of accumulation," ships could take the short cut across the Caribbean or the relatively shorter and safer Pacific route to North American ports with minimum exposure to submarines. Another road will connect Cali and Palmira, Colombia, on the Pan American Highway, with Buenaventura.

Peru and Bolivia, too, are stepping up auxiliary road construction. Nearing completion is a 350-mile highway which will

link Lima, Peru, with its eastern empire across the Andes, with a terminus at the river port of Pucallpa on the Ucayali River. From here river boats connect with Iquitos at the head-waters of the Amazon, to which 3,000-ton steamers ply from the Atlantic mouth of the Amazon. Thus a transcontinental Atlantic Ocean-Amazon River—Pacific Ocean river-road artery may soon traverse the widest part of South America.

Ships crossing the Gulf of Mexico and Caribbean Sea from South American "ports of accumulation" could be docked in the United States at Houston, New Orleans, Mobile, or other ports, or at Tampico or Vera Cruz, Mexico, from which highways and railways run to the United States.

Another alternate shipping route is from the oil center and port of Talara, Peru, or from Buenaventura, Colombia, up the Pacific coast to Acapulco, Mexico (whence a surfaced highway connects with the Pan American Highway at Mexico City) or the ports of Mazatlan, Manzanillo and Salina Cruz which are connected with the United States by railways; or ships can sail directly to United States west coast ports.

Our "Burma Road" linking the Americas is close to realization. The few remaining gaps are rapidly being closed. They can be, and quickly, if we can build a wilderness road to Alaska in eight months. Every mile of highway built and used now may save lives, ships and vital cargoes. Development of the Pan American Highway as the "Lifeline of the Americas" will prove of inestimable value in maintaining a continuous flow of materials to United States war industries and a return flow of essential goods to the other Americas. It would be a lifesaving artery if the Panama Canal were damaged. And it would remain as visible evidence and perpetual nourishment for our "Good Neighbor" policy.

Saving the Air Force "Rejects"

(Continued from page 77)

Dr. Strong continues:

"The young men that we are putting into the air services today have lived their lives in an atmospheric pressure of between 14 and 15 pounds to the square inch. We are going to require that they operate efficiently under an atmospheric pressure of per-

haps $3\frac{1}{2}$ pounds to the square inch. Some of these men have been out in temperatures of 30 degrees below zero a few hours at a time, but we must think of them operating efficiently a high-powered airplane at 50 degrees, and more, below zero.

(Continued to page 178)

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REASON: Casein Glue (CASCO) is easier, more fool-proof to use than resin. CASCO is "self-bonding," needs only moderate, not extreme pressure. Has "filling action" on poorly fitted joints. Highly water-resistant, withstands any interior conditions except extreme dampness or mold. Used at any temperature (above freezing).

RULE 2

USE RESIN GLUE: Where a water-proof, moldproof or stainfree glue is required—boats, outdoor furniture, screens, in damp basements, on thin veneers, etc.

REASON: Resin Glue (CASCAMITE) is completely waterproof, moldproof, stainfree. (Resin glue requires well-fitted joints, smooth wood surfaces, positive clamp pressure and workroom temperature of at least 70° F.)



CASCO Powdered Casein Glue

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"All of us on the earth's surface are moving through space at the rate of a little more than 12 miles per second. This has no effect upon us because the atmosphere is moving at that rate with us. Perhaps a number of aviation candidates have traveled in automobiles for a short period of time at 80, 90 or 100 miles an hour. One has to think of these things to get a rough idea of what may happen when, in an airplane, the candidate assumes a speed of 300 to 400 miles per hour, perhaps more, at atmospheric pressures ranging from 14 to 3½ pounds per square inch.

"The effect of high-velocity diving and the centrifugal force of high-speed turns in airplanes have caused many crashes in all countries. One need not be a specialist in medicine to realize how important it is that we maintain the highest physical standard in the young manpower for this work."

Often a candidate fails for no other reason than that he is afraid he will not pass the examinations. This fear may have such a disturbing effect on blood pressure and heart action that the subject may be unable to pass a routine physical test. In a case like this, psychoanalysis might be worthwhile, to permit the candidate to voice, and thus rid himself to a large extent, of the subconscious fear.

With the need for fighting pilots so great, and the necessity for maintaining high physical standards so important, the foundation's task of salvaging men for the air services assumes real significance.

Air Depots on Wheels

(Continued from page 63)

ert, jungle and Arctic, a half-track truck which can negotiate heavy going through sand or mud, must be used. All air force vehicles carrying gasoline for the air forces are equipped with gasoline segregators which eliminate water from the fuel.

A lifesaving unit is the flight operations trailer which has mechanical devices that make it safe from gas attack. This trailer provides all the principal facilities found in any airport operations office.

Using all this equipment in more than a score of combat areas are Air Depot Groups and Air Service Groups, maintenance and supply units which can move whenever a combat unit shifts its position. The Air Depot Group performs the heavier

repairs, hence is equipped with a vast assortment of vehicles and machines that form an air base several miles behind the combat unit. Between depot group and combat unit is a service group equipped to perform repairs of less serious nature.

At the outset of World War II, it became obvious that the increased speed of modern aircraft and ground vehicles must be matched with increased speed in supply and maintenance units. In the early stages, the United Nations placed large stocks of supplies at large bases. In some instances, these stocks were destroyed by the enemy. Since operations now are worldwide it was deemed necessary to organize many smaller concentrations of supplies operated by mobile units. With the idea that these units would have the four purposes of supply, maintenance, repair and salvage, the name of "Air Depot Groups" was selected.

Many depot groups are in the field and in training. Each is complete, being comparable to an infantry regiment, and ready to see service in isolated areas at considerable distances from major bases.

After a period of initial training at one of the big air depots, the group is moved out to a "Staging Area," where training is continued under what approximates conditions in the theater of operations. It is contemplated that this stage of training will include the repair of airplanes and engines of different types with the block testing and actual flight testing of the repaired airplane. Many non-commissioned officer ratings are offered in the depot groups. In the training process the group receives some 20 percent of the instruction in military subjects and 80 percent on technical subjects. "Graduation" results in a highly organized "machine shop" crew of over 1,000 officers and men.

Even newer than the Air Depot Group is the Air Service Group, which operates close behind the flying unit in the field. This group is charged with servicing aircraft, fueling, and making light repairs. The mobile base carries supplies for several service groups and each group is equipped to serve several flying units.

Without its transportation system, the Air Corps would be ineffective, lacking any maintenance and repair service. A victorious air force is a co-ordinated machine of men and equipment. The machines keep rolling to keep the airplanes flying.



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Jungle Mechanics

(Continued from page 71)

hide behind the nearest tree. The rhino can't rely much on its eyesight, but its sense of smell is acute. Infuriated by the human smell, the rhino drives toward Matata's contraption. With its terrific horn, it jabs upwards against the network.

But, instead of being thrust up through space, the network falls limply upon the rhino's head, sticks to it, envelops its eyes, nose and ears. Maddened, the beast hurls itself against the nearest tree. But Matata has run behind another trunk, and from there lets out a shrill cry. The rhino turns, charges again, hears a cry from another direction, whirls, makes a new attack.

The perilous game continues. But Matata is light and agile and experienced. The brute is led on and on, with terrific impact knocks itself against one trunk after another. Its energies become spent. Finally, exhausted, the rhino makes a supreme effort, hurls itself against one more tree, reels, crashes to the ground and can be speedily finished by a stab of the knife, through one of the few soft spots not protected by the rhino's armor.

Matata's native cunning, the knowledge he has inherited from his forefathers, the inventive talent upon which he must rely to survive, have triumphed once more.

Fighting the baboons is different. They come by hundreds, storm a granary, gorge themselves. One can catch or kill a few, but they are too numerous to make any difference.

But the Wambas are not easily stumped. They have noticed that the one and only thing which can rout baboons in panic is a snake. So they kill the biggest snake they can find. They trap a baboon and a dozen men hold down the snarling beast. Before it knows what's happening, the head of the snake is fastened to its tail.

At a word, all the men let go. The baboon leaps away; the snake, naturally, follows. The baboon runs frantically, climbs a tree, swings from branch to branch, but the snake never lets go. The baboon rushes toward his tribe, screams for help, and at sight of the snake all the other baboons flee in terror. The chase becomes a race, and before it ends the tribe of baboons is far away, never to return to the place where such extraordinary snakes grow.

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The Battle of Brains

(Continued from page 5)

pounds; previous machines of equal power were two stories tall.

One apparently minor, but tremendously important step achieved by this company was the substitution of plastic fuses for trench mortars, which saves a pound of bar aluminum every time a mortar is fired.

One accomplishment of General Electric was the reconditioning of the propulsion apparatus of the submarine Squalus, which sank off New England. Raised after 16 weeks under 240 feet of water, the sub has joined the Pacific Fleet, and under the new name of the U.S.S. Sailfish, has torpedoed and sunk a Japanese warship.

Explosive rivets engineered by Du Pont are performing quick repairs on damaged planes; Mareng cells, rubber tanks engineered by United States Rubber Company, are turning ordinary freight cars into liquid carriers.

Other miracles of engineering are being conducted in the reclamation of metals and the development of new ones, in building construction, in straightening out kinks in assembly lines, in the production of new and more deadly weapons. If you get some pleasant surprise in the trend of this war during 1943, much of the credit will be due to the engineers who are fighting a valiant battle of brains.

The Army's Giant "Five-by-Five"

(Continued from page 13)

The entire project, including grading and roads, cost about \$70,000,000—enough to build a battleship.

One interesting section contains the special suites of Secretary of War Stimson and the General Staff. Here are fine offices, dining rooms, kitchen, sleeping quarters and the only passenger elevator in the building.

Already the public is asking what use will be made of the building after the war. It's anybody's guess, but those best informed believe it will continue to serve as a federal office building and possible storehouse of archives. Right now the Pentagon architects will admit only one fault in the building—it isn't big enough. Vast as it is, the War Department cannot squeeze all of its workers under the green slate roof of the Pentagon.

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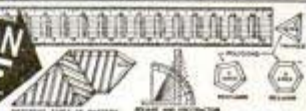
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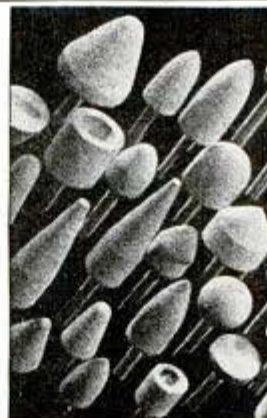
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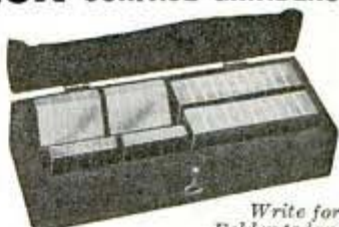
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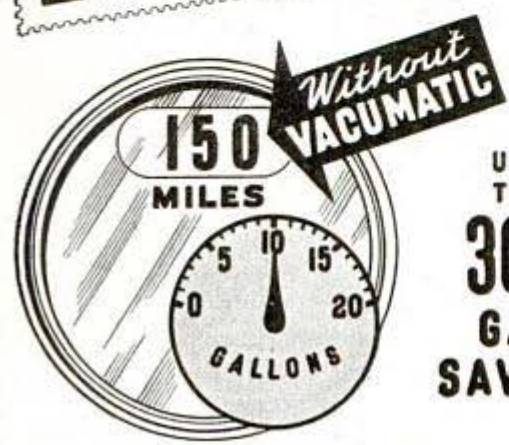
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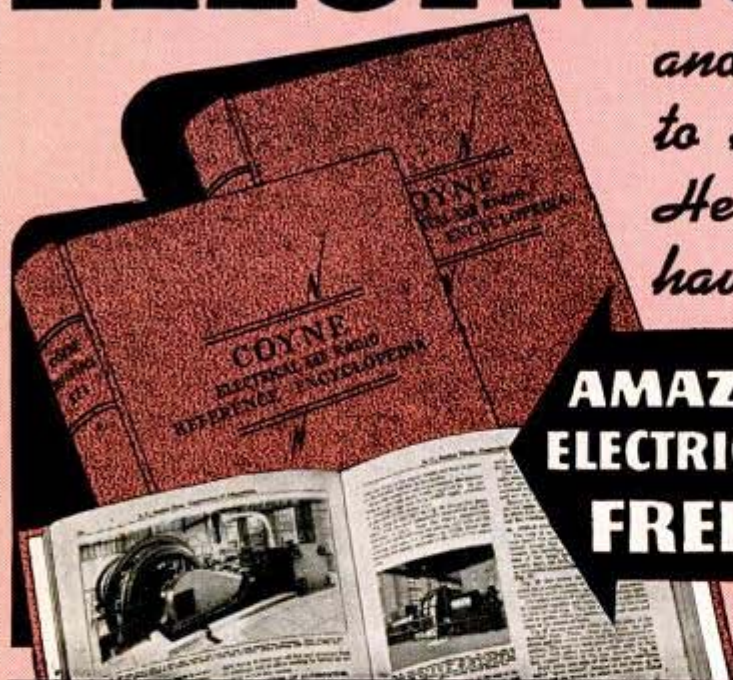
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