

Hitler's 500-Acre Headache

POPULAR MECHANICS

MAGAZINE

WRITTEN SO YOU CAN UNDERSTAND IT

NOVEMBER
25 CENTS
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NATIONAL WAR FUND



THREE FRONTS—ONE CAUSE

SEE PAGE 27

Completely at Sea

ABOUT WHAT BATTERY TO BUY?



BUY THE BATTERY THAT IS THE CHOICE OF EXPERTS

Why not let the experts help chart your course when you buy your next battery?

A million-mile, trans-ocean flying record has just been established by a Pan American Clipper equipped with Auto-Lite batteries. Auto-Lite batteries, too, are specified for service with our fighting

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Manufacturing Plants at: Niagara Falls, Indianapolis, Atlanta, Oakland, Oklahoma City, Toronto
BACK THE ATTACK WITH WAR BONDS



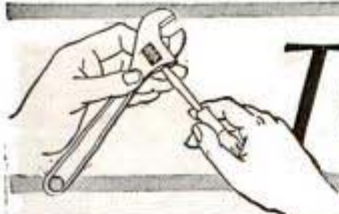
The "Million-Mile" Pan-American Clipper uses AUTO-LITE Batteries for its ocean-spanning record-breaking flights.

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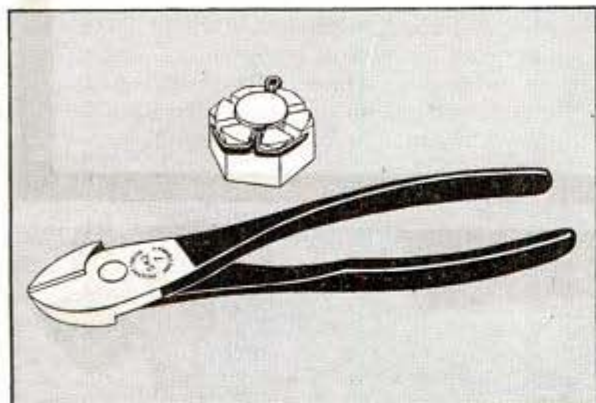
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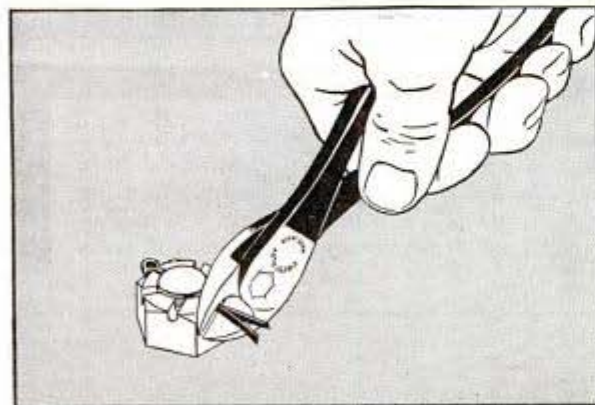
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"How To Do It"
Information For
Crescent Tool Users

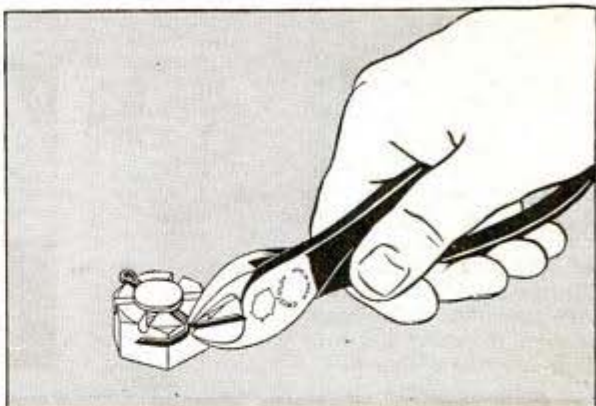
No. 13 HOW TO REMOVE COTTER KEYS



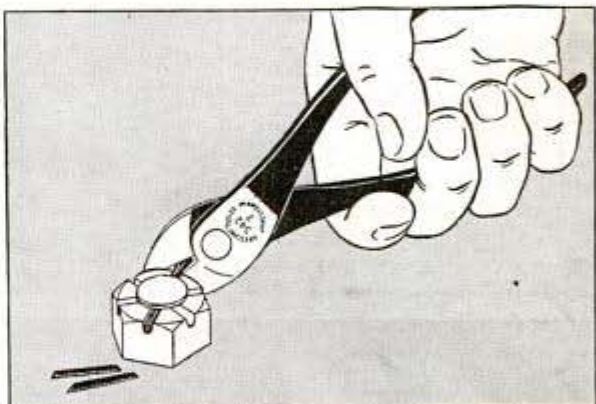
The following is a simple, effective and workmanlike method of removing cotter keys. It is not safe practice to reuse these keys and this method makes it impossible. Crescent's Heavy Diagonal Pliers, No. 542, should be used for this purpose.



First, straighten out the spread ends sufficiently to permit cutters to "bite" both pieces at one time as shown in following illustration.



With cutters close to nut, as shown above, sever spread ends with a single cut.



Now grip the head or "eyed" end of the cotter key as shown above and with a sideways motion, pry the cotter key out. *Don't attempt to pry it out without first cutting off the spread ends.*

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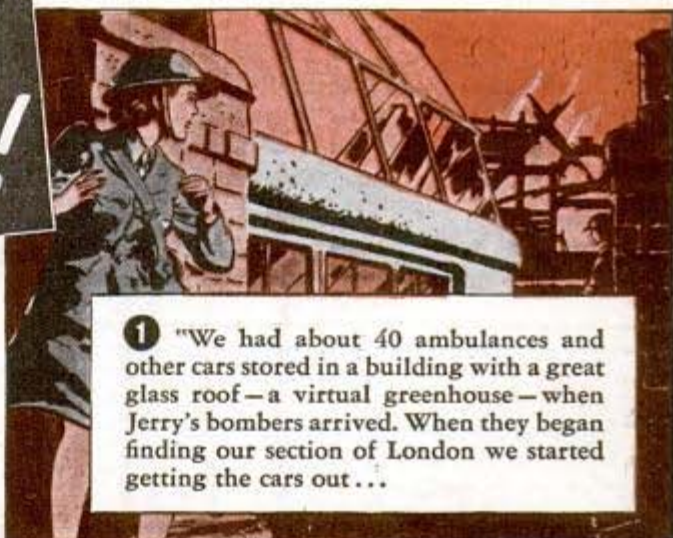
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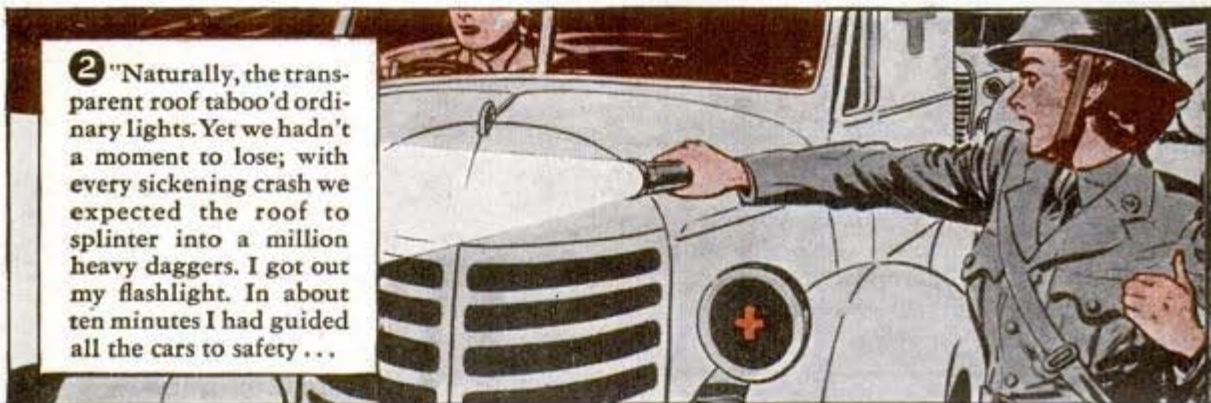
BLITZED IN A GREENHOUSE!



(The exciting experience of Margaret Bridges, of the London Auxiliary Ambulance service, during one of London's heaviest raids. Pretty, attractive 30-year-old Miss Bridges is part English, part American. She volunteered for the ambulance service, reporting for duty just three days before war was declared.)



1 "We had about 40 ambulances and other cars stored in a building with a great glass roof—a virtual greenhouse—when Jerry's bombers arrived. When they began finding our section of London we started getting the cars out..."



2 "Naturally, the transparent roof taboo'd ordinary lights. Yet we hadn't a moment to lose; with every sickening crash we expected the roof to splinter into a million heavy daggers. I got out my flashlight. In about ten minutes I had guided all the cars to safety..."



3 "I was working alone in my office when the roof finally did cave in. Only my flashlight could have helped me find a way through that deadly, glittering sea of broken glass... You begin to see why ambulance drivers must always carry flashlights with fresh batteries!"

Your dealer may have no "Eveready" flashlight batteries. If so, please don't blame him—almost the entire supply is currently going to the armed forces and those war industries with the highest priority ratings.

Send for "You and the War," official O.C.D. guidebook to all vitally important war posts available to civilians. This free booklet tells exactly what there is to do and how to do it. Write National Carbon Company, Dept. DR, 30 E. 42nd St., New York 17, N. Y.

NATIONAL CARBON COMPANY, INC.
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FRESH BATTERIES LAST LONGER...
Look for the DATE-LINE



Popular Mechanics Magazine

Registered in U. S. Patent Office and Canada

H. H. WINDSOR, Founder

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

November, 1943

Vol. 80, No. 5

Next Month

SPIES have landed on American shores. They were very promptly snared in the FBI's efficient spy trap before they could perpetrate any sabotage. There have been derailments on the railroads, explosions in powder plants, sabotage in warplane factories—but not one incident has been traced to a paid enemy agent. As J. Edgar Hoover, director of the FBI, tells one of our staff writers in an article in the December issue, the war is going into the seventh inning and thus far the FBI has scored a shutout. Since the days of gangsters and kidnapers, hunting spies and draft dodgers has been a 24-hour job for G-men.

Task Force

WHEN the Navy has a job to do, a task force does it. There may never be two task forces alike; each is tailored of just the right component of destroyers and small craft, cruisers, aircraft carriers and perhaps battleships to accomplish the mission of the moment, which may be something as critical as the Battle of Midway. Next month, "Task Force—the Pick of the Fleet," tells how the flotilla is selected for its job.

Giant of the North

TWO-YEAR-OLD secret, the Shipshaw hydroelectric power plant in the wilds of northern Quebec will soon be ready to take off its wraps and go to work. A December feature tells how construction gangs battled 50-below-zero weather to dam the waters of the Saguenay, building a 1,500,000 horsepower plant to power nearby giant aluminum factories.

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Umbrella Army

BACK from Africa, three young veterans of the Yankee paratroops held a reunion at Camp Mackall, N. C., and traded stories while a member of our staff listened in. One had made the lowest parachute jump in history. Another, badly wounded, had survived a 20-millimeter shell that burst inside a transport plane, killing six men. The third had walked away unhurt after a 500-pound bomb hit the dirt 25 feet from where he lay, then had a jeep shot from under him the same day. For a stirring story of the paratroopers in action, read "Umbrella Army" next month.

Putting the Fight in Fighter Pilots

WHEN that budding fighter pilot levels off and streaks head-on for his instructor's plane, to pass it at a relative speed of 800 miles an hour, that's the beginning of as deadly a duel as any he'll fight—except that camera guns substitute for bullets. If he graduates from this school at 20,000 feet, he will go on to more hours of dog-fighting and formation flying at treetop and substratosphere altitudes in a "finishing school" for fighter pilots, described in a December article.

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CLEAN OUT THAT ENGINE NOW!



THE TOUGHEST MILES ARE YET TO COME!

It's easy to put off the job of getting your car ready for colder weather. But, Mister, if you neglect your car too long, it may neglect you!

Miles will get tougher now. Against this, your car can stand a good check up, end to end. Start in by giving the engine a good clean out with Pyroil. Ten to one this will eliminate troubles before they hatch.

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Keep your car fit until Victory. Pyroil will help you do it. Ask your service station man about this, today. Manufactured and Guaranteed by Pyroil Company, W. V. Kidder, Founder, 511 Pyroil Bldg., LaCrosse, Wisconsin, U. S. A.



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Send details of your Plan for Distributors

Name

Address

City or Town..... 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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Can a man have "Oomph"?

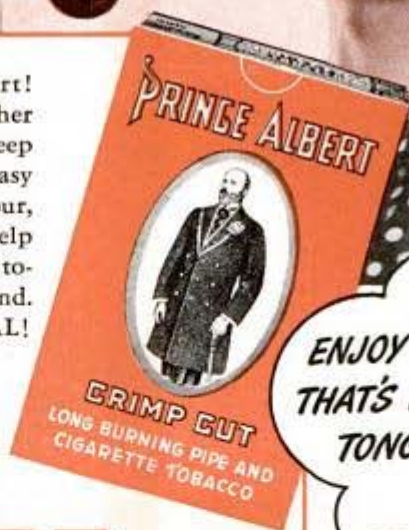
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Pipe Appeal



PIPE APPEAL—Prince Albert!
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TONGUE—

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P.A.**

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AND
STAMPS

50 pipefuls of fragrant tobacco in every handy pocket package of Prince Albert

70 fine roll-your-own cigarettes in every handy pocket package of Prince Albert



This One



68J5-ZZN-S3CA

NOVEMBER, 1943

5A

Материал, защищенный авторскими правами

"FUSSY" CRAFTSMAN? These are the tools for you!

FOR CRAFTSMEN who want to know their work is accurate, Millers Falls makes an interesting line of precision tools including 14 sizes and styles of steel rules and slide calipers — light, semi-flexible, flexible, and narrow. They're all of carefully heat-treated crucible steel, ground and polished, and graduated with precision by dividing engines developed and perfected by our own engineers over a period of forty-odd years. Accuracy guaranteed.

THOUGH moderately priced, Millers Falls surface gauges are well-made, well-finished, and unusually versatile. Base is ground for use on flat surface plate and grooved for cylinder. Scriber is spring-held in position as thumb nut is tightened . . . a big help for quick, accurate settings. Spindle can be used as depth or scratch gauge. Many other features for accuracy and convenience demonstrate this tool's background of long skill and experience.



L O N G
AMONG the most highly-prized items of Goodell-Pratt (now part of

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MILLERS FALLS TOOLS

SINCE
1868

MILLERS FALLS
COMPANY

Greenfield, Mass.
U.S.A.

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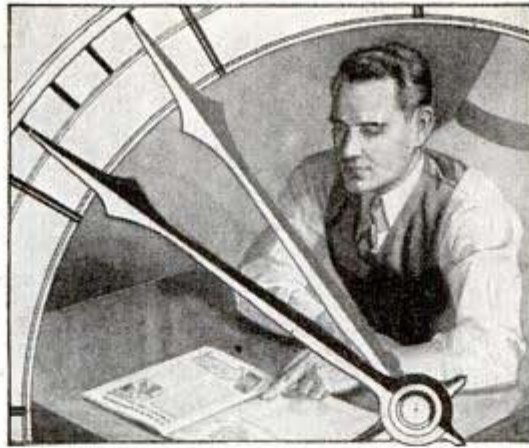
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IMPORTANT NOTICE

It is the intention of this magazine to provide its readers with information regarding the latest developments in the mechanical arts. We take no responsibility as to whether the disclosures contained in our articles are covered by patents and advise readers to investigate this subject before making, using, or selling any of the products, machines, or processes described in order to avoid possible liability for patent infringement.



How Do You Use The Most Important Hours of Your Day?

The most important—and they can be the most profitable, too. Men—ordinary men in ordinary circumstances—have had returns of as high as \$5, \$10, \$25, even in exceptional cases \$50 per hour for these hours.

They are the hours of your leisure time—usually spent in recreation or odds and ends.

These can be your growth hours, the time when through training you can prepare for more efficient service on the job or for the job ahead. During your working hours, you are usually buried in routine details, growing slowly if at all. But in these spare hours, your mind can reach out to absorb the experience of others, to learn the principles and methods behind your job and behind your field. The next day on the job, you will find yourself using something of what you learned the night before to the benefit of your job and the pleasure of your boss.

Interestingly enough, this spare time study can be fascinating recreation, not drudgery. And the few minutes spent this way tone up the remaining hours of your leisure

—make them more interesting.

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We can't say exactly. But we can tell you what they have meant to thousands of others. They have brought to these men and women promotions, new jobs, more money and prestige, greater success and happiness, security for the future. If these are the things you want, we invite your investigation of LaSalle home study training.

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DEPT. 1164-R CHICAGO, ILL.

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*H. C. S., Calif.



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*S. E. A., Kansas City, Mo.



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*E.N.J., New York.

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*J. S., Okla.



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*W. E. D. N. Max.

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Pictures by professional models.

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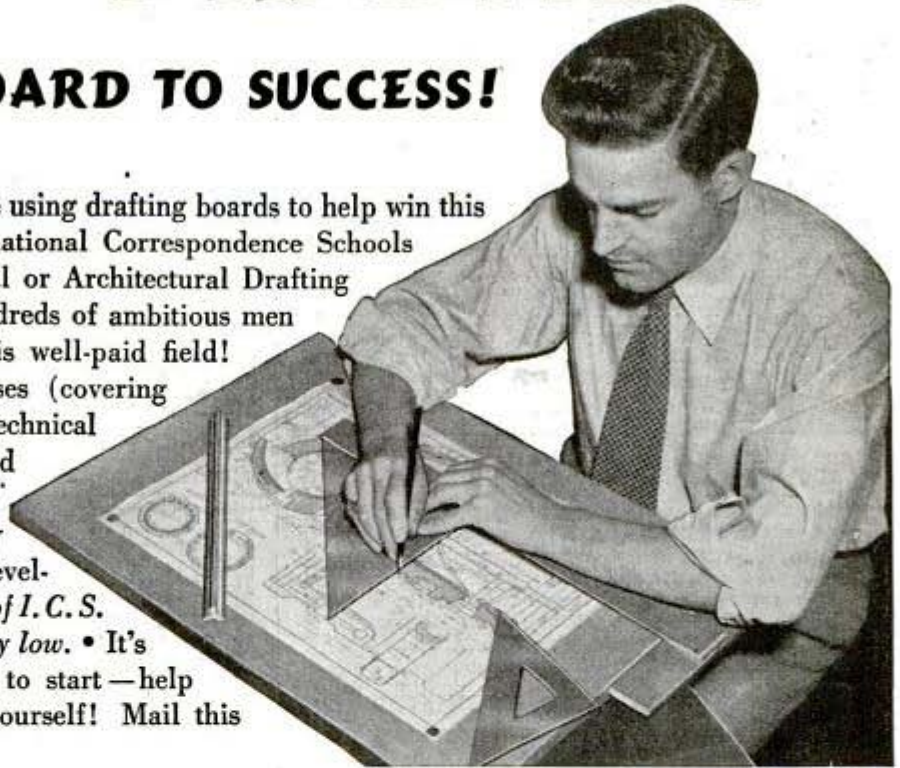


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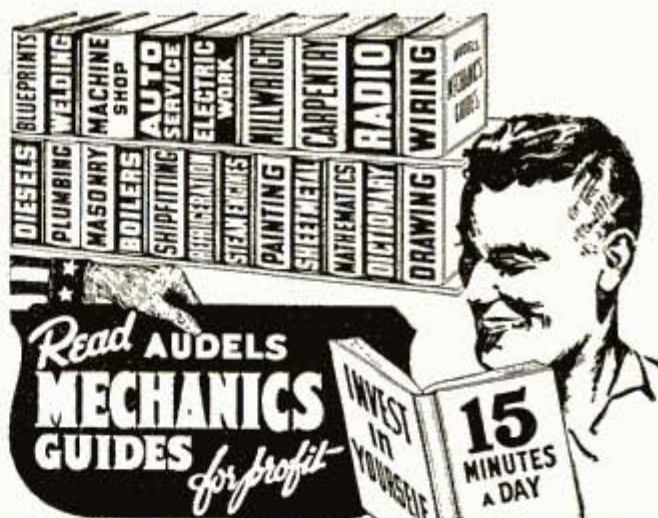
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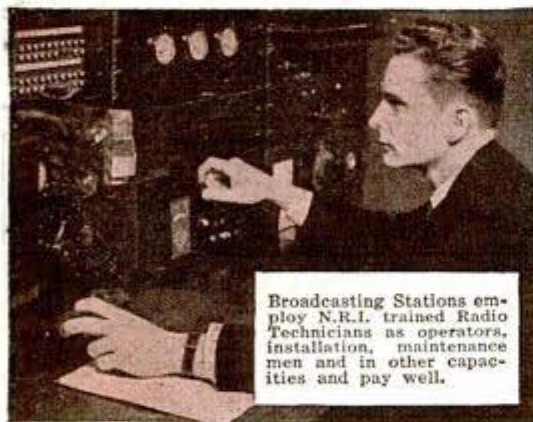
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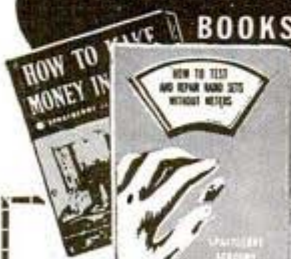


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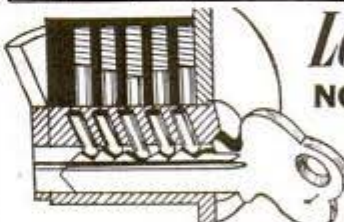
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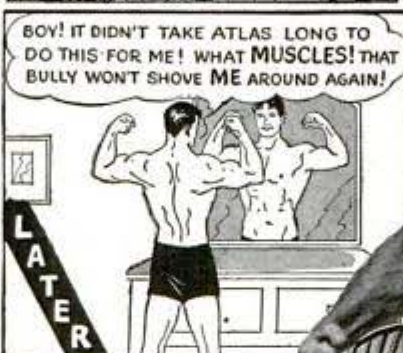


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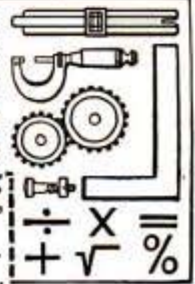
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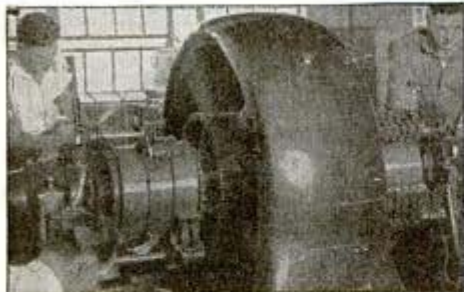
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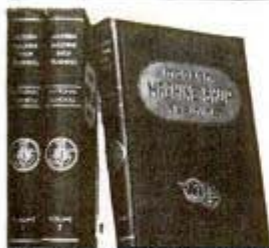
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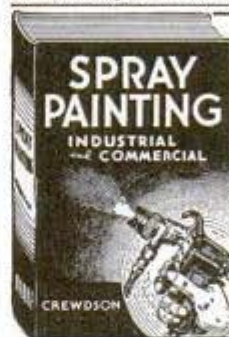
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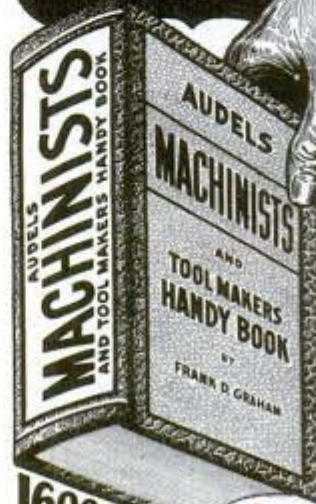


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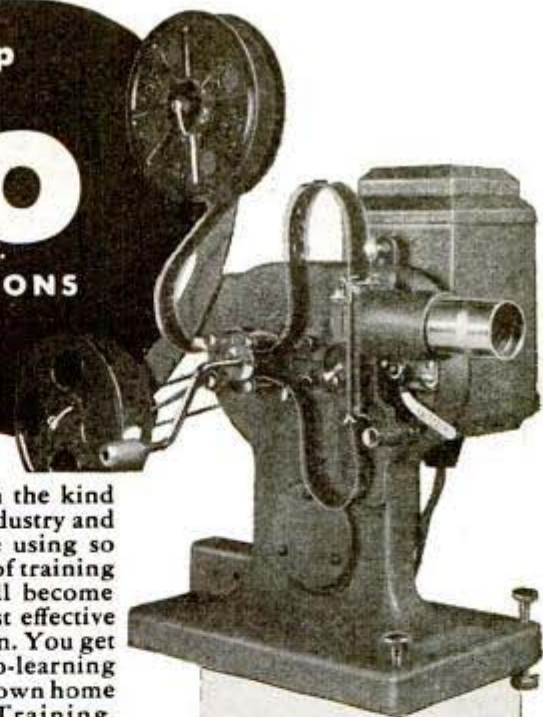
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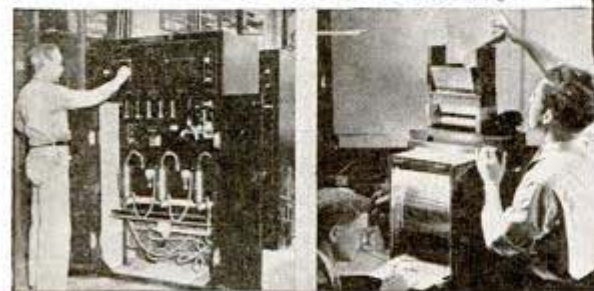
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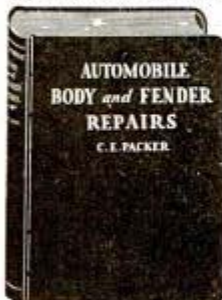
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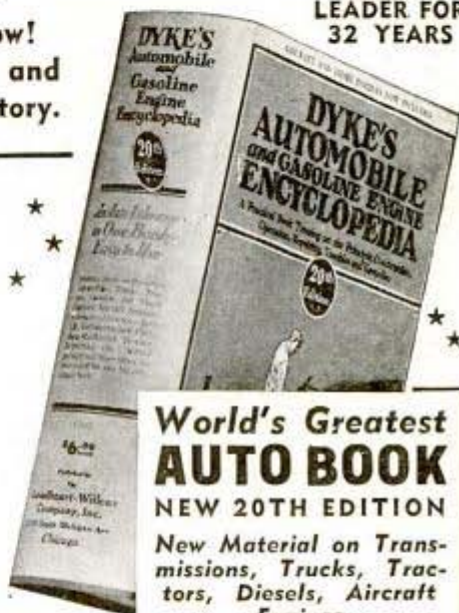
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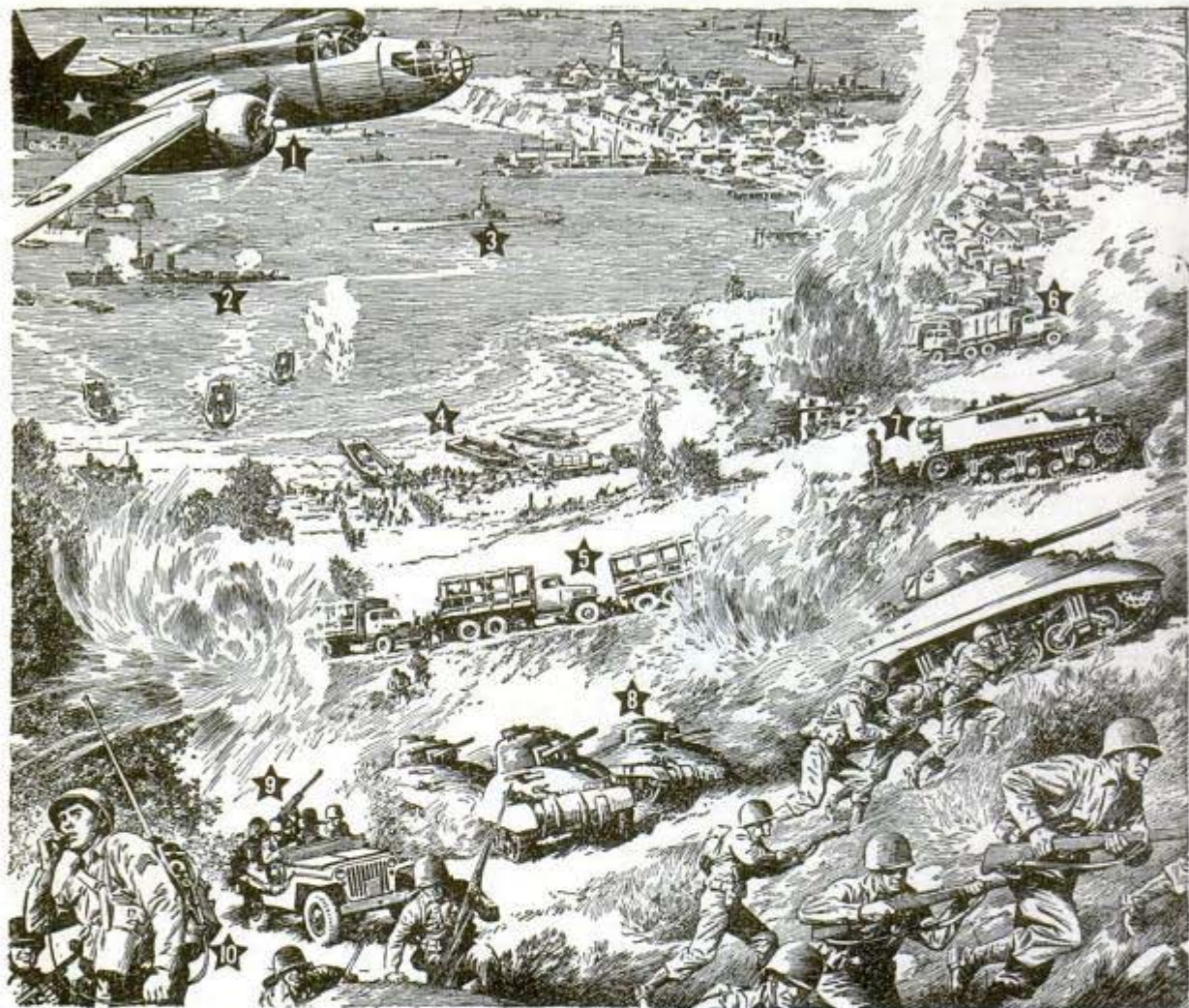
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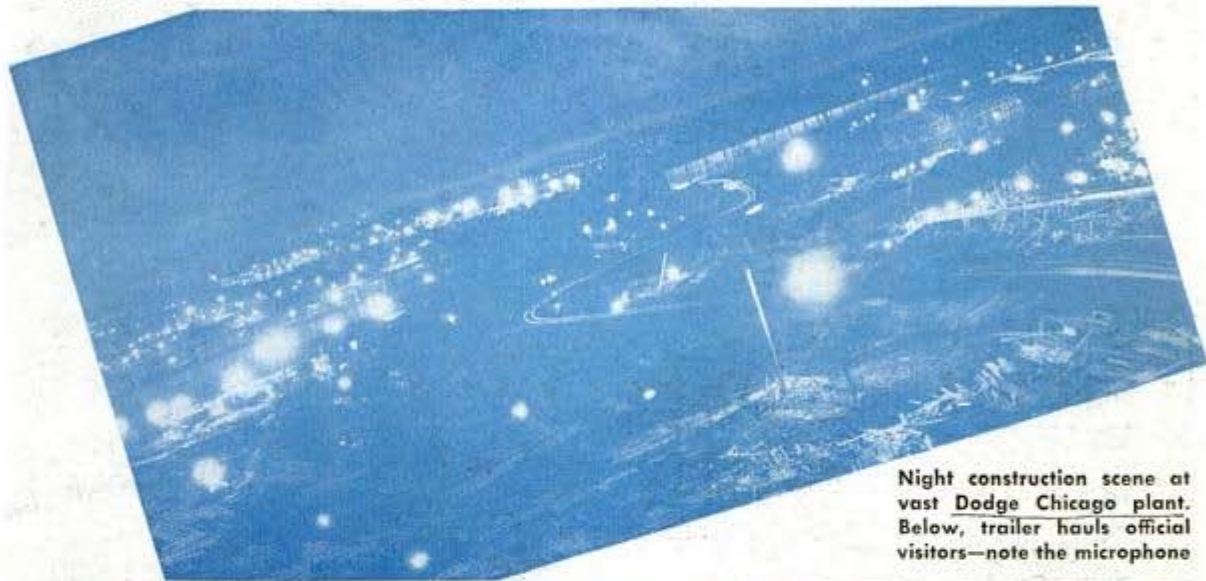
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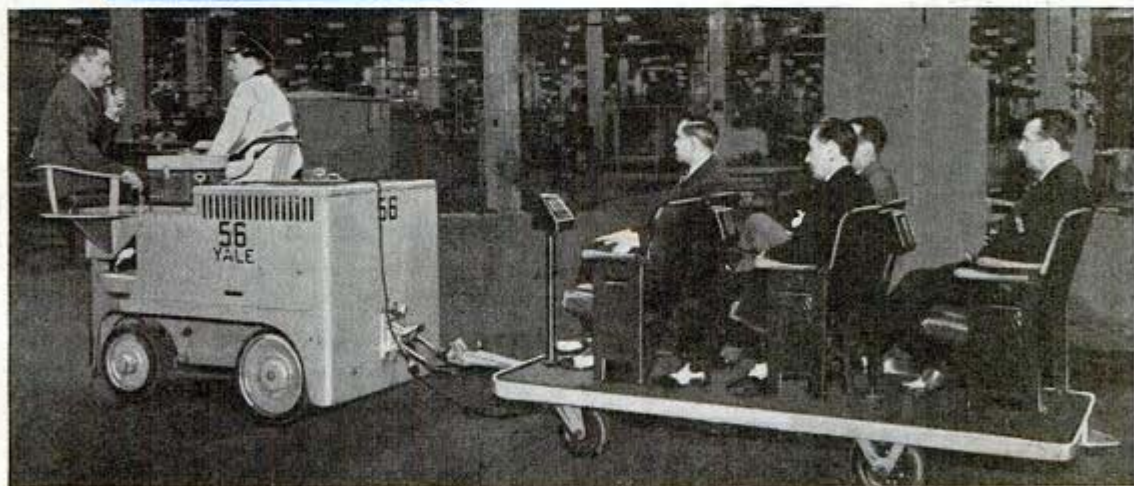
NOVEMBER, 1943

No. 5

HITLER'S 500-ACRE HEADACHE



Night construction scene at vast Dodge Chicago plant. Below, trailer hauls official visitors—note the microphone



By Wayne Whittaker

MOVE over Willow Run, Pentagon Building, Merchandise Mart, and Boulder Dam. Make way for Uncle Sam's giant war baby and Hitler's latest headache—the Dodge Chicago Plant, Division of Chrysler Corporation. It's the world's largest airplane engine factory, and about to move along its assembly lines are some of the world's most powerful bomber motors.

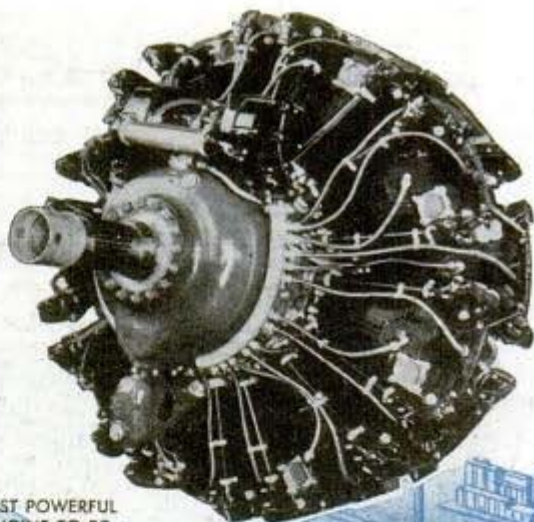
One building in the immense plant covers some 80 acres of ground, or about 50

city blocks. Nothing like it has ever been constructed. Experienced automotive and aeronautical executives, who are used to doing big things in a big way, are literally flabbergasted by its size, by the thousands of shining machine tools arrayed under a concrete roof that seems as big as the sky.

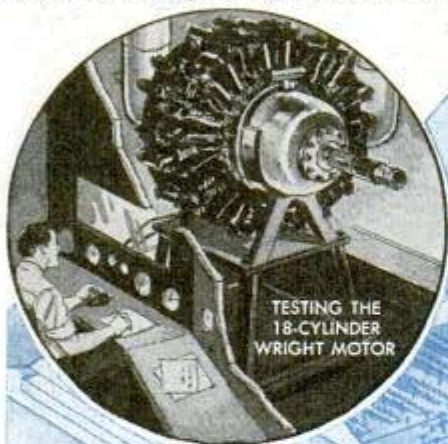
The only way you can see clearly from one end of the main building to the other is with a pair of binoculars. This mammoth one-story structure, the queen of nearly a

score of buildings sprawled over 500 acres, could swallow the Ford Willow Run bomber plant and leave room for 20 baseball diamonds around the edge. It has more floor space than either the War Department's Pentagon Building or Chicago's Merchandise Mart. And when the plant reaches maximum production its weekly output of engines will be tremendous.

The great bombers for which these engines are designed are the No. 1 U. S. military secret. But anyone can guess that they are the ships to which Gen. Henry H. Arnold referred when he spoke of the Flying Fortress as "the last of the small bombers." And anyone can guess that the new Wright engine made in the Dodge Chicago Plant—it has 18 cylinders and considerably more than 2,000 horsepower—will enable bombers to carry



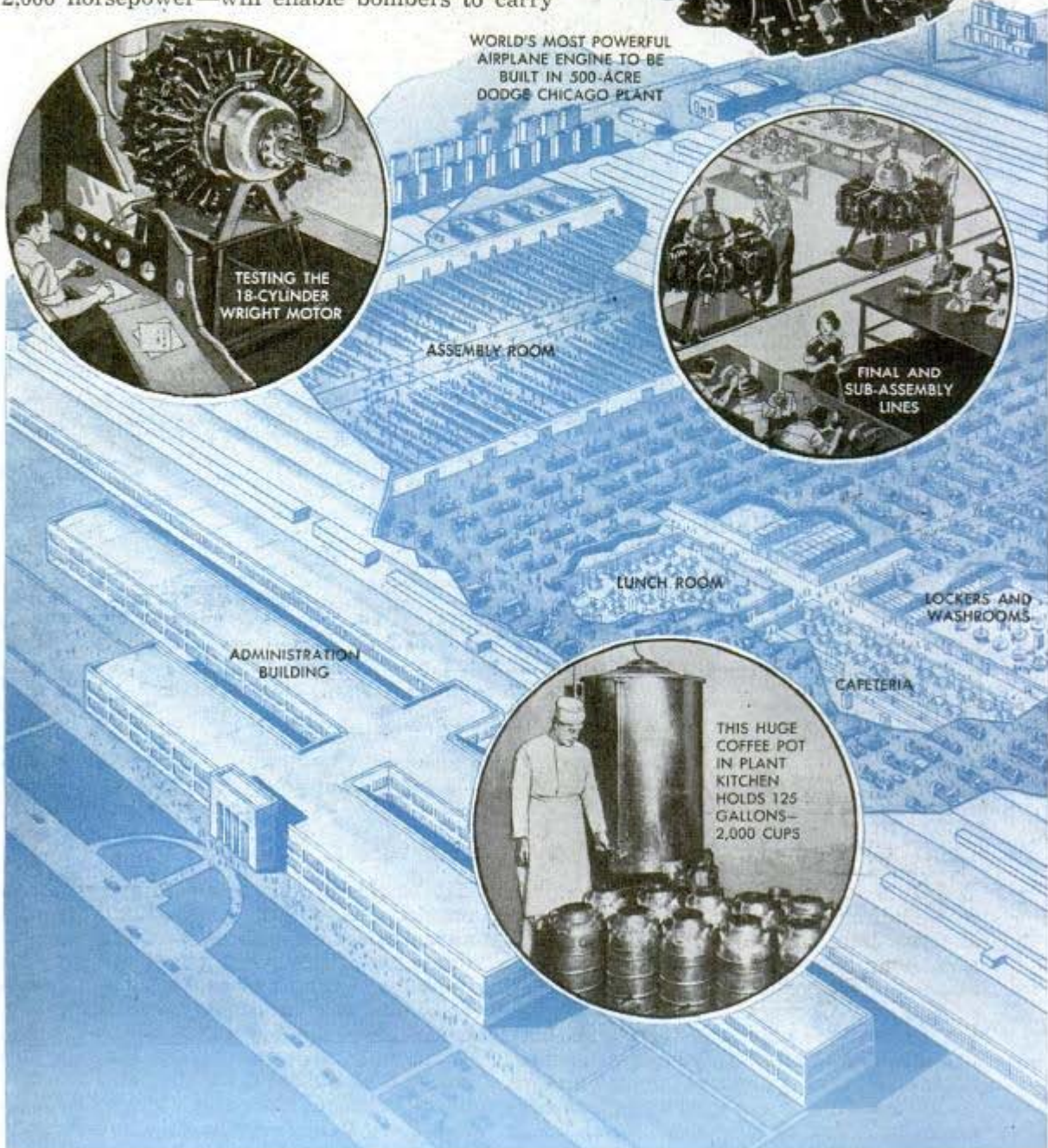
WORLD'S MOST POWERFUL AIRPLANE ENGINE TO BE BUILT IN 500-ACRE DODGE CHICAGO PLANT



TESTING THE 18-CYLINDER WRIGHT MOTOR



FINAL AND SUB-ASSEMBLY LINES



ASSEMBLY ROOM

LUNCH ROOM

LOCKERS AND WASHROOMS

ADMINISTRATION BUILDING

CAFETERIA



THIS HUGE COFFEE POT IN PLANT KITCHEN HOLDS 125 GALLONS—2,000 CUPS

record loads of block busters on round trips from American bases to Berlin and Tokyo.

That is why the plant producing these engines is regarded as the most important war industry in America today. It also explains why much of the activity in the plant, which is financed by the Defense Plant Corporation and operated by the Chrysler Corporation, is shrouded in secrecy.



WATER RESERVOIR FORGE SHOPS

300,000-TON COAL PILE

ALUMINUM AND MAGNESIUM FOUNDRIES

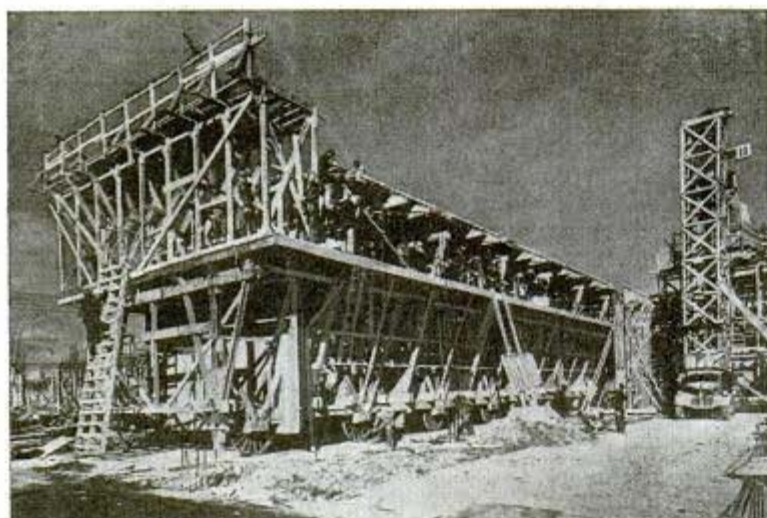
FORGINGS AND MOLDED PARTS HAULED TO MAIN BUILDING FOR FINISHING



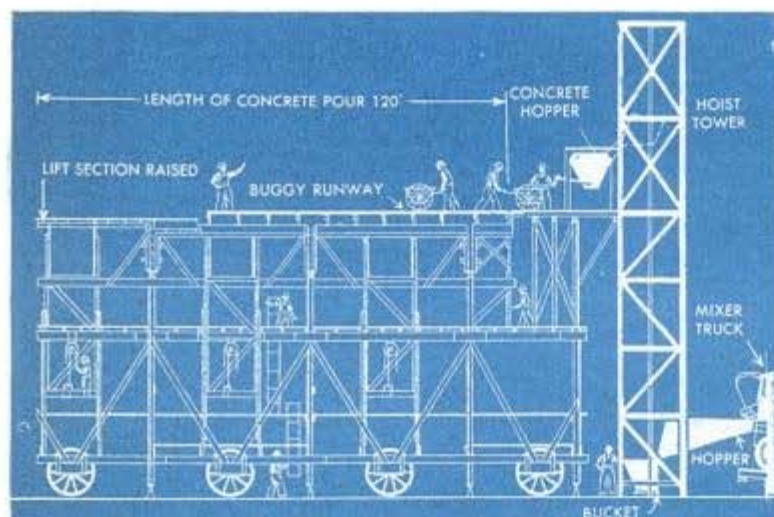
THOUSANDS OF LATHE, DRILLING AND MILLING MACHINES



PARKING LOT 1 BLOCK WIDE 1 MILE LONG



One of 60 portable concrete forms used to pour sections of main building that covers 80 acres. Diagram (below) shows how the form operates



Many areas in the place are blocked off with letters a foot high: RESTRICTED.

But it can be told that this vast plant, enclosed by four miles of fence, will take in raw bars of steel, pigs of aluminum and magnesium at one end and turn out finished motors at the other. It is the only airplane engine plant in the world that will do this. When the engines take their final leave of the testing cells they will be ready for flight.

In construction alone, so many records were broken that Chrysler engineers long ago gave up keeping tab on them. The first ground was broken June 4, 1942. In 12 months all the buildings were completed, and in 14 months many were already in production. During the height of day-and-night construction activity, 150 carloads of sand, cement and stone were brought into the plant every day. In addition, 800 truck loads of building material were used daily.

At one time there were more than 16,000 workmen and some 1,400 engineers on the job.

A new and speedy type of construction was used for the buildings which are of reinforced concrete with a roofing of concrete slabs. Even the building arches are concrete. Sixty portable concrete forms, resembling Helen of Troy's wooden horse, were used to pour the main building. They moved on wheels as the concrete work progressed along the length of the huge structure. The concrete was hoisted up towers and transported in "buggies." The amount of lumber in the forms would have built 2,000 four-room bungalows.

"With this method of construction, we didn't have to stop after covering 80 acres," one engineer said. "We could have kept right on going across the country."

After the concrete was poured in one section, vacuum pumps sucked water from the cement so that in three to seven minutes the concrete would support the weight of a man. When the section was set, the form was

whisked away to a new position in just eight minutes. The amount of concrete, used in the construction would make a solid block 100 feet square and taller than

Messenger car speeds work orders around the plant



the Empire State Building.

This type of construction required only one-half the normal amount of reinforcing steel, saving enough of that precious metal to build 14 destroyers and about 600 M-4 tanks.

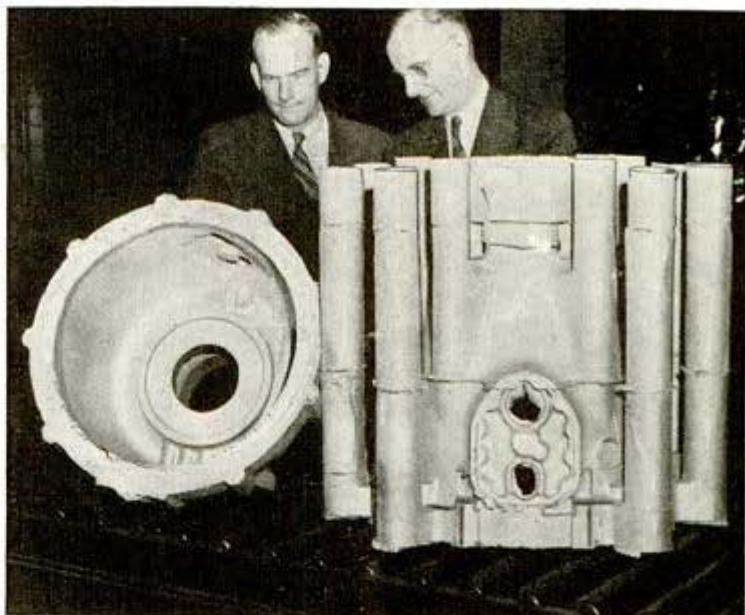
The principal units of the plant consist of the main building where the engines are machined and assembled; two large foundries, one for aluminum, the other magnesium; light and heavy forge shops, heat treating and die shop, testing buildings, tool shop, and an H-shaped, brick-faced administration building. The latter is the only two-story structure at the plant.

Parking lots accommodate more than 13,000 automobiles. The largest is a block wide and a mile long and situated in such a way as to expedite entrance or exit of thousands of employees at one time. Subways beneath the building speed pedestrian traffic. One busy subway intersection is called "42nd and Broadway." Opening off the subway are neat washrooms, miles of locker space, and 9 model cafeterias that will seat 5,000 workers at one time. There is a total of 14 cafeterias in the plant.

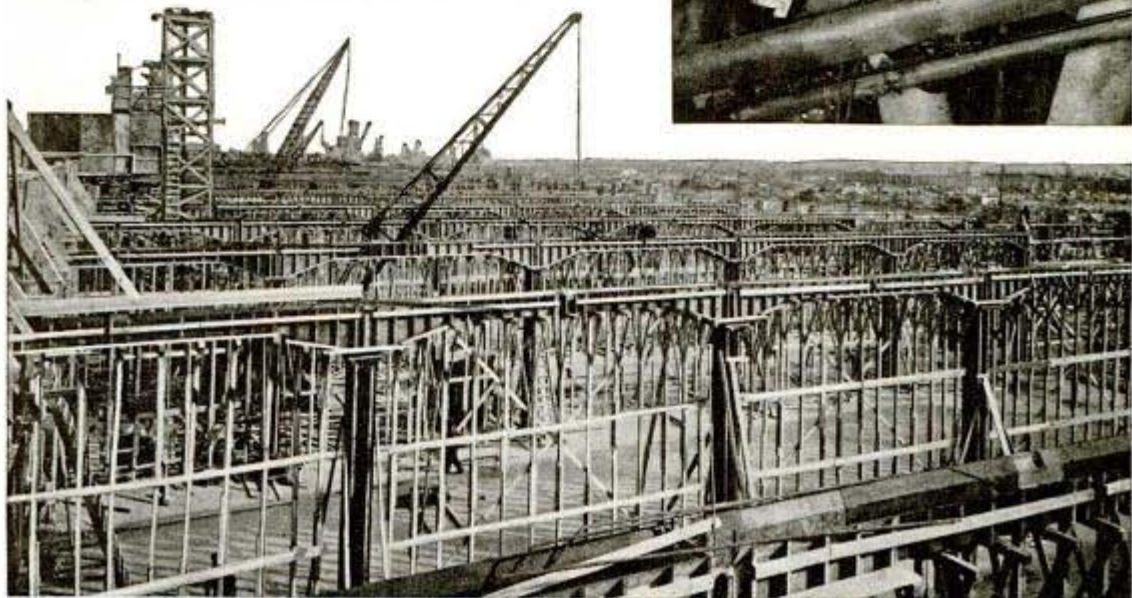
Two immense water towers, made of concrete with cypress tanks to save steel, provide facilities for water lines, while a reservoir holds nearly 3,000,000 gallons. The plant affords enough sewerage, gas and electrical service for a city of

(Continued to page 160)

Hoisting slabs of asbestos coating (right) to cover miles of pipe. Below, skeleton of plant two months after start



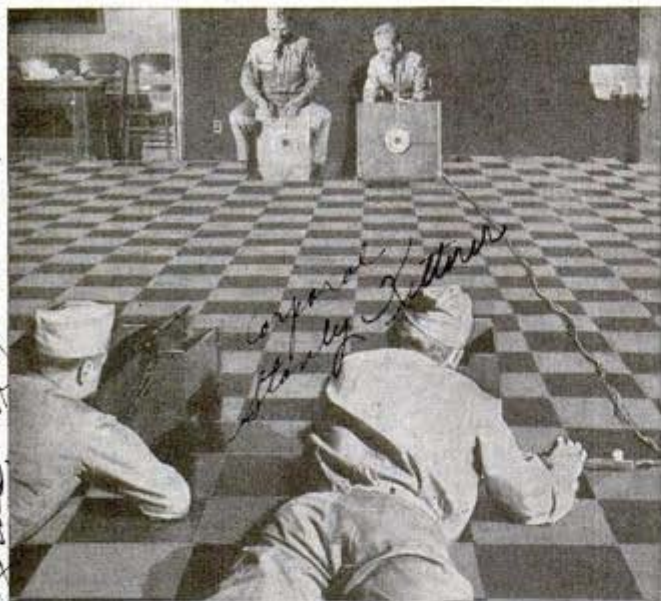
Inspecting world's largest magnesium casting. Risers are still on the one at the right



21434

Magnet Marker Scores on "Dry Firing" Target

Market Blvd.,
St. Louis, Mo. to Col. C.A. H. Shyler

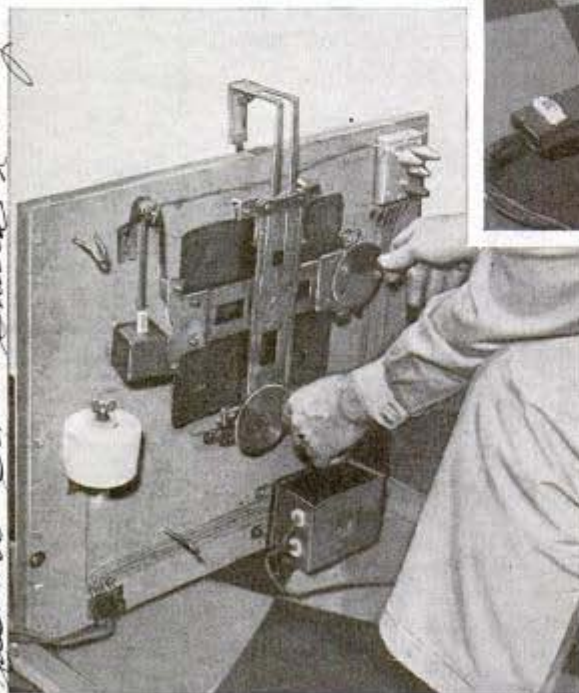


All is quiet during "dry firing" target practice in the First Missouri Infantry Armory. Flashing lights on the back of the target convey the firer's instructions to the target operator, eliminating the confusion of shouted orders. When the firer thinks the bull's-eye is in line with his gun sights he presses a button which energizes three magnets. The target, made of sheet steel, is suspended by a flat steel spring and has a pencil attached to the bull's-eye. When the magnets pull the target to the board, the pencil marks scoring paper

Above, the old system (left) and the new (right). With the new semi-automatic system the marking is entirely controlled by the firer. His accuracy is determined by number of marks made in a one-half inch circle. Right, operating control buttons



Corp Stanley Ketterer
Missouri State Guard Armory



Lights in upper right hand corner on back of plywood target board tell operator direction in which to move target. Center mechanism consists of steel plate with cross pieces for suspending target and gears for moving it. Note roll of paper for marking. Right, Corp. Stanley J. Ketterer, Missouri State Guardsman, the inventor, shows paper used to record score

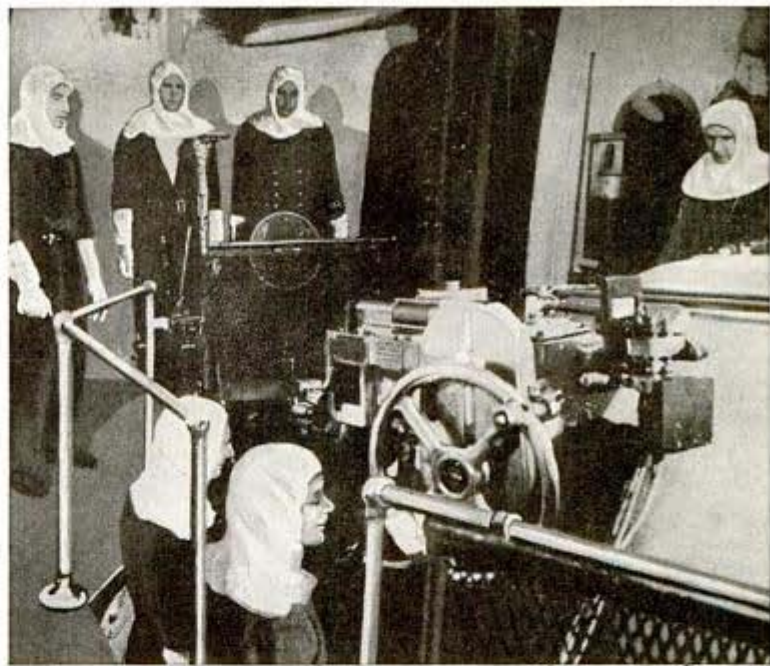


Home address
6 4984 Fryler Ave,
St. Louis Mo.

Gunners in Ship Turrets Wear Asbestos Suits N 472

When the order to man the battle stations is given on board the 30,000-ton British battleship Malaya, turret gunners quickly don their asbestos suits. These suits, which include hood and gloves, give the gunners the appearance of bewigged English jurists. They afford protection against a sudden flashback of fire from the 15-inch guns.

On the British battleship Malaya, gunners in the turrets wear protecting suits and hoods made of asbestos. They come in handy during fiery flashbacks of the big cannon



Arctic Tractor Has Buggy Top for Comfort at 40 Below N 448

Especially equipped for work at 40-below temperatures, a Ford tractor is light of

weight and equipped with a hydraulically operated angledozer, a contrivance similar to a snowplow, for leveling runways and removing snow. Its equipment includes a dig-and-carry scraper, a large crawler truck, and a mount on the rear to accommodate a 200-ampere arc welder, drawing its power from a take-off shaft through a V-belt. For operation in extreme cold, the crankcase was ventilated to get rid of water and condensed vapors. Spark plugs were raised half an inch, and run out of the cylinder on a riser so they could contact the cylinder through a small hole and not foul.

7 and 2 years Bureau
3000 Schayer Rd.
Dearborn Mich



Angledozer on front of tractor is used to level runway or remove snow

Designed for operation of
Sir Hubert Wilkins U.S. Army

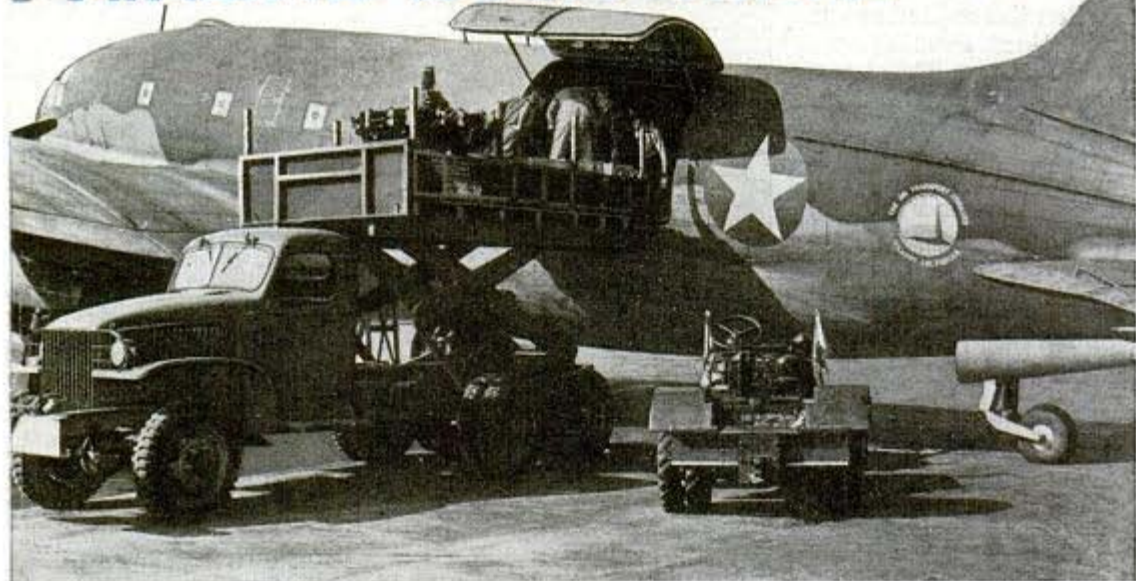
Lavish Lighting in Future Home at Only One-Tenth of Today's Cost N 564

Electric light will be used lavishly in homes 30 years hence, and will cost only a tenth of what it does today, in the view of Ward Harrison of the General Electric Company. Future building designs will emphasize light itself, rather than lighting fixtures, as part of the whole construction plan. Conquering glare and heat are two probable eventualities. As a gauge of future progress, a 100-watt lamp of today

gives five times the light of a lamp of the same wattage in 1913, and at one-half the cost of the current. Best current source of artificial light, the fluorescent lamp, is less than one-quarter efficient, and its improvement will mean more and better light. Maintenance of candlepower and elimination of the starters which are now used on all fluorescent lamps are two refinements to be expected in the future.

Schenectady, N. Y.

AIRLINE to ANYWHERE



A truck with elevating platform lifts cargo aboard a Curtiss "Commando" at an Air Transport Command station

By Roderick M. Grant

FROM half a world away an SOS crackled into U. S. Army headquarters in Washington. General Douglas MacArthur was in critical need of two tons of emergency parts in Australia.

Within a matter of minutes the Army Service Forces had located a source of the essential materiel.

Minutes later a pilot of the Air Transport Command, flying on a routine freight run between St. Louis and San Antonio, picked up an urgent call on his radio. It was midnight. He turned his plane around, headed for another city off his regular route, downed his cargo there and picked up the urgent shipment for General MacArthur.

Next morning his "special delivery" package for MacArthur was delivered at a west coast airport. Forty-eight hours later the two tons of emergency parts were set down in Australia.

Another pilot was forced to cancel a luncheon date in Washington.

"Sorry, fellow," he said, "I've got to be back in Burma in two days."

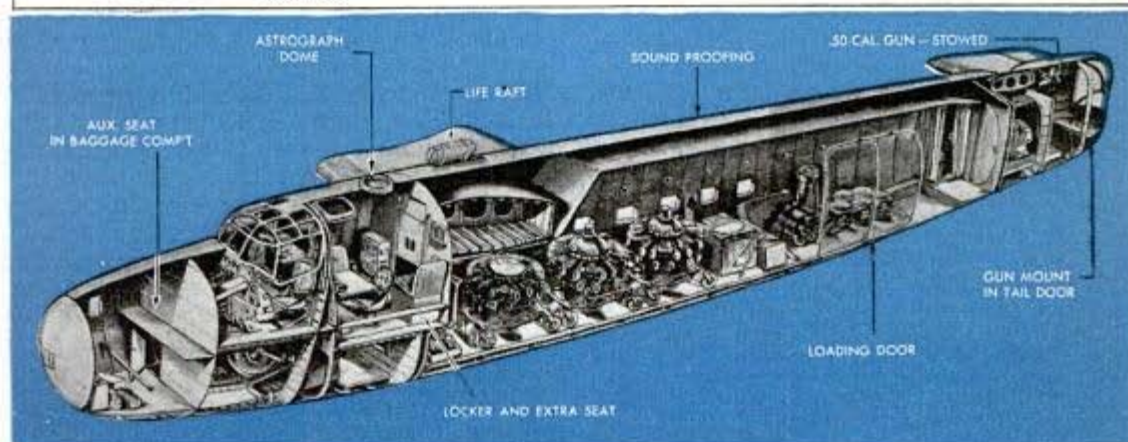
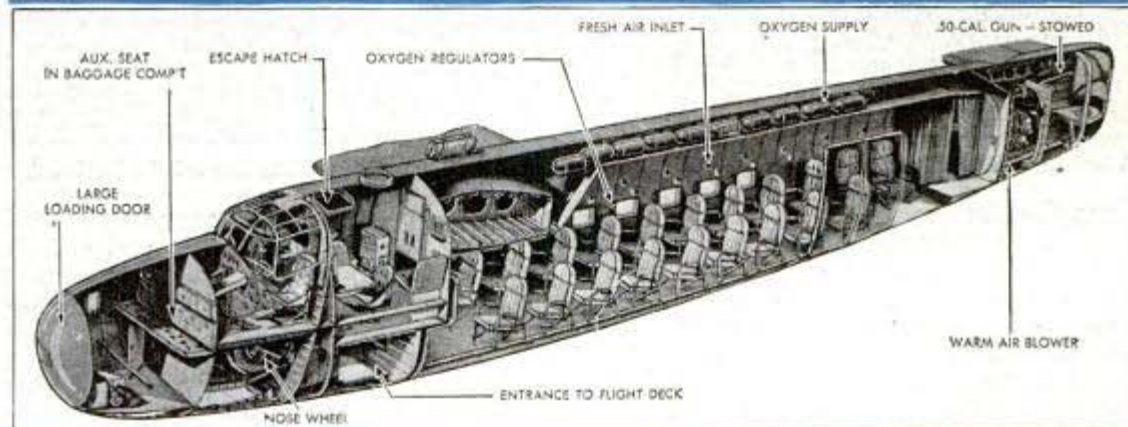
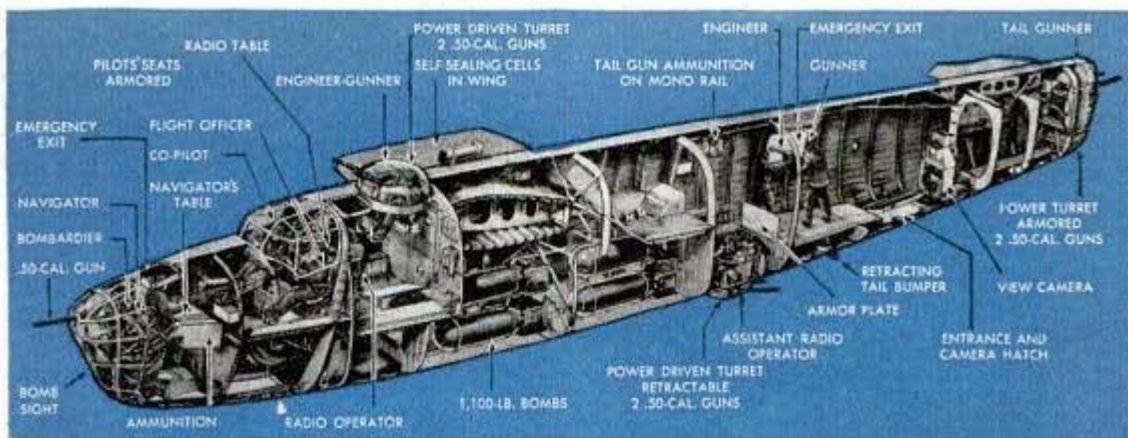
The Air Transport Command is the air line to everywhere. Just a little over a year old, this prodigious baby has far outstripped

its big brother, the U. S. commercial air lines, which are manning some of the ATC routes to Alaska and South America and across the South Atlantic and the South Pacific. Army air transport planes fly 90,000 miles of scheduled air lines.

"I can't tell you how many planes are



Quick return of Yankee wounded in ATC ambulance planes has saved many lives



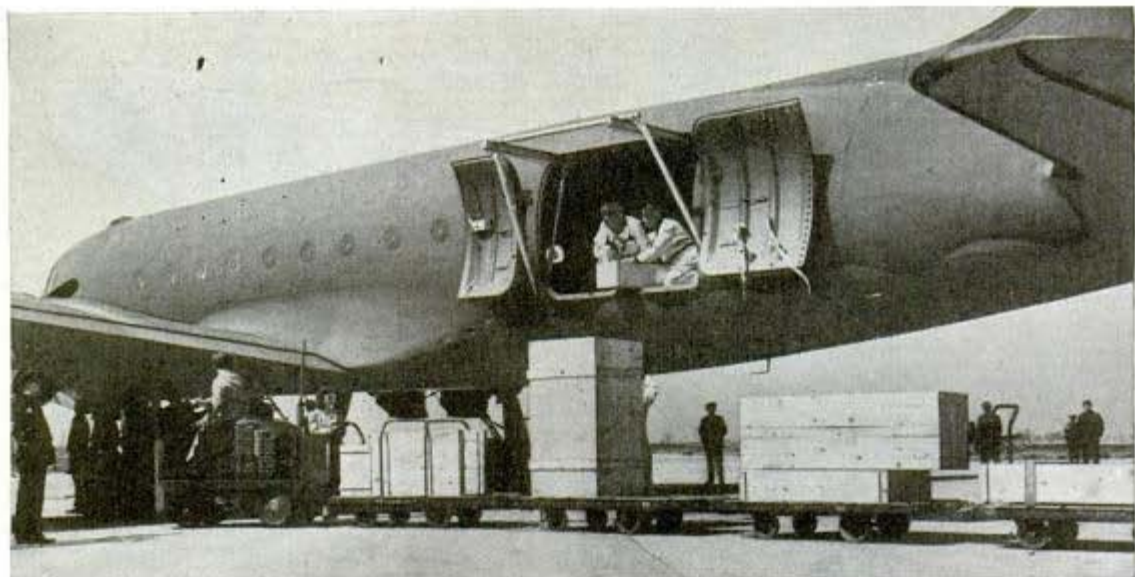
Cutaway drawings depict the Consolidated Liberator as B-24 bomber, as troop carrier and C-87 cargo carrier

shuttling back and forth over these routes," says Maj. Gen. Harold Lee George, Chief of the Air Transport Command, "but a year ago we counted them by scores and today we count them by thousands. In the ATC alone we have more officers today than the entire U. S. Army had before this war began."

Before its worldwide cargo service was established, the ATC already had a year's experience in delivering military planes from factory to training field, to modification center, and on to fighting fronts throughout the world. In the year ended last April, ferry pilots ran up a score of

80,100,000 plane miles. Bomber and fighter planes headed for the skies of Europe and Asia and the Aleutians are delivered from American factories to the Air Transport Command's Caribbean Wing, North Atlantic Wing, Pacific, Alaskan, European, South Atlantic, Africa-Middle East and other Wings.

The freight that flies around the world is weird and wonderful. Movies and mail for the boys in New Guinea. Tungsten from far away places, balsa from Central America to build gliders and mosquito boats in the United States; 20 tons of rubber seeds from Liberia, \$475,000 worth of platinum



A trailer-train rolls freight to the cargo door of Douglas C-54A "Skymaster," which has a hoist for loading

from the Persian Gulf; silk stockings and soft drinks and wounded Yankees.

British factories were running short of mica for aircraft instruments. Within three or four days after the appeal came to the U. S. Air Transport Command, mica from India was delivered in England and the stoppage of work in the aircraft plants was averted. A new freighter faced a delay in port at Seattle for want of 15,000 pounds of copper tubing. A Waterbury, Conn., factory was called upon to produce the stuff, the first ton of tubing was delivered at LaGuardia field, New York, a day later, and within four days—a day ahead of deadline—two commercial air liners and eight ATC planes had delivered the entire shipment in Seattle without interfering with any high priority cargo or passengers.

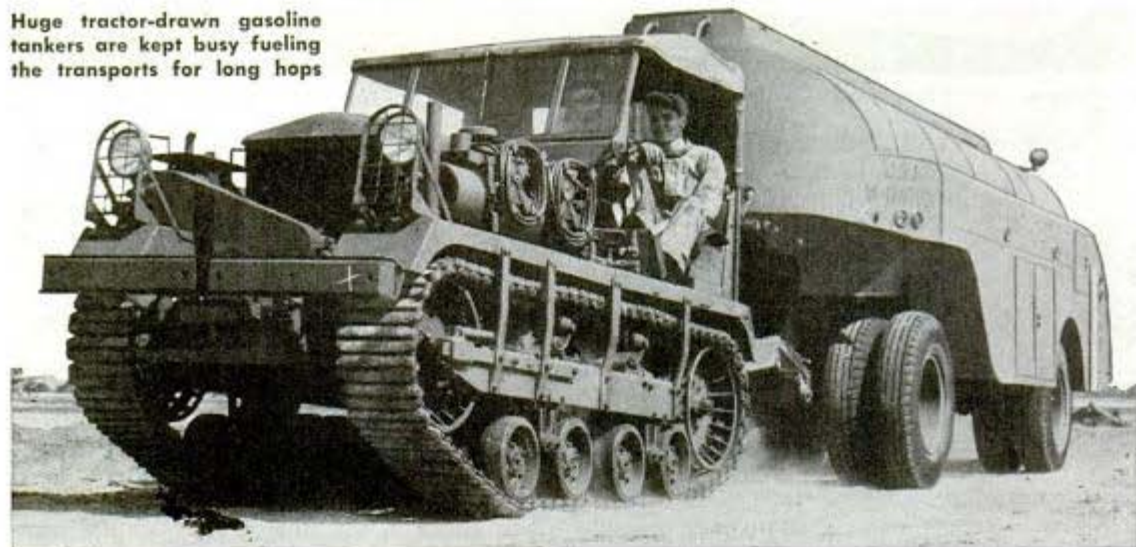
An army hospital at Nome, Alaska, was destroyed by fire. Two days later two ATC

planes dropped in with a complete 24-bed hospital, X-ray, hypodermics and all. In another emergency an entire sawmill was ferried to the far north. When a 1,200-gallon gasoline truck was needed up the Alaska highway, welders cut it in three pieces, loaded it into an air freighter, and flew north with the truck to weld it for immediate use at the scene of operations.

Jump-off bases are a closely guarded secret, but from London came a broadcast telling of the "biggest airfield in the world" in Labrador, from which warplanes take off for England. In one 24-hour period, the broadcast said, it serviced more than 100 planes and sent them overseas. In an area favored by good weather the year around, the field may become a great junction for transatlantic air travel after the war.

Weather being, of course, a vital factor in air transportation, the Air Transport

Huge tractor-drawn gasoline tankers are kept busy fueling the transports for long hops



Command has set up its own weather forecasting service on a global scale. Observers from the equator to the arctic and antarctic radio their meteorological data at frequent intervals. Some of them are isolated for nine months of the year. One group of observers reached their post in a desolate arctic spot last Oct. 15. The next white man they saw was a corporal of the Northwest Mounted police, who came in by dogsled on Jan. 2. Two months later a Hudson Bay company factor, trading agent to the Eskimos, paid a call by dogsled.

For the most part the job of flying 130,000 critical items to army posts on every continent is a routine one, but occasionally the pilots run into adventures unscheduled. One cargo plane flying 100 feet above the waves of the North Atlantic sighted a Nazi submarine plowing along the surface. Unarmed, the plane could do nothing but evade the U-boat's guns. Other pilots have crossed and recrossed the Atlantic many times at high altitude with only one or two glimpses of the ocean. Records for ocean crossings have become such a common-



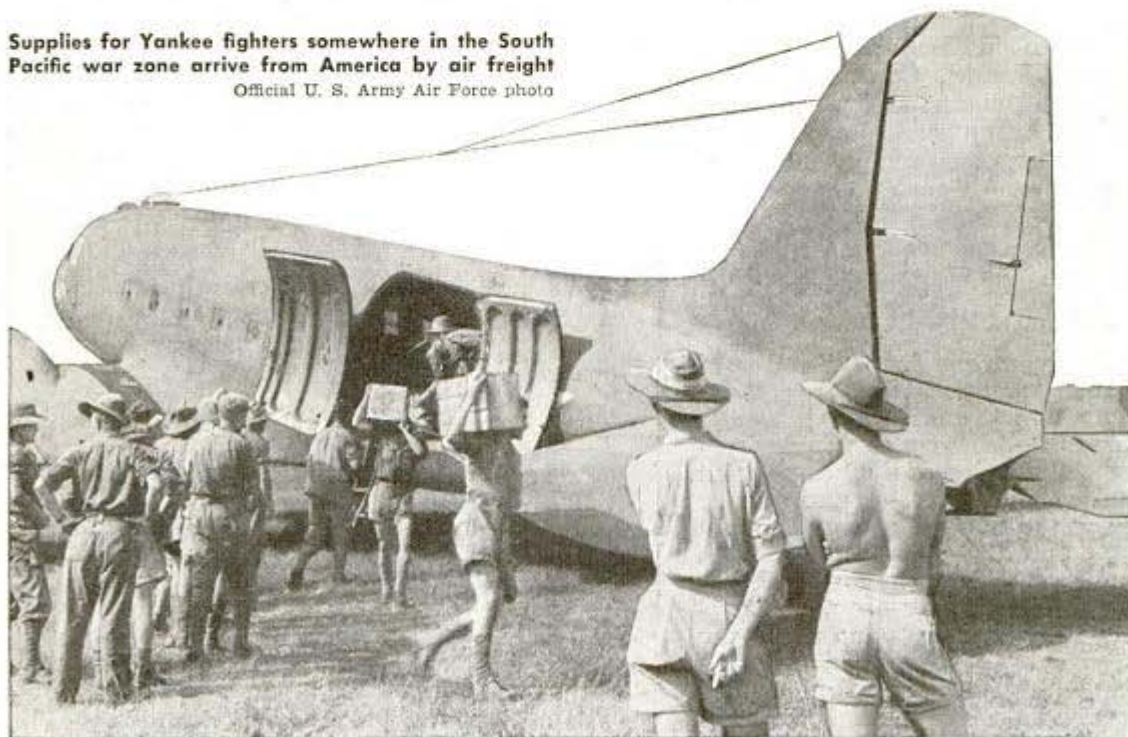
Stowing cargo in an ATC freighter. These giants of the world's largest air line carry more than a million pounds a week in this hemisphere alone

place that they cause no stir at ATC headquarters. The latest remembered was the 6 hours and 40 minutes crossing of the Atlantic by a Liberator bomber; another of that breed flew from America to Australia in a day and a half.

It was an Air Transport Command crew ferrying a Flying Fortress to England that deviated from its routine path to go to the aid of another crew that had crashed and stranded on the Greenland ice cap. It was

(Continued to page 156)

Supplies for Yankee fighters somewhere in the South Pacific war zone arrive from America by air freight
Official U. S. Army Air Force photo



Mobile Hoist Loads Half Ton Of Freight Into Plane



With portable hoist, two men can handle a 1,000-pound parcel

Minutes saved in loading or unloading a plane on the ground can be interpreted as added miles of flight, since it cuts down the aircraft's wasted time. With the aid of a hoist manufactured by the Elwell-Parker Electric Co., only two men are needed to raise or lower a half-ton of freight. The hoist picks up the bulky parcel and deposits it on the floor of the plane, or as readily removes it from the plane and lowers it gently to the landing strip.

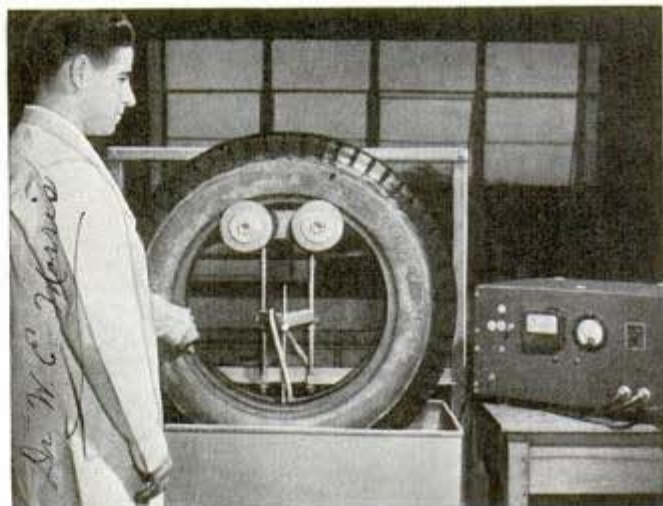
Glider Aloft Roars 'Shhh!' As Air Flows Over Wing

By no means does the sound of a plane's motor account for all the noise it makes as it hurtles through the air. Contrary to popular notion, the inside of a glider—which has no motor at all—is a very noisy place; so noisy that conversation at a speed of about 150 miles an hour is all but impossible. Air turbulence is the reason. Air flowing over the wings and about the fuselage produces "distressing, high-frequency, random noises which sound like a mighty Shhh!"

according to a report to the Federation of American Societies for Experimental Biology. In an airplane, part of the noise is due to the "thunderous" agitation of the air by the propeller, and the higher the horsepower of the motor the noisier that thunder, because as the tip speed of the propeller increases a large proportion of its driving energy is converted into sound.

"Supersound" Tests Tires By Finding Break in Plies

Waves of sound above the audible range, created by magnetostriction of a nickel rod, are used at the Goodyear Laboratory to detect separations at the vulcanizing point of two plies in a tire carcass. Such a rupture will not show under X-ray. If there is a separation, the tire is unsuited for retreading. Magnetostriction, actually microscopic shortening and lengthening of the rod, produces a sound wave that, though inaudible, penetrates the tire carcass and is picked up by a microphone on the other side. Activation of the microphone causes a green light to glow on the recording panel. Where there is a rupture, the wave will not penetrate the resulting air pocket; there is no signal to the microphone and instantly a red signal replaces the green one, indicating that the tire is defective and not suitable for retreading. The casing is hung on two rollers during the test, making it easy to inspect the entire circumference.



Red light flashes on showing a separation between two plies

Goodyear Tire & Rubber Co.
Akron, Ohio.
POPULAR MECHANICS

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Dr. W. C. Hession

Ref: Sidney J. Wain, 247 Clark Ave., N. Y. N. Y.
 C. A. Squibb & Sons, 745 5th Ave., N. Y. N. Y.
 7/6/43

Wonder Drug Made From Mold Aids Wounded

Dr. Whittaker



Penicillium notatum mold (left), similar to that found in bread, secretes the new lifesaving drug known as penicillin. It grows in glass culture bottles (below) and it takes about 500 quarts of fluid to make one ounce of microbe-killing powder

Photos courtesy E. R. Squibb & Sons

Penicillin, hailed as the miracle drug of 1943, is so potent that one part in 25 million parts of water will stop the growth of bacteria. This new microbe killer, which promises to surpass the phenomenal family of sulfa drugs, is made from a mold similar to that found in bread. It was discovered accidentally in 1929 by Dr. Alexander Fleming in the University of London laboratory. One morning he discovered that a secretion from mold had killed all the bacteria in a culture dish. The greenish-brown powder made from this secretion is today fighting infection on battlefields. Penicillium notatum mold grows on a liquid concoction of mineral salts and sugar. As it grows in glass culture bottles, the penicillin diffuses into the liquid beneath from which it is harvested by high vacuum evaporation. It takes about 500 quarts of culture fluid to make one ounce of the drug—one reason why all present production is allocated to the armed forces. Tests show it is superior to the sulfa drugs for infections produced by staphylococcus aureus. It is also



used to fight pneumonia, gonorrhoea, osteomyelitis, and streptococcus infections. There are no unpleasant after effects for the patient. Penicillin acts faster than sulfa drugs and cures certain infections those drugs cannot touch. While the limited supply of this drug is already at work saving the lives of fighting men, efforts are being made to increase production on a vast scale.

Superfuel Gives U. S. Warplanes 50 Percent More Power

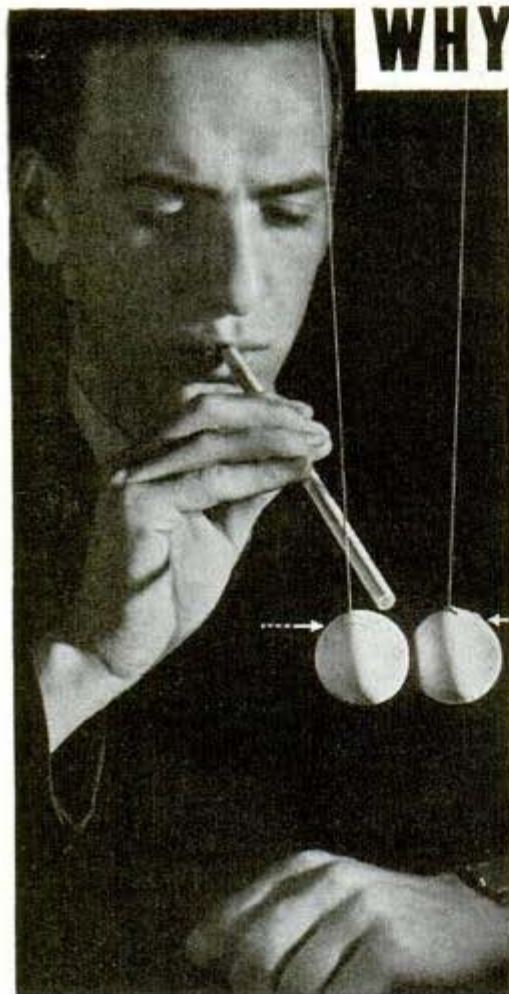
Triptane, a supergas that raises engine power half again over that of motors burning 100-octane gasoline, can now be produced in quantity. Known for seven years, the hydrocarbon was made in only limited amounts, and at costs ranging up to \$3,000 a gallon. By a new process developed by scientists of Universal Oil Products Company, the fuel can be made commercially

at an estimated selling price of less than \$1 a gallon. Antiknock qualities of pure triptane, called "the most powerful hydrocarbon known for use in internal combustion engines," are so great that no commercial engine has been built that can utilize its full power value. Added to aviation gasoline, it makes possible future engines of even greater power and efficiency.

NOVEMBER, 1943

*310 S Michigan Ave.
 Dr. Gustav Gloff Chicago, 4, Illinois.*

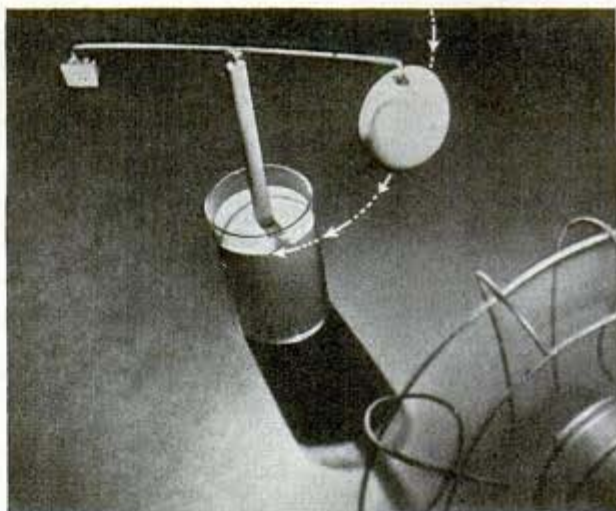
WHY *an* AIRPLANE FLIES



The simple experiments on these pages might be called the "A-B-C's" in the basic theory of flight. At first glance you wonder what a couple of balls suspended on strings, a blown-out egg shell, pieces of cardboard and an electric fan have to do with aeronautics. In their small way, these objects react to the flow of air in the same manner as a giant bomber weighing thousands of pounds with a heavy load of fuel and block busters. Where does the pressure come from that can lift this plane off the ground? Two centuries ago a famous Swiss physicist, Daniel Bernoulli, discovered that the pressure in a fluid decreases as the velocity of the fluid increases. The "Bernoulli effect" explains the curve of a spinning baseball. In aviation it explains the reduction of pressure on the wings that accounts for the greater part of an airplane's lift. The experiment with the two balls suspended on strings (above) shows how a region of low pressure is created. To your surprise, the balls come together when air is blown between them. The velocity of the air flowing between them causes a reduction in pressure, and normal pressure on the outer sides of the balls pushes them together. The reduction of pressure, or partial vacuum, is the lift that keeps an airplane aloft. When airflow becomes too slow, the plane stalls

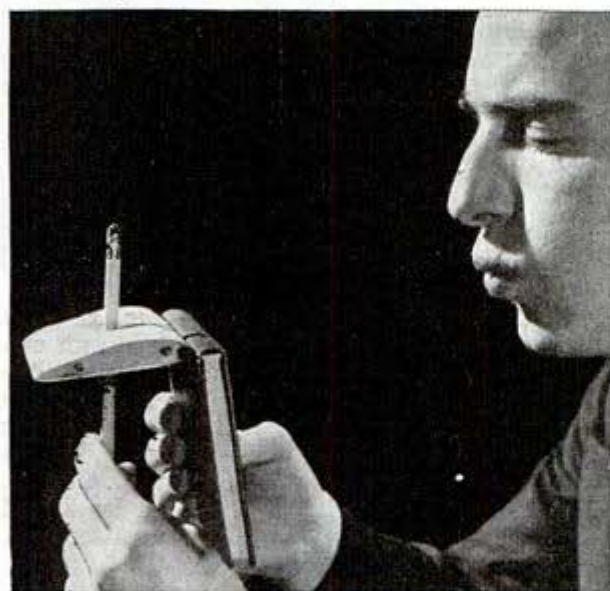
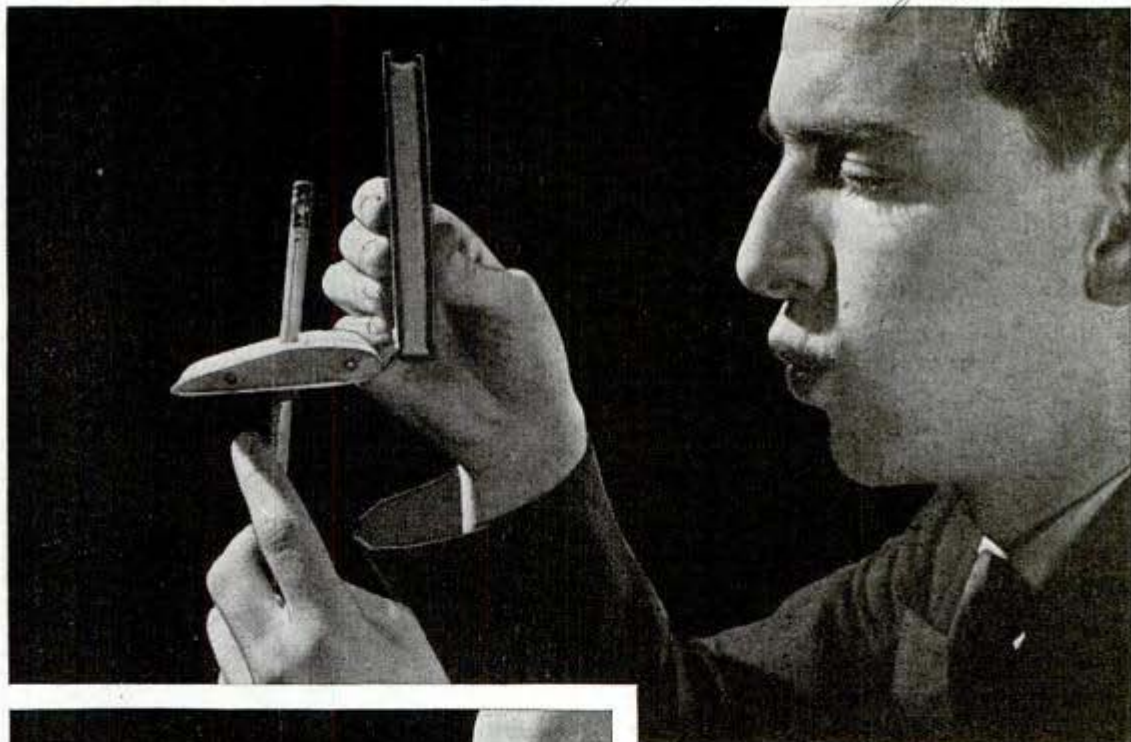


With a blown-out egg shell and a small piece of cardboard mounted on opposite ends of a stiff wire, effect of streamlining is made clear. The wire is pivoted so it is free to turn when placed before fan. Tiny cardboard pulls away (below) showing greater air resistance



Blowing at candle here causes low-pressure pocket behind card—flame angles forward. Such pockets hinder flight

Three Leons, 551 Fifth Avenue
New York, New York.



Homemade wing section, made of thin paper on cardboard frames, demonstrates lift. Pencil is stabbed through wing section, permitting it to slide easily up and down. If book is held to cover upper edge of wing (above) and you blow against it, wing will lift slightly or not at all. If you hold the book to cover lower edge (left) and then blow, reduced air pressure on upper surface will cause wing to rise considerably. Below, strips of paper on end of tube are forced together by flow of air



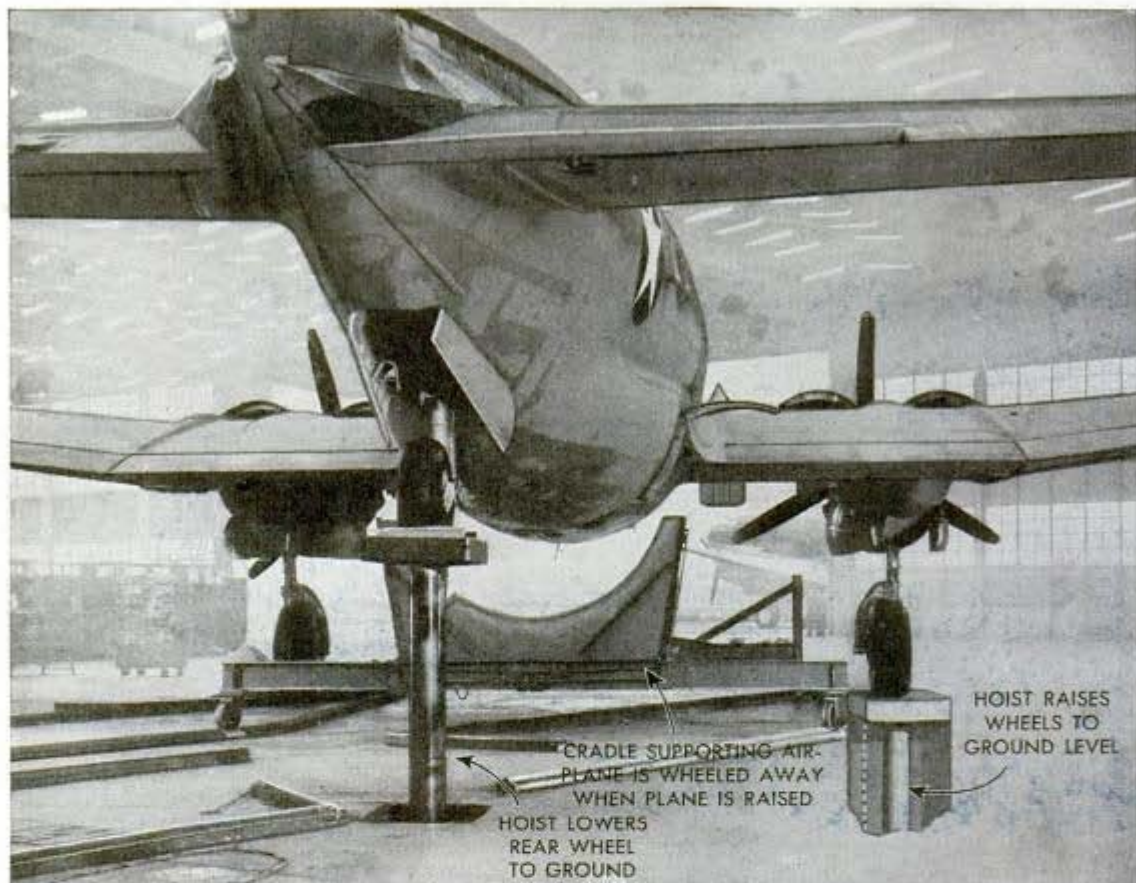
So here's the why of streamlining: If the card is teardrop-shaped, air flows smoothly around it; flame blows away



*Curtiss - Wright Corp.
Aeroplane Division
Buffalo, N. Y.*

71457

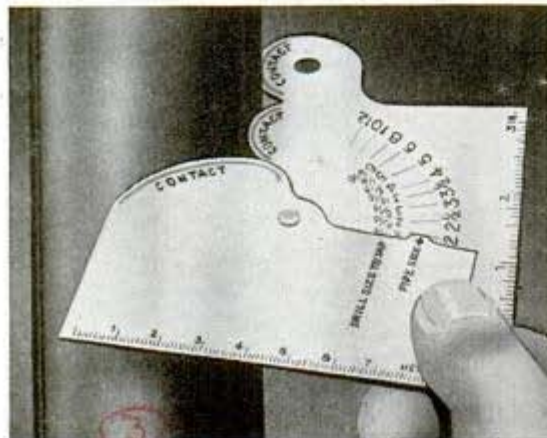
Wheel Hoists Lift Plane From Factory Cradle



Rolling to the end of the production line, a Curtiss Commando transport is removed from its production cradle as almost the last step before it rolls out of the hangar. To remove the huge plane from the cradle, on which it has rested during preceding stages of manufacture, three Globe hydraulic hoists are utilized, each of the three recessing into the floor. The plane is rolled

into position over the hoist pits, and the main landing wheels are locked in an extended position in the two front pits. The hoist at the rear is raised to support the tail wheel. Then the two front-wheel hoists are raised, and the production cradle is rolled on its track out of the way. Lastly, the rear hoist is lowered to floor level, and the plane rolls away on its own wheels.

Gauge Measures All Pipe Sizes From 1/8 Inch to 12 Inches



With a vest-pocket gauge you can measure all sizes of pipe from one-eighth to 12 inches in a few seconds. The measurement is made by three points of contact, two stationary and one on a movable section. A marker not only indicates the size of pipe, but the drill size for tapping. The gauge is handy for measuring pipe that is against a wall or in dark places where it can be carried to the light and read. Two edges of the gauge, which is made of steel with numerals etched in the metal, provide an inch and a metric rule.

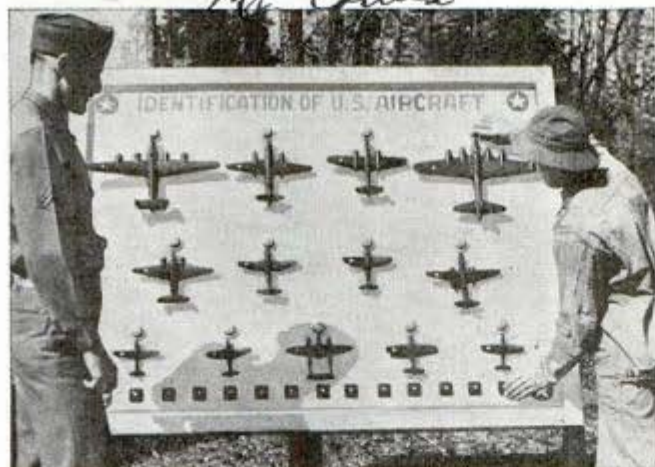
Marker on movable section of pocket-sized gauge shows size of pipe. To take measurement, gauge contacts pipe at three points

*Three Point Gauge Co.
3821 Broadway
Chicago, Ill.*

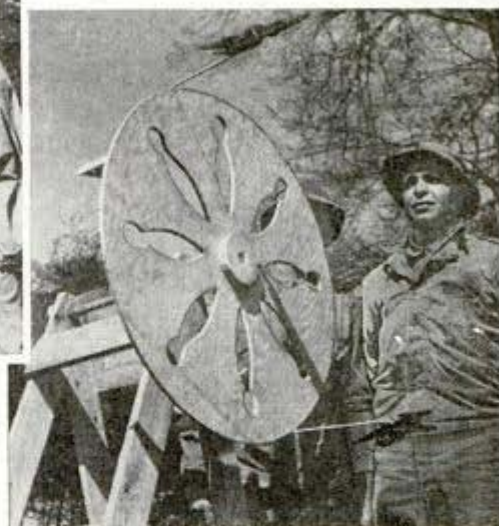
*L. B. Shawe, Major, LMC
Public Relations Officer
Quartermaster Replacement Training Center
Camp Lee, Va.* **77498**

Spotter's Wheel Gives All-Around View of Plane

Mr. Colvin



"Spotter's wheel" below is whirled to give view of plane at various angles. Left, a bell rings when proper plane is identified



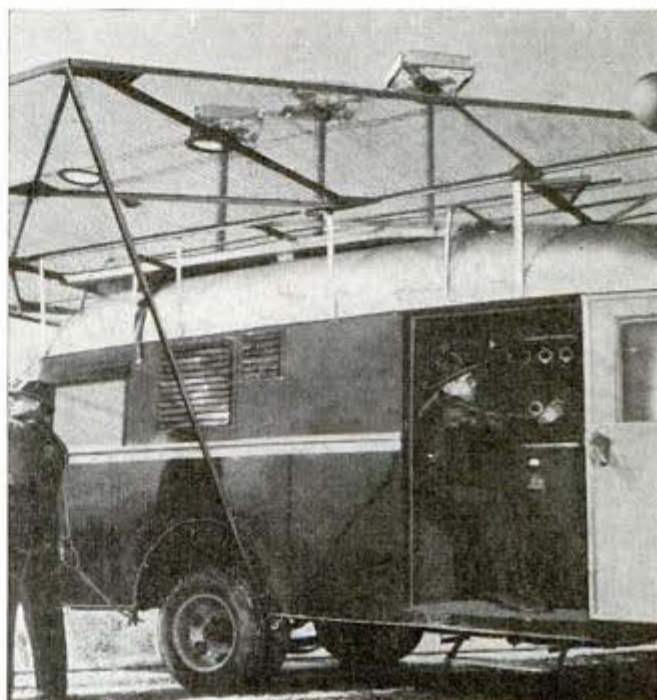
Men of the Quartermaster Corps who deliver the goods to soldiers in the front lines are constant targets of enemy planes, seeking to interfere with supply. To prepare the supply forces for antiaircraft firing, a thorough course in aircraft identification is given at the corps' replacement training center. One device to help the soldiers identify aircraft, whatever their angle of approach, is a wheel, revolved by a crank, to which are attached model planes. Revolutions of the wheel make the models spin in a constant loop, presenting views of the plane at virtually all angles. Another recognition device is an electric

board, studded with models of various planes. On the bottom of the board is a row of buzzer buttons, each tagged with the name of a plane. A trainee is asked to identify, say, a "Flying Fortress," then presses the button above the model that he believes to be that craft. If his choice is correct, a bell rings. If not, no connection is made, and he must try again.

Radio Trailer's Test Beam Locates Landing Transmitter

77510

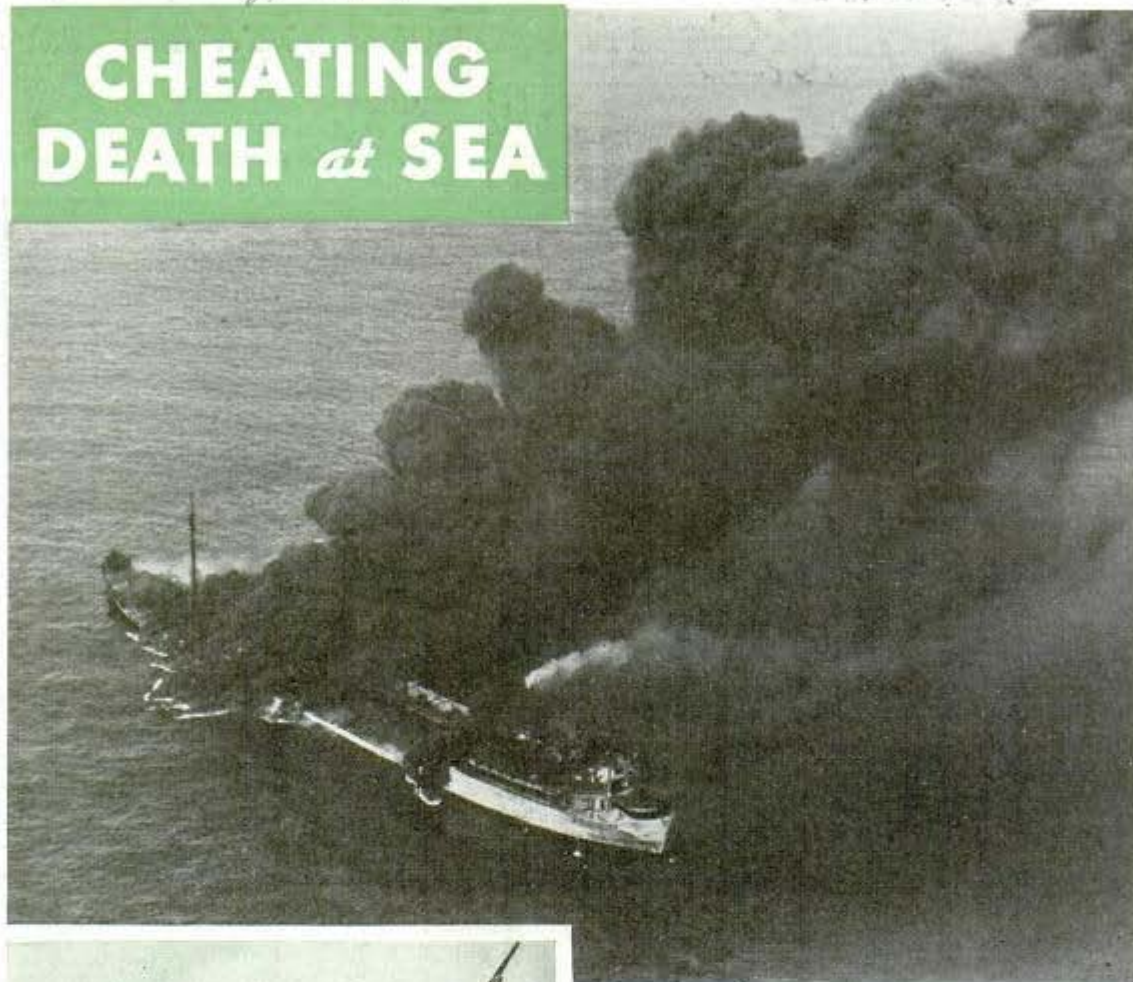
Steel buildings, railways and numerous other structures may cause severe reflections of radio waves. Accordingly, transmitters intended to guide airplanes to safe instrument landings must be located where such interference and distortion will not occur. Each location for such a transmitter requires research, to produce a straight localizer path. In the words of Civil Aeronautics Administration officials, it is a question of "cut and try" in setting up every location. Equipment to test the efficiency of such radio waves is mounted in a trailer, to simplify the testing of various sites for the transmitter, and speed the choice of the site of the permanent installation.



To assure freedom from interference at site of airport landing beam, portable transmitter is used to test locations

77169

CHEATING DEATH *at SEA*



U. S. Navy photos

Seamen on this torpedoed tanker put out flames and made port. Left, salty firemen wear asbestos suits

ONE of the most fascinating developments of the war has been the manner in which man, a creature of the land, has learned to cheat death in the world's seas.

Every man who ventures forth on, above or beneath the waves of the world's oceans today is a hunted creature. This is primarily a war of transportation and the aim of the Axis is to throttle global movement of men, weapons and supplies. The aim of the United Nations is to free the seas. The struggle never ceases, day or night, in this liquid jungle.

Just as hunted animals of the forest exhibit cunning which fits the special dangers of their environment, so inventive man is developing courses of action, tricks and machines to bring the men back alive, even though the ships and planes sink to the bottom forever.

Hundreds of men died in the early months of war before the familiar cork life preserver was improved or discarded, after it was discovered that it often jerked up as a man leaped into the sea, hitting him

on the chin with a knockout blow. In times of peace a man could make a comparatively leisurely exit into a lifeboat; in time of torpedoes and bombs, he often had to jump. He sometimes leaped into the arms of death. Hundreds more were killed by this type of preserver because it slipped above the head as it struck the water, serving only to keep the face under until the wearer was drowned. An extra piece of cord to keep it down would have helped, but no one seems to have thought of this at first.

Now there are dozens of types of efficient life belts and jackets. One light rubber, inflatable belt can be worn around the abdomen with such ease that it does not interfere with shipboard duties. Yet, squeezing a couple of cartridges of carbon dioxide fills the belt with buoyant gas and snugs it tightly below the armpits. Life belts operating in the same way are so comfortable they serve as an added piece of warm clothing. Rubber tubes permit the belts and



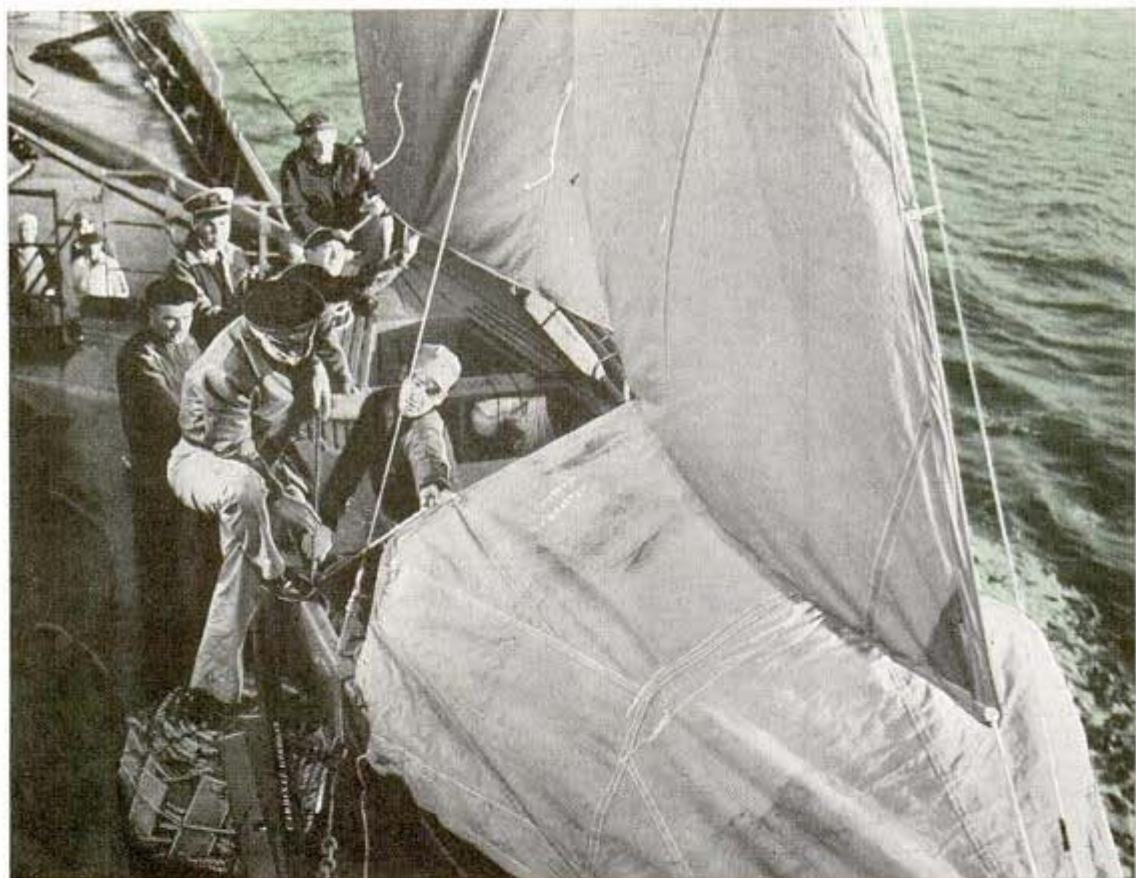
Alert Navy gun crew on a merchant ship snaps into action during a practice alarm. They cheat death by scaring off subs or planes

Right, rescue buoy can be worn like a pair of pants, or, with ropes attached serves as a breeches buoy. Seamen vouch for its safety



Below, rescuing men on patrol bomber forced down at sea by engine trouble. The plane was towed in for repairs by a helpful destroyer





U. S. Maritime Commission photo

Rigged with sail and spray sheet, the new lifeboats on Liberty ships are designed for safety and comfort

vest to be inflated by mouth if necessary. Feathery kapok-filled life vests can be worn day and night aboard ship without discomfort.

One type of "overall" life saving suit, now standard equipment on U. S. merchantmen, covers all of the body but the face and when in use, keeps the wearer bobbing head up in the water, dry, cozy and comparatively warm for days if necessary. Weighing only 14 pounds, it contains a built-in flashlight and whistle. The hood and palms of the gloves are a brilliant yellow to attract attention.

The suit may be worn over regular clothing and a life jacket besides. It is donned by first putting the legs into boots with weighted shoes which

keep the body vertical, putting the arms in sleeves with gloves attached, pulling a hood over the head and then yanking up a special watertight slide fastener which makes



Swinging through the air on transfer device for injured



the whole garment waterproof.

The tanker affords a startling example of the changes that the war has effected. In times of peace, this lumbering, cigar-shaped vessel was a safe type to sail upon. Crewmen, veterans and landlubbers alike, were unprepared for what torpedo, bomb and shell brought—a burning sea of gasoline with flames reaching 75 feet in the air, or a sluggish patch of heavy oil.

At first, many panicky seamen leaped into the blazing gasoline, only to be burned to death. Later, they were taught that tanker fires looked more formidable than they really were and that tackling them with fire hoses pouring out chemical extinguishing agents usually snuffed out the flames. Or clouds of "snow" from carbon dioxide cylinders were enough to quench the worst blazes. They also learned that because of their bulkhead and compartment construction and lighter-than-water cargoes, tankers are hard to sink and a man has plenty of time to wait before plunging into a sea of fire.

They also learned that it is just as easy to wait until wind or sea has cleared away a blazing area of gasoline or a gummy patch of oil, or to put off from the windward side of the vessel and to avoid use of rafts when possible because they cannot be maneuvered in either burning gasoline or sludgy oil. They became aware that a lifeboat is hard to work out of a heavy patch of oil and must usually be guided by oars instead of rudder. And that a man in a life jacket might as well paddle through swamp muck as through a slick of clinging oil.

So men live and learn—live because they learn.

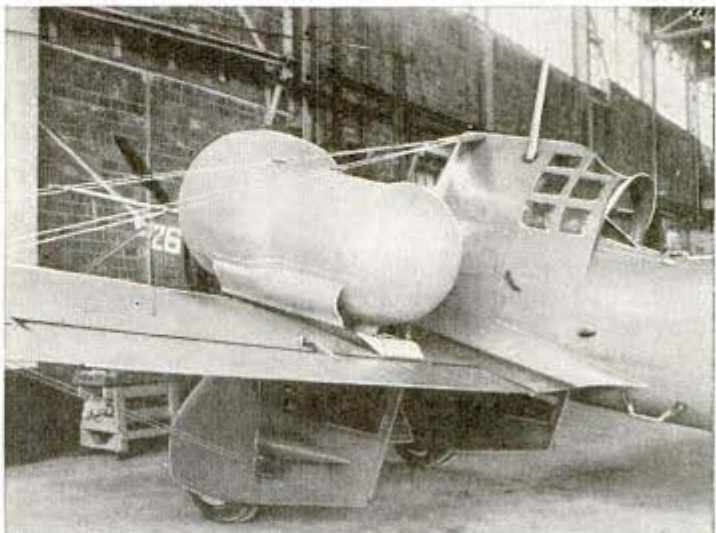
In times of peace, the death of a gallant merchantman was

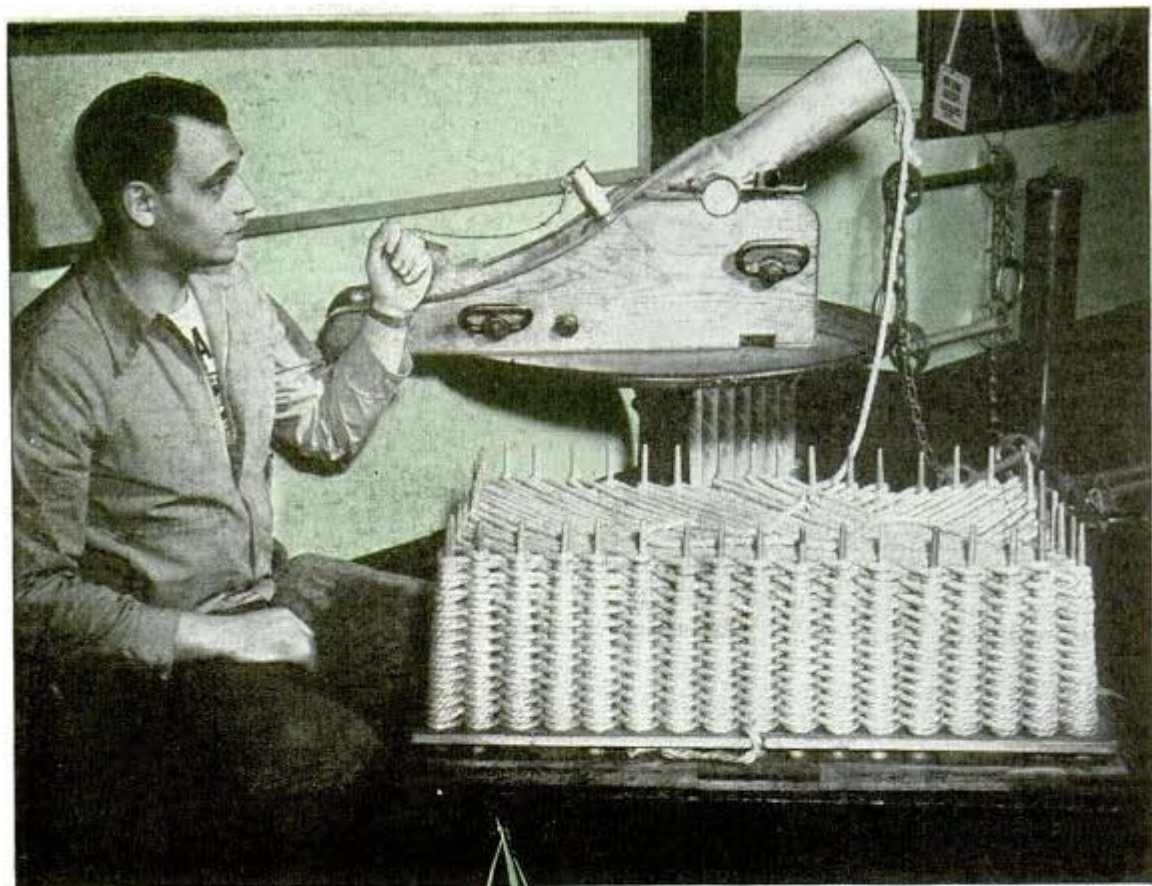


Sailors on convoy duty protect their faces from icy blasts with this Arctic weather mask. Opening for the mouth has snap-on flap



"Doughnut" life raft can sustain 15 men inside mesh on platform and hanging on outside ropes. Below, emergency flotation gear on wing of land plane will keep it afloat if it's forced down at sea





An oddity to landlubbers is line-throwing gun for rescue work. Note the line holder

Below, inspecting model of an unsinkable lifeboat which has special compartments

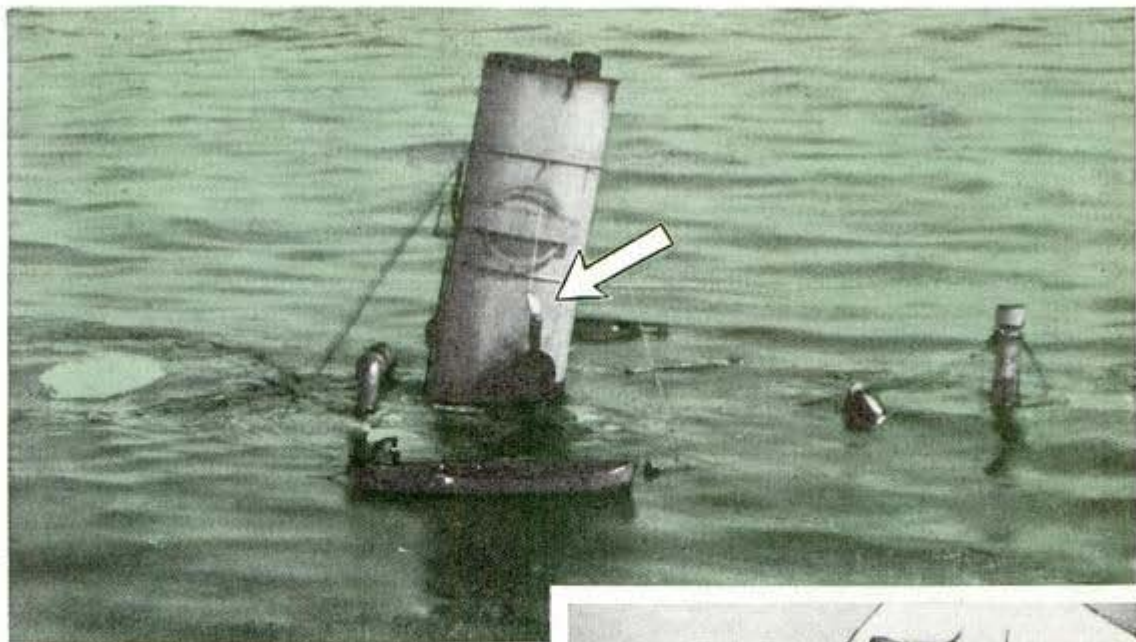
usually a slow process with plenty of time for a safe getaway. The crash of a bomb or the blast of a torpedo changed this.

Instead of a graceful dive after hours of preliminary settling on even keel, the merchantman often blows out her decks, splits in two or keels over. Seconds count where hours were available before ships were blasted to their doom. Hundreds of lifeboats and rafts went down with the vessels because the quick list made it impossible to launch them. Either they were dipped into the water on the downside or they were hung on the side of the hull on the upper side. Often weighing tons, they could not be maneuvered by hand. Also, during the early panicky days, the crew would attempt to put down boats while the ship was still making good headway. The boats



*Charles Farrington
432 W. 22nd St.
N. Y. C.*





Sailor (see arrow) gets ready to jump from perch on doomed ship. Right, Very pistol and cartridge

often swamped. Dropping the forward end first into a wave swamped many more.

Improved davits, better trained sailors, and mechanically improved skidding devices for launching rafts have made the getaway from decks easier and quicker.

Another lesson was learned on vessels which carried depth charges. The charges are usually pre-set for explosion at certain depths and in the excitement following a torpedoing, the crew forgot to neutralize the firing devices. Depth charges went down with the ship, exploded as scheduled and hundreds more lost their



lives. After such a tragedy, dozens of men were picked up dead without a visible sign of injury. Concussion carried through the water had ruptured organs such as the heart or kidneys.

It was commonplace with the sailors of many nations in the early days of the war to tumble into a lifeboat only to find the oars had been lost in lowering, or that the water

Waterproof telephone in station of bow lookout on Liberty ship



Morse code signaling lamp has key which causes it to blink. Below, wounded marine is lowered carefully into a tank lighter



tanks were empty, dooming them to thirst, or that the food was moldy or saturated by sea water. Or that no knife or hatchet was available to cut them loose from the davits or to free the tiny bobbing craft from tangled ropes. Or the fittings were rusted away, causing masts to fall.

These days are gone and the lifeboats are regularly inspected, fully equipped, many with motors, and fully provisioned. Just about everything a man can want when shipwrecked is firmly attached to rafts, too, including signaling devices galore.

An early mistake which has been corrected had to do with the lack of ladders and ropes which enabled men to escape from the lower regions of a vessel or from the decks if they reached them. Every engine room of a modern ship usually has several exits aside from the main corridors and their stairways or ladders. At the beginning of the war, men were not trained where



to look for them. The addition of rope ladders leading to emergency engine room exits, in case a broken steam connection shuts off ordinary passages, has saved hundreds. And the use of patented metal ladders and easily handled rope cargo nets has enabled thousands to climb down the slanting sides of a dying ship.

Warwise sailors who formerly made frantic and often fatal haste to get away from the sinking vessel to avoid being sucked into the depths of the sea as it dived, have learned that when a ship goes down bow first or stern first, it slides under the waves and very little suction is created. Only when a ship goes down quickly on a horizontal plane is there much danger from suction.

The code of lifeboat conduct has been pretty well established. Some of its rules are to drink no sea water because it contains about a teaspoonful of salt to each cupful and only increases thirst. Avoid eating



Crew of torpedoed tanker battles flaming oil with chemical fire extinguisher—standard tanker equipment

if no water is available. Be sparing with food containing sugar or salt. Regardless of the weather, do not discard clothing because the tropic sun can be as torturing as the Arctic wind is cold. Stop exertion as far as possible. Avoid alcohol as it increases thirst. Do not depend on fishing

lines too much because the little fish which are attracted by boats and rafts only attract bigger fish and if you hook a little one, a big one will usually snap up the little one and perhaps your hook along with it. Lacking tackle, try spearing small fish with a knife or catching them with the hands.



In this war, the ships that sail the air above the sea are far more numerous than the ships which plow the waves. Starting with fresh viewpoints, the designers of lifesaving apparatus for airplanes developed some tricky devices, most of which are based on the fact that rubber containers take up little space, but hold a lot of air, and air will float.

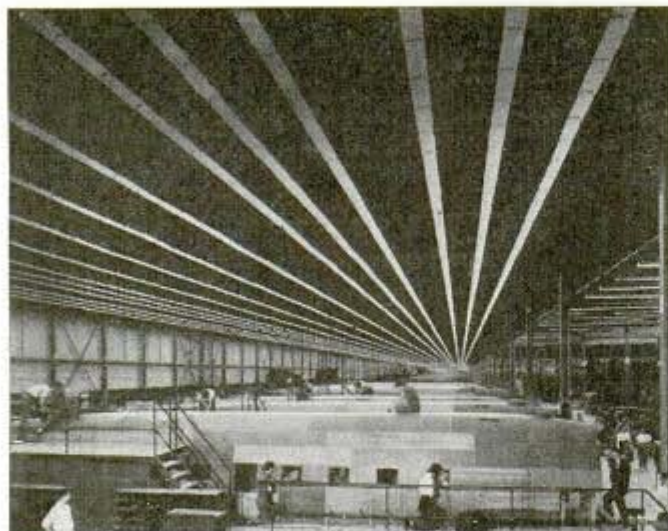
The doughnut-like rubber boat or raft is remarkable in efficiency and scores of men have lived weeks with little food or water with noth-

(Continued to page 152)

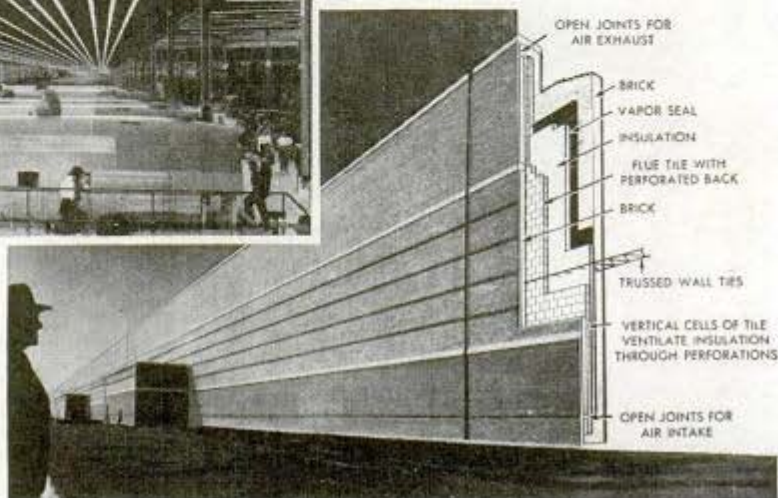
One-man parachute boat has paddles for downed aviator

Hill + Knowlton, Guildhall Bldg. Cleveland, Ohio. City, Okla.
for The Electric Co., Architect-Engineer Manager, 77 517

"Breathing Wall" Has Flue to Combat Moisture



Above the fuselages of C-47 cargo planes (left) fluorescent lighting gives fanlike effect in windowless building. Below, cross-section of wall in aircraft plant shows inner flue arrangement with open joints at bottom and top for "breathing" to keep moisture out of insulation



Believed to be one of the largest masonry structures in the world, the new Oklahoma City Aircraft Assembly Plant has nearly two miles of windowless "breathing" walls. Inside the brick wall is a flue of ventilating tile that permits a passage of air through openings near the top and bottom. The tile has a perforated back which allows a four-inch blanket of rock wool to "breathe," thus keeping it dry and providing insulation equal to that of an 80-inch brick wall. The only steel in the wall is in the lightweight ties that hold the many layers of the structure together and also serve to hold the insulating wool

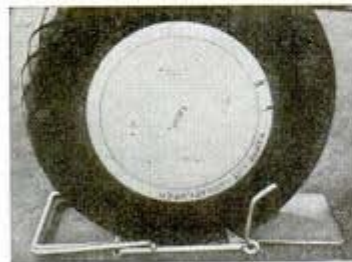
in place. Another steel saving—170 tons—was effected by the use of Masonite instead of porcelain enamel in reflectors for more than 20 miles of fluorescent lighting fixtures. These reflectors have a synthetic enamel surface. A white cement floor insures light reflection on the underside of the wings and fuselages of the big Douglas C-47 cargo planes built in the plant.

77 339

Collapsible Plane Wheel Chock Permits Faster Takeoffs

Light, collapsible metal chocks make possible swifter takeoffs at several army airfields because the plane's tire merely runs

over the chock after it has been released. Designed by Earl C. Gregg, civilian mechanic at an Oklahoma flying school, the



Above, chock is collapsed when plane is ready for takeoff. At right, it is shown set up to prevent sliding of wheel

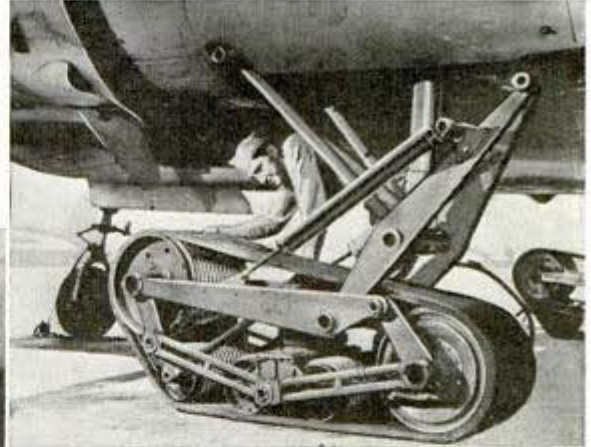
chock consists of hollow steel tubing, a small amount of solid steel shafting, and a boiler plate apron. The apron and retaining framework bear the weight of the plane during the warmup period, preventing the wheel from sliding forward or backward. The chock can be collapsed by pulling free a solid steel loop handle at the rear of the chock, allowing the weight of the plane to force the structure flat.

29th Sub-Depot aircraft maintenance group at King Air Base Flying School, Combs, Okla.

Plant at Douglas Aircraft Co. Inc. Oklahoma City, Okla.

"Tank Treads" Let Plane Land on Soft Ground N 559

Landings on soft or sandy ground, or even on excessively rough fields, are possible with a caterpillar-type landing gear, resembling the endless tread of a tank. In spite of its size, the tread uses about the same amount of rubber that would go into an airplane tire, but gives



Caterpillar-type landing gear permits ship to land on unfavorable terrain at speeds as high as 120 miles per hour



the plane from four to eight times greater contact area on the ground. Landings on unfavorable terrain can be made at speeds as high as 120 miles an hour in planes equipped with the gear. It is constructed

with steel bracing and grooved aluminum bogie rollers. The rubber track has a wire beading on the edges grooved to fit into the roller grooves, to prevent side slippage. Firestone Tire & Rubber Co., in co-operation with the Dowty Equipment Co. and the U. S. Army Aircraft Laboratory at Wright Field designed the structure.

Largest Mobile Gun in World Is U. S. 240-mm. Howitzer N 567

Shooting a 350-pound projectile whose effect is said to be more potent than that *Calvin*

of any aerial bomb, the Army's 240-millimeter howitzer is the largest mobile gun in the world. Its primary use is to batter down fortifications. It has a range of slightly over 14 miles, and with the fire-control apparatus in good work-order, experts say, under average atmospheric conditions its projectile will not miss the mark by more than three feet. In spite of its huge size—240 millimeters is equivalent to about nine and one-half inches, and the barrel is some 27 feet long—the big howitzer is capable of astonishing mobility behind the Army "prime movers" that haul it.



This gun can hit within three feet of its target 14 miles away. The barrel is about 27 feet long

Mr. Thomas E. Stinson, Jr.
3872 Franklin Avenue
Los Angeles, Calif.

71 360

SAGA of the REDWOODS



California Redwood Ass'n

IN THESE days of metal shortages, imagine how valuable a lumber would be that was fire-resistant, didn't rot or swell, and that was practically insectproof. Lumber like that could be used in place of metal for water tanks, flumes, chemical storage vats, and for a host of other things.

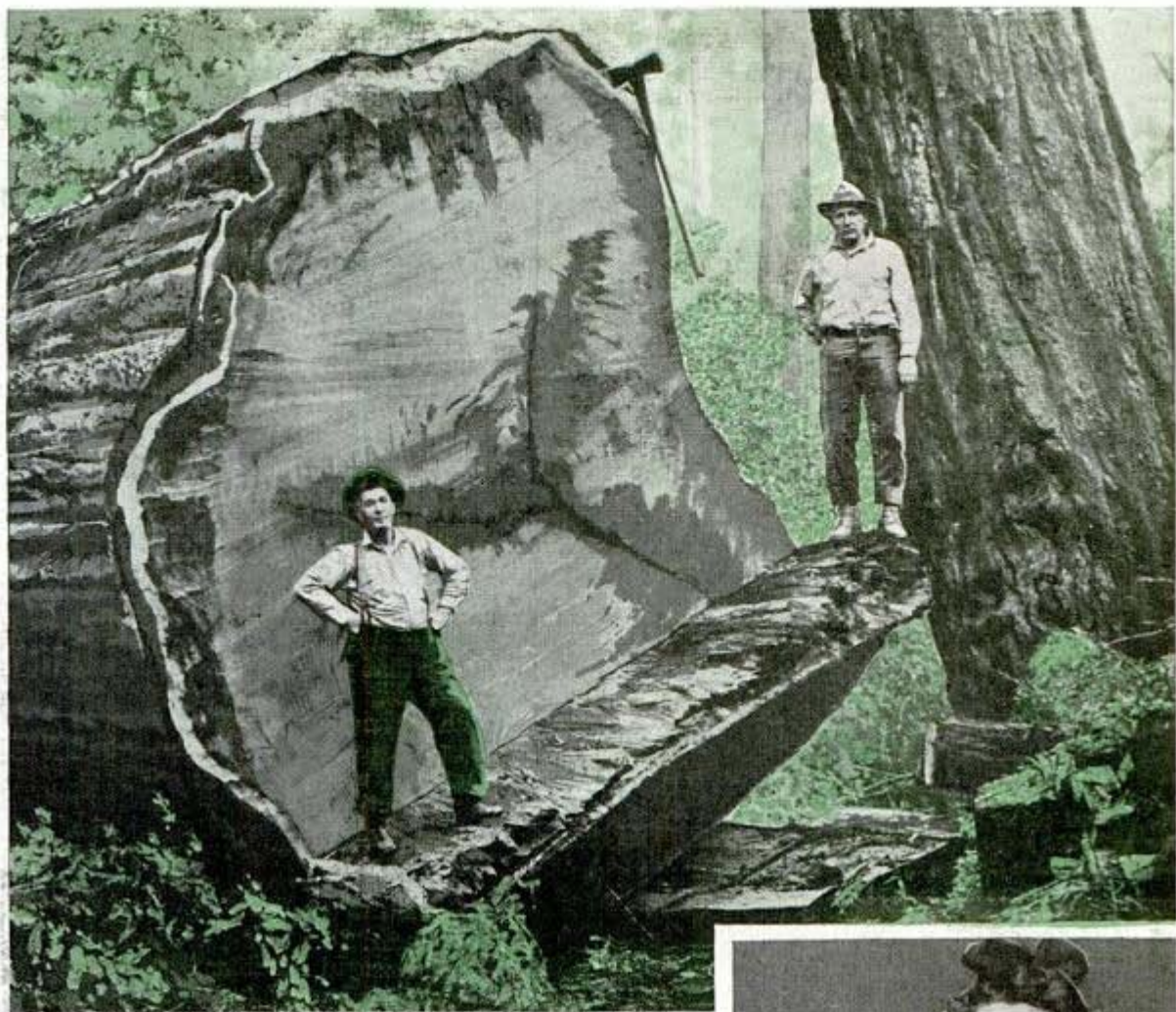
America has such a wood, and is using it for just those purposes. In fact, we have

Above, cutting up a huge redwood downed for commercial lumber. Left, a fallen redwood at least 1,000 years old now overgrown by another tremendous tree

a world monopoly in this uncommon timber. California redwood is not only a strategic material but is unique because its trees are the oldest and largest living things in nature.

A large redwood may measure more than 20 feet in base diameter and tower to a height of more than 300 feet. The tree may have been a sturdy sapling at the beginning of the Christian era. Its trunk may weigh some 500 tons and contain more than 100,000 board feet, enough to build an estimated 20 or more homes. Its bark sometimes grows two feet thick.

Redwoods grow in a coastal belt from south of San Francisco on up into southern Oregon. Their impressive grandeur makes a trip along the Redwood Highway unlike any other in the world. You drive, on a modern highway, through primeval forests of redwoods that are so tall that from the car window you see only the bases of nearby trees. You must stop and get out to look



Redwood Empire Association photos

From the bark of such trees as the monarch above come fibers now mixed with wool to make blankets and felt hats (right)

at their tops. Ferns, mosses and needles carpet the ground between the trees.

You appreciate the age of the giants when you inspect a section of trunk that has been placed on display. Sawed straight across so that its annual rings are easy to see, the cross section reaches way over the spectator's head. The redwood may have been 1,400, 1,700, or 2,000 years old when it fell. It was a mature tree at the time of the First Crusade.

The impressive thing to the observer is that he can span with his hands, reaching in from the bark, the dates of the annual rings with which he is most familiar. Beyond his hands the wood still reaches foot after foot toward the heart. Practically at the outer edge is the ring that marks the start of the first World War. An inch away are the rings that grew during the Civil War, another few inches is the 1776 ring, and within reach of his hand is 1492. The second word of the coast redwood's botanical name, *sequoia sempervirens*, means "forever green."

From the growth rings, too, can be traced the life history of the tree itself. Study of a 1,200-year old trunk at one grove shows that the tree was





Tallest and oldest living things are these redwood giants. In the 1,500,000 acres of the Redwood Empire in northern California and southern Oregon are 97 percent of the world's redwoods



scarred by fire in 1147, that it was attacked by fire also in 1595 and that new growth, coming together from each side of the wound, imprisoned some bark at that point. A series of fires all on one side attacked the tree in 1789, 1806, and 1820, leaving it in an unbalanced condition. Immediately the tree began to throw out a strong supporting buttress on the weak side, building itself out for 36 inches during the next 100 years. But the buttress didn't grow fast enough to provide the

support needed and in 1933, when the ground had been softened by heavy rains, the tree fell.

The Russians were the first white people to utilize the redwood. Russians who colonized in an area north of San Francisco more than a century ago built numerous buildings from redwood saplings. Mature trees were too big to be cut or worked with the tools they had. Their wooden church still stands today, in excellent condition.

In the gold rush days when redwood lumbering began in earnest, a crew of Paul Bunyans was needed to fell one of the giants. The base of a tree was usually too thick to attack, so the lumberjacks cut holes through the bark 12 or 14 feet above the ground, placed springboards in the holes to stand upon, and sawed through the tree above that point. Even so, a redwood saw with a husky man at each end might be 20 feet or more long. When a tree had been felled, trimmed, and cut into sections, these sections were still too big to handle, so they were split open with dynamite. Ten or 12 yokes of oxen then hauled a chunk of the wood to a mill.

Modern lumbering methods have changed all this. The trees are still felled by hand although motor-driven saws are also used. A tree is dropped onto a bed of bark and branches to ease its fall,

Left, building a protective roof of redwood over a water reservoir. Below, great logs are handled with ease at a sawmill



the bark is trimmed from it, and the trunk is cut into sections that can be handled efficiently. A tractor with a special trailer hooks onto a section and drags it down to camp, where it is loaded onto a truck or narrow-gauge railway for the trip to the mill. Of course, not every redwood tree is of giant size. Most of those cut commercially range from 8 to 10 feet in diameter.

Redwood is a soft, close-grained, dark red wood. Few woods possess its resistance to fire, decay, or insect attack. It is these features, of course, that allow it to attain great age. It has a very low shrinkage factor with little tendency to warp. It resists chemical attack. These characteristics have led to its wide use in the United States and in many other parts of the world as bridge timbering, water storage tanks, cooling towers, aqueducts, for fermenting and storage vats in a number of chemical industries, and for the storage of wines, cider, cheese, and petroleum products, among others. It is wide-



Above, felling a big tree with an electric saw powered by a generator on a Caterpillar Diesel tractor. The logging train below is hauling new-felled timber to a sawmill in the Redwood Empire



Snaking around the mountain at left is a continuous-stave redwood pipe built to carry irrigation water



ly used in areas where other woods are rapidly destroyed by termites. It withstands the effects of weathering. In fact, the best example of the durability of the wood is to be seen in one redwood grove where a giant tree has grown around and over a fallen trunk. The fallen trunk has been imprisoned for 10 centuries or more, yet its wood is still strong.

Redwood lumber has been widely used in residential construction, outside for its durability and inside because of its decorative value. Burls, or close-grained knots of redwood, take a high polish and are made into ornamental trays and other pieces. Redwood bark has a high insulating value. Shredded and ground up into a wool, it protects homes against summer heat and winter cold, and is also used for insulating locker refrigeration plants. The bark is fire- and vermin-resistant.

The fibrous bark is also woven into



Redwood Empire Association photo
Here is the famous "Tree House," built within a giant of redwood forest

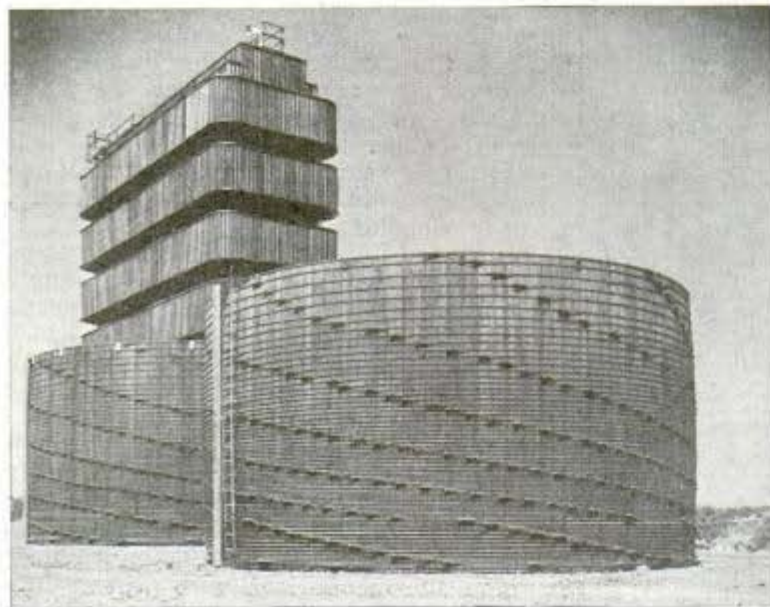
cloth. Redwood cloth consists of up to 60 percent bark fiber with a corresponding amount of wool. It is made into suitings, blankets, and felts, and produces a warm, fluffy cloth that is worked and dyed easily.

Vast areas formerly occupied by redwood forests have been logged off and one estimate is that one and a half million acres of the trees remain. Preservation of large tracts of the giant trees in their original wilderness settings is the purpose of the Save-The-Redwoods League which has joined with the state in acquiring and deeding to the public some of the best and most accessible groves. Lumbermen are in sympathy with the movement and are practicing a selective logging program and

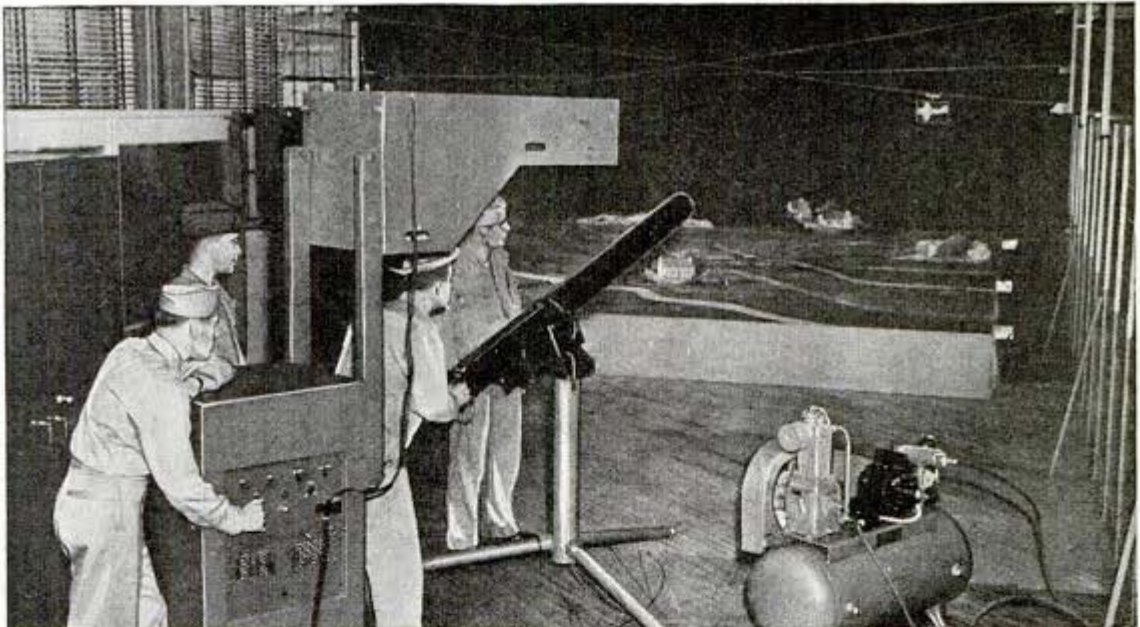
size alone the coast redwood doesn't compare with its relative, sequoia gigantea, that is found in a 50-square-mile area east of Fresno in the mountains of central California. The sempervirens rarely exceed 20 feet in diameter as compared to gigantea that approach 40 feet in base diameter. The largest officially measured redwood, the General Grant Tree in General Grant National Park, is 40.3 feet in diameter at the base and is 267 feet tall. It is situated in a mixed forest in which sugar pines with base diameters of 11 feet and ponderosa pines, silver firs, and cedars almost as large occur. There are stories that an even larger "big tree" than the General Grant is located somewhere in the mountains in the same area.

The redwoods have been called a living link with the past, which they truly are. Public and private agencies that are continuing their work to preserve more of the forests are doing so in order that future generations may also enjoy them. Barring an abrupt change of climate or some unpredictable catastrophe, the California redwood groves should still be flourishing thousands of years from now.

Cooling tower and tanks built of redwood which does not swell and so remains watertight even if alternately wet and dried
 Black, Sivalls & Bryson, Inc.



Training Machine Gun Fires Pellets of Plastic



Raking target with realistic "bullets," this training weapon performs like a regular Browning machine gun

Operated by compressed air and electricity, a training machine gun simulates the action of a Browning weapon. It fires 600 times a minute, but uses only 100 plas-

tic pellets so they are in the same ratio as tracer bullets. Pellet velocity and trajectory are according to scale, and recoil and noise are much like that of a real gun.

Chicago war plant

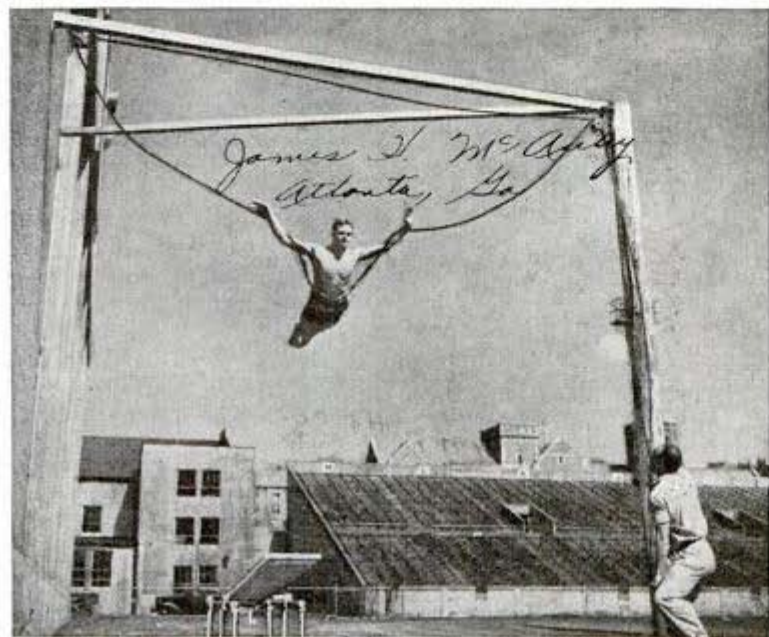
Rope Harness, Sawdust Pool, Used in Dry-Land Diving

"Dry-land diving" is what Coach Fred Lanoue of Georgia Tech calls his technique for teaching proper form off the springboard, without benefit of any water. The student diver is sustained by ropes, operated by the instructor, who can let the

diver down easily into the sawdust pit that passes for the pool. The diver wears a tumbling belt, padded with old football hip pads, according to Coach Lanoue's description in the Southern Coach and Athlete. To an overhead beam in front of the spring-

board are attached a single and a double pulley, with one rope running through both pulleys and one rope through only one. The ropes are spliced where they come through the double pulley, and the instructor thus has only one rope to manipulate. Snap clips attach the rope ends to the tumbling belt. Because the instructor stands always ready to let the diver down easily, student divers readily acquire confidence.

*Coach Fred Lanoue
Georgia Tech*



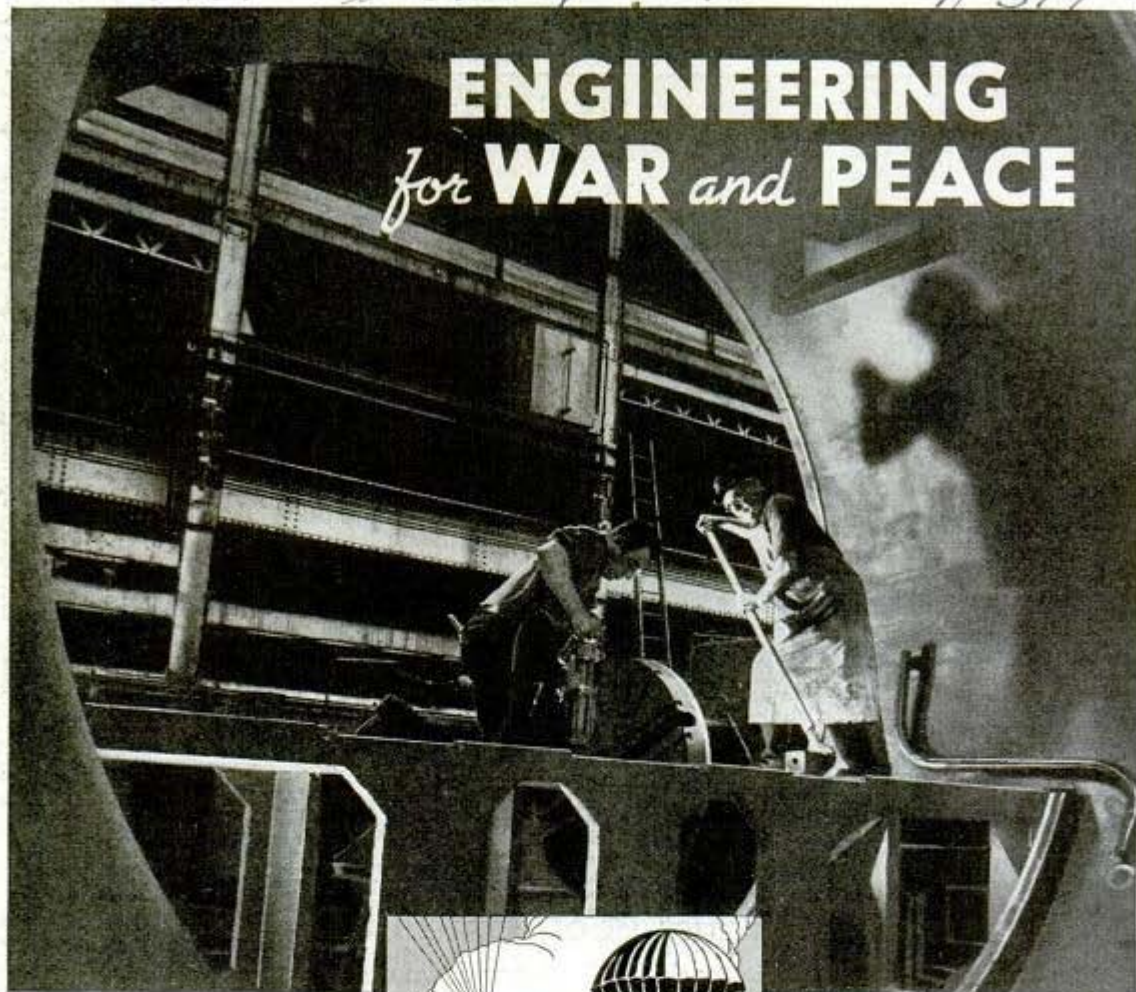
*James H. McAlister
Atlanta, Ga.*

Soaring off springboard, student diver practices his form over a sawdust "pool," safely held in a rope harness by instructor

Ed: Dave Mc Keith, Southern Coach & Athlete, 751 Park Dr., N.C. Atlanta, Ga.

ENGINEERING for WAR and PEACE

Mr. Grant



UP THE mountain roads of Sicily the American M-4 tanks rolled, their 75's blasting at the German positions ahead. No stopping to sight and fire. The big guns talked as they ran.

No enemy tank could do that. The enemy must stop and reaim, else they would waste shells at random.

A peacetime search for means of stabilizing American railway and industrial vehicles gave Yankee tank gunners this vital advantage over the foe. Westinghouse engineers had been seeking to control side-sway, vibration and jackrabbit performance of cars on road and rail. When war changed their goal, they turned up with an electric control by which the gunner can train his 75 quickly, with little effort, and fire five times as accurately. Gen. L. H. Campbell, Jr., Chief of Ordnance, says "We can fire this 75-mm. gun when the tank is in motion, which is more than any enemy tank can do. And we hit the target."



Power for war industry—above, building a 60,000 kilovolt-ampere condenser. Center, bicycle tail-lights get a war job lighting cargo parachutes after dark

That is one instance where peacetime research, turned to wartime use, has delivered victory. It works both ways. Wartime engineering is developing new techniques and products that will change our mode of living after the war. The gun control will smooth your railway trip,

but, more important, effect great savings of maintenance on track and train. It will be applied to velocity, acceleration and position controls of ships and cranes, elevators and steel mills.

War necessity has accelerated the development of electronic devices, power systems and engines. Westinghouse engineers who cannot talk of the present, which is wrapped in military secrecy, can tell something of the future. They predict that current improvements in electric locomotives

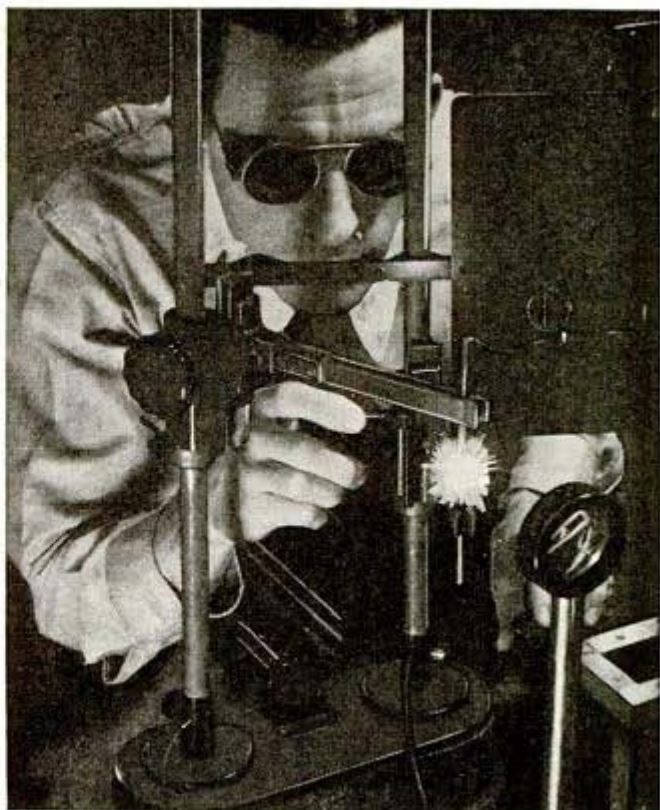
and power systems will bring an expansion of electric railways in heavy traffic centers after the war. They look for turbine-driven locomotives, perhaps with turbines geared direct to drivers. Such locomotives have already been designed and are ready for manufacture. A turbine locomotive of 6,500 horsepower would save more than 30 percent in pounds of steam per horsepower hour over the conventional steam locomotive. Besides economy in power, there would be smaller wheel diameters, no reciprocating parts, consequently less wear on engine and track.

Gas turbines are a possible motive power for the airplane of the future, too, and electric drive between turbines and propellers may revolutionize aircraft design.



The impact of the war probably has been greatest in the aeronautical field, and is manifest in the bewildering array of instruments that face the pilot of the 400-mile-an-hour fighter plane and the ocean-hopping bomber. Westinghouse research men believe it will be possible to relieve the pilot of much work by developing automatic engine controls that will take over such operations as carburetor adjustment, ignition advance and speed synchronization without attention from the pilot.

Not only did war take over the tools of peacetime industry, it took over the brains. Engineers who had thought in terms of kitchen equipment turned to wing-flap assemblies. Men engaged in electric motor research switched to



Top, electric current arcs sample of pure iron and spectrograph focuses radiation through prisms to record wavelength portrait of iron. Pilot's oxygen need is discerned (left) by watching blood color with phototube device. Below, welders work on turbo-generator, circled by frame for a huge motor





Heat guns firing explosive rivets used in aircraft manufacture incorporate the heater element from your electric stove, the thermostat from an ironer

problems of motorized tank turrets and anti-aircraft range finders. The anti-aircraft gunner has only two or three seconds to make the complex computations involved in knocking down a Messerschmitt or Zero. Among the factors are distance to target, its speed and direction in three dimensions, wind, force of gravity, elapsed time between sighting and firing. No human brain could add up those factors in time to meet a six-miles-a-minute plane with a shell. Engineers have built mechanical brains to compute the range automatically, instantly and accurately.

A metal disk the size of a half dollar used to control the temperature of electric irons so that your white shirt wouldn't be charred. Now the iron is a memory, but its little thermostat is very much in business. It is a watchman guarding against fire on planes and battleships. Attached to motors and strategic parts of warplanes, the thermostats operate like automatic sprinklers in factories. Fire causes the bimetallic disk to move and close an electric circuit flashing a light on the pilot's instrument board warning of the fire and its location. He then pulls a lever releasing carbon dioxide at the point of danger. Similarly, thermostats detect overheating in tanks and flash a warning if overheating occurs as air compressors "blow out" the big guns of a warship after firing.

Life in the jungle is not quite the nightmare it might be because the refrigerator engineers, when they quit making refrigerators, didn't simply go home and sulk. Not that they contrived air conditioning for

the hammocks on Guadalcanal. They turned from making ice cubes to murdering mosquitoes.

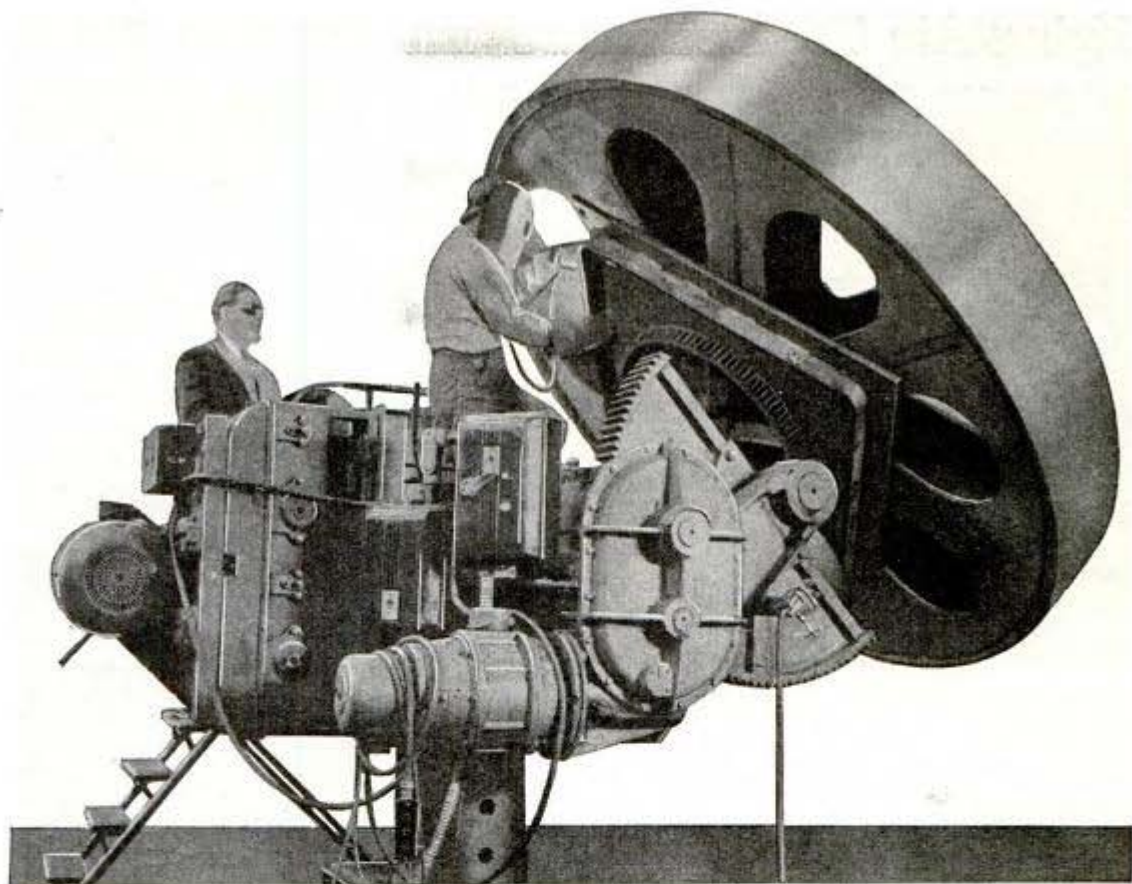
Years ago a Westinghouse man helped design a "charging bomb" which held the exact amount of Freon refrigerant required to fill a single refrigerator system. When the unit was assembled the bomb was connected to it and Freon under pressure flowed into the refrigerator's arteries.

When the same engineer heard of the army's need for an insecticide gun he had the answer. He loaded the handy little bomb, about the size of a No. 2 can, with oil of sesame and pyrethrum—

deadly to bugs but harmless to man, and nonflammable—and used the Freon gas under pressure as an "explosive" charge. Released in barracks or hospital or pup tent, the bomb sprays the air with a penetrating fumigant that kills mosquitoes quickly, seeks out insects hiding in crevices. Even in a foxhole it will drive away the pests. Millions of the bombs have been distributed to fighters in the tropics. One "health bomb" in 12 to 14 minutes will fumigate 150,000 cubic feet, the equivalent of 240 pup tents or 50 giant bombers. The spray can be turned on and off, and will



Canned death for malarial mosquitoes comes in containers first used to charge refrigerators with Freon



The manipulator above easily flips into any position the huge blank for bull gear of turbine-driven cargo ship, making welder's work easy. Below, the 97-ton metal monolith is a housing for steel rolling mill

clear the air in a pup tent in three seconds. You can be sure it will be hanging on the wall of your summer cottage, your cow barn or in your camp tent when the boys are back from Tokyo.

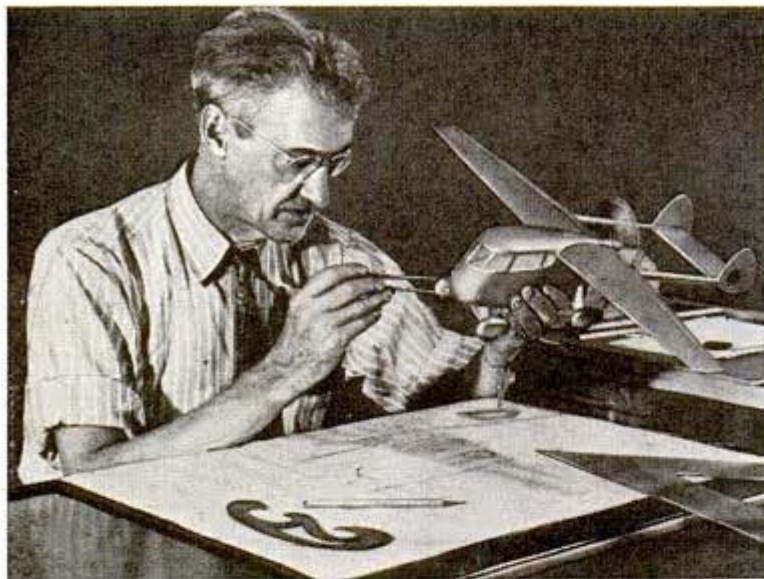
What might have been a taillight for your bicycle is now attached, with lamp and dry cell, to cargo parachutes so that paratroopers can find quickly the supplies dropped to them at night. From the heater unit of your electric range the engineers developed a thermostatically controlled heat gun which fires the explosive rivets used in aircraft fabrication. In a laboratory designed to test power line circuit-breakers, engineers fired painlessly-killed birds from high-velocity compressed air guns to test the impact resistance of airplane windshields. The new windshields have withstood the impact of a four-pound bird at 300 miles an hour, that of a 15-pound bird at more than 200 miles an hour.

Emergency war problems get emergency treatment. American bombs delivered to an Allied air field would not fit bomb racks of British planes. American bomb racks would not accommodate British bombs. An adapter was needed desperately. A Westinghouse factory got the problem by telephone one afternoon. Designers put the adapter on paper while materials were

(Continued to page 150)



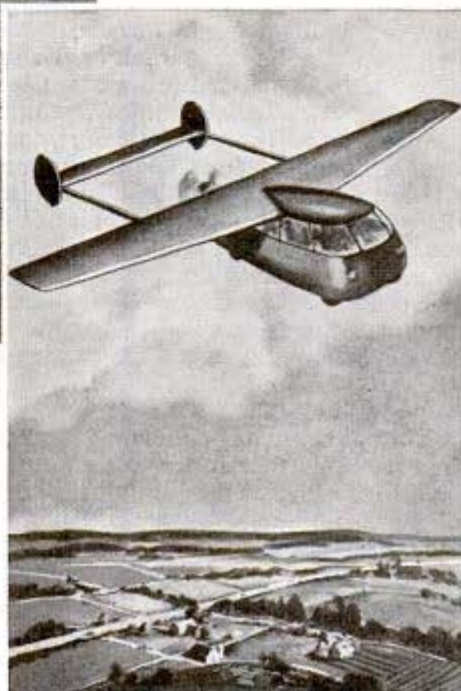
Flying Air Car Designed With Hook-on Wings



W. B. Stout, shown above examining a model of his latest development, the "roadable airplane," operates on the theory that accepted methods "ain't necessarily so." Among the "firsts" he has designed by breaking consciously with the past were the first thick-wing plane, first all-metal plane, and Scarab car, called "10 years ahead of its time"



Stout's Aerocar, the flying family auto, is to be equipped with "hook-on" wings, shown being installed above. Shown below is the Aerocar in flight. Unlike the roadable plane, which is intended to be primarily a plane and secondarily a car, the Aerocar is, first, a good automobile



Stout's Aerocar would do 60 to 70 miles on the highway, and 100 miles an hour in the air with about the same gasoline consumption. Its air range would be about 250 miles. His roadable plane would be for use in the West, where distances are longer, and would have a range of 400 miles in the air, coming to the ground only if the weather is bad, and remaining on the road only until the storm area is passed. Its wings would fold for road driving. It would speed at 120 m.p.h. in the air, 35 m.p.h. on the ground. Above is a third of Stout's conceptions for postwar travel, a Helicab. He considers it most practical for use in congested cities, especially for home-to-office commuters. Stout says he foresees electronic controls to prevent collision and constant ground-air communication

W. S. Silver Springs, Fla.

Navy Uses "Submarine" Camera To Film Diving Under Water

Aircraft Corp.
-Warhawk- which

Postwar transportation, according to W. B. Stout, will rely largely on the aerocar, or flying automobile for families; the roadable airplane, for distance flight accompanied by short trips on the ground, and the helicab, a new type of helicopter. Stout, renowned engineer and designer, is now head of Stout Research Division of Consolidated Vultee. He believes the public is ready for such machines, and that industry is ready to provide them.

His aerocar is a three-passenger family model which takes wing for week-end or vacation trips. Weighing 1,500 pounds—half as much as a pre-war light coupe—it will be a good automobile first, and a plane only second, capable of speeds of 70 miles an hour on the highway and 100 in the air with pre-war gasoline consumption. Its cruising range would be 250 miles. To convert it to a plane, you let down wing and outrigger assembly, hook it on, and fly away.

His roadable plane will be a good airplane first, and a ground vehicle second. Light, weighing only 800 pounds, it would be capable of 400-mile cross-country hops, and could be used as a light delivery truck—say in areas of the West, where communities are far apart. It will do 120 miles an hour in the air, but only about 35 on the ground. To convert it from plane to car, you land it on the road, fold up the wings, and drive on.

These two models would be primarily for the Midwest and West; in the more congested Northeast, and indeed in any metropolitan area, Stout's "helicab" is designed to provide the nearest thing to personal wings yet devised. A helicopter type, designed to carry up to five persons, it would weigh about 1,700 pounds. He foresees a half-million helicopters taking commuters to Los Angeles and New York each morning, and back to their suburban homes each evening.



Navy cameraman goes to the bottom to film technique of diving

In the crystal waters at Silver Springs, Fla., a Navy cameraman was lowered to the bottom of a lake to film underwater sequences in a training film on the proper technique of diving. Himself wearing a diver's mask, but otherwise unencumbered, the cameraman hung half suspended beside his submarine camera, which was designed to protect film and operating equipment from water damage.

Plane De-Icer Heated by Exhaust Gas Keeps Wing at 60 Degrees

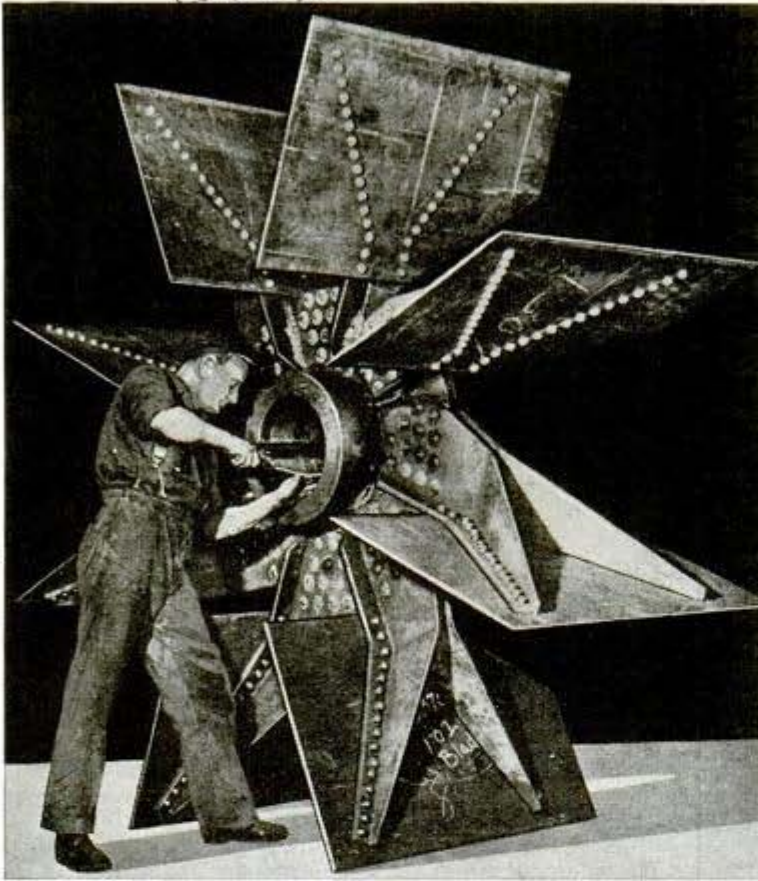
Thermal anti-icing, a system by which air warmed by the exhaust gases is blown through ducts onto wing and tail surfaces, has been installed on big bombers made by Consolidated Vultee. Exhaust gases, formerly wasted, heat the de-icing air through heat exchangers in the exhaust pipes. The air then is circulated through wing and tail surfaces. The heated air keeps the leading edges of the wings, where ice usually forms first, at 60 degrees when the outside temperature is 40 below zero. Its chief advantage over rubber pneumatic anti-icers is that the latter may alter the aerodynamic efficiency of the wing. Thermal anti-icing can be used in combat, at slow flying speeds, and during takeoffs and landings. The anti-icing effect begins as soon as the motors are started, and will begin instantly to remove ice that accumulated on a grounded airplane, which formerly had to be removed by hand.

Aircraft Corp.
San Diego, Calif.

71496

Giant Fan Exhausts Hot Gases At 242,000 Cu. Ft. a Minute

Calvin



Mammoth exhaust fan weighs 41,000 pounds, resists heat of 505 degrees F.

Used to supplement a sintering furnace that dries and purifies iron ore destined for making steel, a mammoth exhaust fan was constructed to resist operating temperatures of 505 degrees Fahrenheit. Each of four fans used in the operation exhausts 242,000 cubic feet of hot gases and abrasive dusts each minute. Each fan weighs 41,000 pounds, and measures 13 feet high, 20 feet long, and 14 feet wide. The enormous fan wheels turn in water-cooled bearings, to prevent lubrication from breaking down at the extreme high temperature.

71584

'Remote' Compass in Wing Avoids Magnetism

Remote-reading magnetic compass indicators and transmitters are being produced for warplanes. They make it possible to take compass readings from the airplane wing, or other points on the plane relatively free from magnetic influences. With the compass transmitter placed in the desired spot,

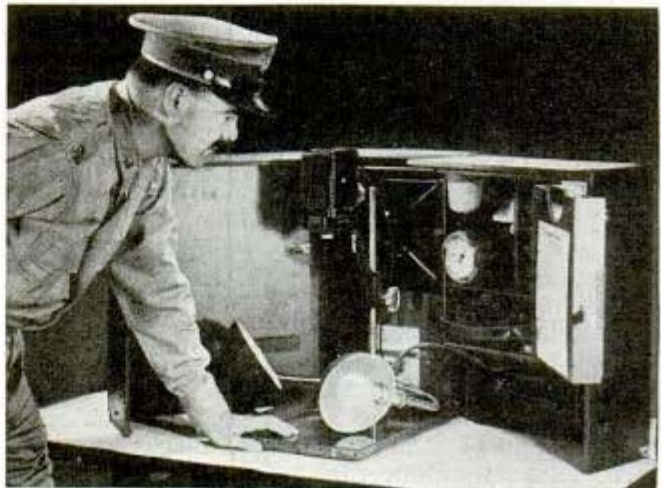
40 Designed & Produced
by Bendis Aviation
Division

the compass bearing is transmitted electrically to an instrument panel in the pilot's compartment. The complete unit of indicator and transmitter contains 206 parts, one a coil about the diameter of a thimble, but with 2,050 windings over 20 laminations of special metals.

71511

Portable Darkroom Housed in a Box Two Feet Square

Army, Navy and Marine photographers can "carry darkness" in their hands in the form of a handy portable darkroom. This military model, which will probably be adapted to postwar civilian use, consists of a box less than two feet square that contains all materials necessary to take and process pictures. Its contents include camera, lenses and filters, film, flash synchronizer, batteries and cable release. In compact shelves and compartments are chemicals, trays, timer, clips, thermometer, daylight loading tank, portable miniature enlarger and other equipment for developing and printing. The necessary electric current can be supplied by an auto battery.



Darkroom box for military use holds a camera and equipment



INDUSTRY'S Dr. JEKYLL *and* Mr. HYDE

IN THE family of the elements, phosphorus leads a double life. Essential both to plants and animals, in an elemental form it is a deadly poison; it goes into soap and smoke screens, biscuits and bombs. It will burn on contact with the air, yet it makes theater curtains fireproof; an excellent drying agent, it is always manufactured and shipped under water.

It mothproofs clothing, makes oil and water mix, and in one combination you even rub it in your hair; it also could burn down cities.

The Greeks had a word for it—"light bearer," from its quality of glowing in the dark. To a modern age, it might better be described as both a Dr. Jekyll and a Mr. Hyde—obliging partner of industry in peace, and a fearsome adjunct of armies in war.

Phosphorus has already gone to war in huge quantities. It is ideal for smoke screens, providing a screen with the highest obscuring

Phosphorus in wartime is an incendiary and screening agent. Above, a nighttime burst of white phosphorus; below, mortar crew lays a smoke screen. In other forms phosphorus goes into food, feed and fertilizer





An ideal screening smoke, according to the Chemical Warfare Service, should produce a cloud of finely divided particles to shield men and equipment. Actually, the screening is produced not by obstructing light rays, but rather by reflecting light. For this reason, white smokes are preferable to black, because the white reflects and even blinds.

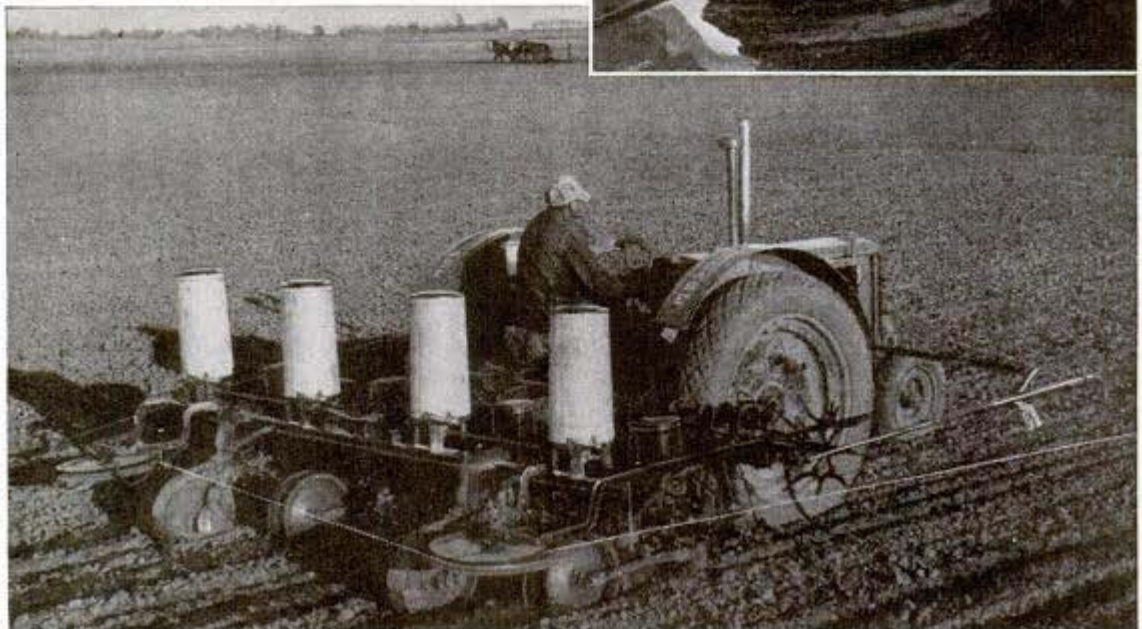
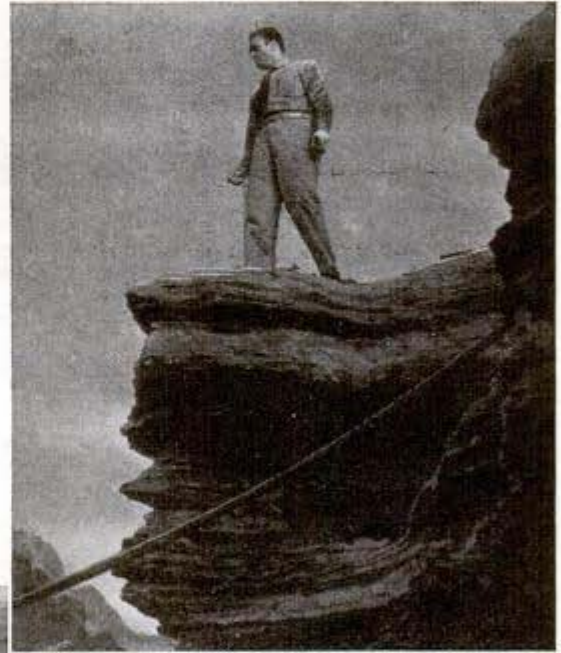
White phosphorus, or "WP" in the Chemical Warfare Service designation, is a pale yellow, waxy solid that combines actively with oxygen to form phosphorus pentoxide. The reaction, accompanied by a smell as of burning matches, produces a flame that will set afire equipment and injure men.

As dicalcium phosphate, phosphorus goes into tooth paste, shown in manufacture at left. Below, phosphate rock open-pit mine of Monsanto Chemical Co.

power of all the known smoke materials.

Smoke is a common weapon of this war. The Germans used it against the Fortress Ebn Emael in Belgium and against the Maginot Line; the Axis used "artificial fog" in the attack on Crete; smoke screened effectively our landings in North Africa. Civilian defense units have experimented with smoke to "white out" whole areas in the event of daytime air raids.

Below: application of fertilizer. Triple superphosphate provides readily assimilated food for plants



The substance is loaded directly into shell, bomb or grenade by melting it under hot water and casting it in the projectiles. When the projectile explodes the solid phosphorus is scattered into the air, forming a bright cloud of burning particles. The pentoxide remaining maintains the screening effect, and is harmless to men or materiel.

Because of this wide dispersal of burning particles, WP may also be used as an incendiary. The particles ignite spontaneously in the atmosphere, and treatment of burning phosphorus on the skin is an extremely difficult job.

Dousing the burn with water immediately extinguishes the flame; but when the water dries the particles flare again. Immersed in water, the tiny firebrands may be removed from the skin, though it is difficult to prevent minute segments from remaining. Preferably, the burn is bathed in copper sulfate, which forms a coating around the particle, excluding oxygen and stopping the burning action, until the particle can be efficiently removed.

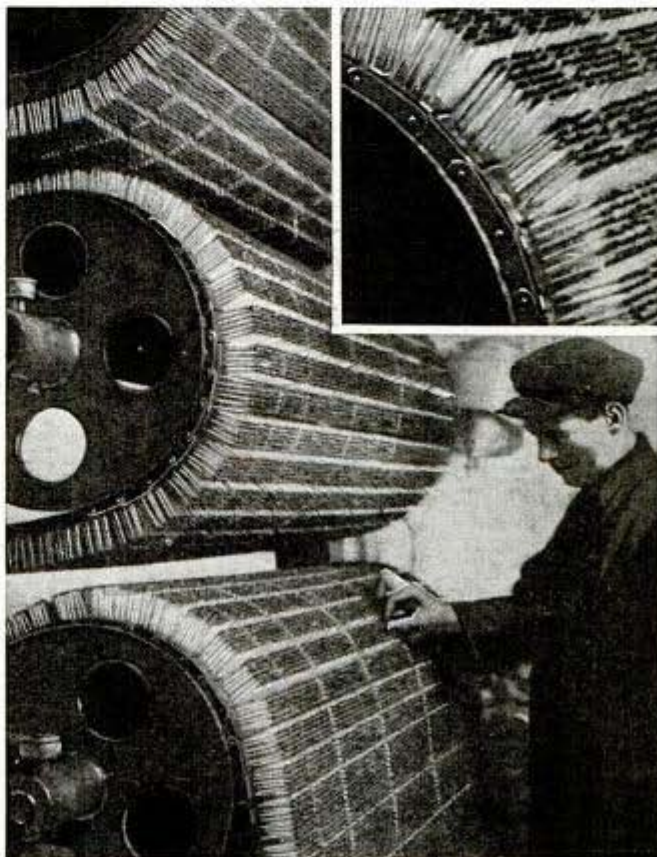
The Japs use phosphorus in a delayed-action explosive-incendiary bomb. Around a central exploder tube is a liquid-filled chamber in which float numerous black rubber cylinders, which are filled with phosphorus. On exploding, the bomb scatters the rubber pellets widespread. A fire spotter would not suspect an incendiary was present until the pellets dry. Then the phosphorus ignites the rubber, causing stubborn, persistent flames.

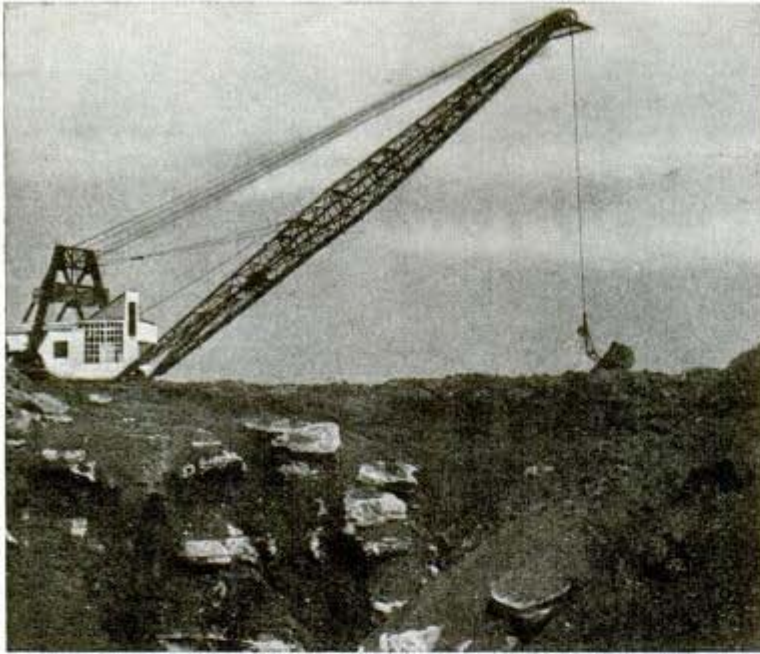
For all its spectacular, wartime "Mr. Hyde" character, phosphorus is as unimpeachable as Dr. Jekyll himself in peacetime pursuits.

Though it never occurs free in nature, phosphorus is the 12th element in order of abundance in the earth's surface, according to the United States Department of Commerce. Concentrations of phosphorus compounds, principally calcium phosphate in mineral rocks, exist in many parts of the world. In the United States the mineral is chiefly mined in Florida and Tennessee, and to lesser extents in Idaho, Montana and Virginia. It is a prime element in the composition of bones,



Above: Monsanto Chemical Co. workman filling tank car with molten elemental phosphorus wears asbestos suit as a safeguard against fire. Below, phosphorus makes matches flame
Ewing-Galloway photo





From Monsanto's open-pit mine comes phosphate ore to be processed into elemental phosphorus, starting point in the making of phosphoric acid

and deposits of fossilized bones formerly were a chief source.

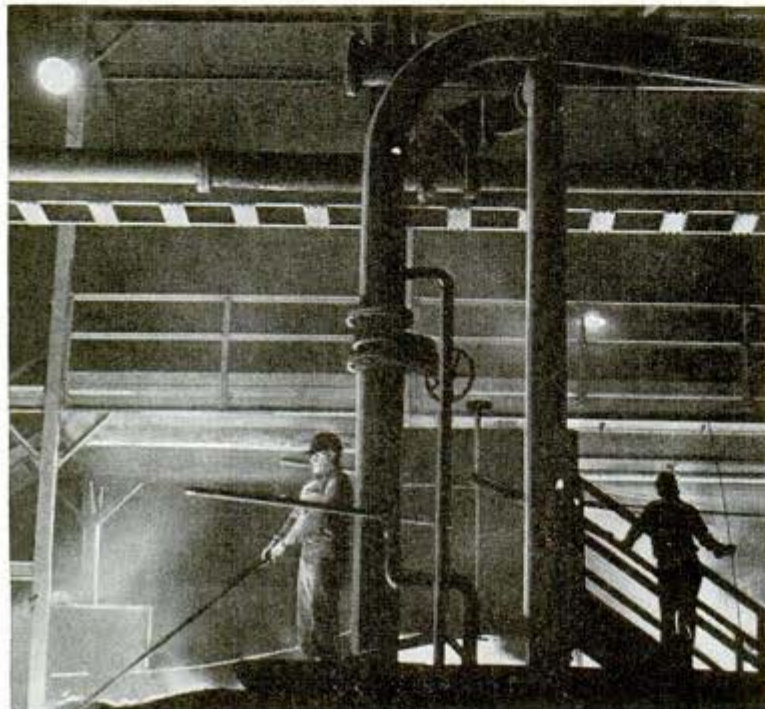
The phosphate rock, together with sand and coke, is heated at very high temperatures in an electric furnace. Elemental phosphorus is thereby distilled off in gaseous form, then condensed and collected under water as a solid substance, or immediately burned to phosphorus pentoxide. From the latter is derived phosphoric acid and phosphatic derivatives.

ble under 350 degrees Centigrade, and is not poisonous.

The element's dual personality is shown in the common match. Whereas its flaming tip may be made of sesquisulphide of phosphorus, the match stick itself is treated with another phosphorus compound—monoammonium phosphate—to eliminate afterglow. This same compound renders wood, paper and textiles fireproof. Thus, in one form phosphorus causes fire; in another, it prevents it.

Monoammonium phosphate also keeps candlewicks from smoking, and helps make yeast, vinegar and bread-improvers.

Phosphates became the first chemical fertilizers, as contrasted with organic manures. The importance of phosphates to successful farming is shown by experiments of the Tennessee Valley Authority. The Central Basin of Mid-Tennessee contains soils almost as fertile as any in the United States—land naturally rich in all nutrients needed by plants, and especially in available phos-



Tapping molten silica slag from bottom of an electric phosphorus furnace at Monsanto's plant in Tennessee

phorus. By contrast, the Highland Rim surrounding that same basin has soil with markedly less of such nutrients.

A visitor doesn't see the difference as one of soil. He sees a contrast between the rich, broad, fertile acres of the Central Basin, with its well-kept homes and prosperous people, and the gullied, meagerly covered hillsides, with their picturesque, but often poor, homes. When Gary Cooper as "Sergeant York" hankered after "bottom land," he was all unknowingly longing for soil containing more available phosphorus, you might say.

Cattle fed on the phosphate-rich hay from the Central Basin grow heavier than those of the Highland Rim; in the basin are 81 animals per square mile, in the adjoining hills, only 23. Cattle on experimental tracts would even avoid untreated land, while keeping that treated with phosphates closely cropped. As to erosion, plant cover is a principal means of keeping the soil bound together, and phosphates make plants grow.

In test demonstrations of phosphating soils over five years, the TVA reported that production of hay was increased by one-third; production of small grains by two-thirds; of corn by one-fourth. Acreage of cotton and tobacco remained about the same, but production jumped by one half; sales of whole milk and eggs increased by one half; wool sales by one-fifth, and hog sales by two-thirds.

Especially in humid parts of the United States, the TVA believes, phosphorus is vital for successful farming. On most soils it is needed to make possible soil-conserving systems of farming. It makes legumes grow, and legumes transfer another needed nutrient, nitrogen, from the air to the soil.

Object of any fertilizer is to get plant food into the soil in such a form that the plants can feed on it. The phosphorus in phosphate rock is insoluble, but more than a century ago in England Sir John Laws found that by treating ground rock phosphate with sulphuric acid he could make the plant nutrient available. Laws' "wet process" produces superphosphate with about 8 percent phosphorus; this percentage can be more than doubled by treating the pulverized phosphate rock with phosphoric acid, which further concentrates the phosphorus.

Phosphoric acid is also used to rustproof metals. Other derivatives of the element are used to treat textiles chemically to prepare them for dyeing and finishing; to improve the effectiveness of both household and industrial soaps; as a water softener and cleaner; as a metal degreaser; as an acid neutralizer.

(Continued to page 150)

NOVEMBER, 1943

Robert Keith, Inc.
3rd & Baltimore
Kansas City, Mo. 71466
Candle-Lit Heater for Dish
Keeps Supper Warm

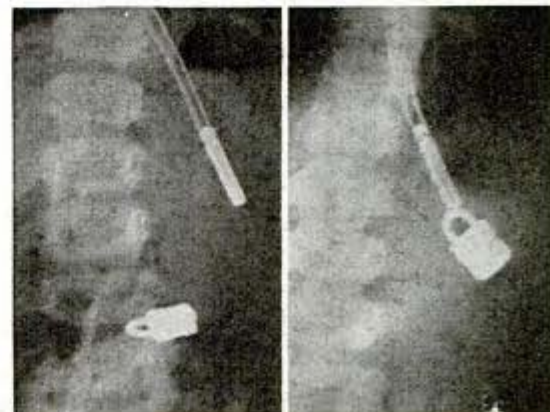


Heat from candle keeps buffet dishes warm until use

Especially suited for buffet dinners, when guests may linger overlong after the first call to the meal, is a dish heater, whose warmth comes from a stubby candle enclosed in a glass base. Heat from the candle is just enough to keep a pot, pan or casserole dish warm for the tardy eater.

71489
Magnet Is Lowered Into Stomach
To Remove Metal Objects

Small metal objects, such as a child might swallow, can be removed from the stomach with a tiny magnet. This revolutionary medical procedure recently averted a surgical operation on a five-year-old boy who had swallowed a padlock. The magnet was lowered into his stomach and the padlock was slowly and safely withdrawn.



X-ray photos show padlock being taken from stomach

Dr. Samuel Silber
Brooklyn, N. Y. ⁴⁵

*Mr. Moore
1362 N. Dearborn
#471 Chicago, Ill.*

WAR MAPS WHILE YOU WAIT



↑ Officers of the army War Plans Division study a world map as Brig. Gen. Leonard T. Gerow, division chief, points to a scene of operations. Map-making for the Army, Navy and Air Forces is a big industry in which American business machines and printing equipment have proved of outstanding value. Data for map-making are obtained by plane, patrol and reconnaissance, brought in by radio, telephone or courier and experts quickly compile and print the maps with duplicating machines, lithograph presses, mimeograph and multigraph. Some machines turn out multi-color maps. In the battle of Egypt quick changes in maps were made by using green carbon for allied positions, red for the enemy



↑ A sergeant of the U. S. Army engineers making a military map in the field prints a lithographic plate in an offset press. Fast duplication is necessary to supply all ground and air units with up-to-the-minute maps in quick time



← On the wall of field headquarters a master map of the battle zone is mounted, the lines changing as phone, radio or plane reports tell of advances or withdrawals. Strategic movements are plotted on the transparent overlay

*Sgt Meyer
Finkelstein
Buffalo, N.Y.*



↑ Aerial photographs taken from various angles at high altitudes are matched into a large strip mosaic map. Sometimes three-dimensional maps are made, revealing the heights of objects seen under stereoscope

At center, retouching prominent features of terrain, battle lines and enemy positions on the negative of a battle map preparatory to making a lithograph (or planograph) plate for map-printing press



*Col. Ho Morrison
Grant Hall
Fort Leavenworth
Kansas*



Above, a colonel demonstrates on huge wall map how an infantry attack is planned, while staff officers of a division look on. Charts used by pilots and navigators in Air Forces are fluorescent, details becoming visible under rays of ultraviolet lamp worn on forehead. Below, plotting gun ranges from telephoned data



71522

Capless Pen Retracts Nib And Adjusts for Altitude



Pen has stratosphere "shift"; inset, nib retracted

You can write at sea level, on a mountain top or in a stratosphere with a fountain pen that has three "shifts" that control air pressure within the ink compartment, according to its inventor. The pen has a retracting nib which is sealed with a special device when withdrawn, eliminating the need for a cap. When the pen is in "low gear" with nib partly extended for use at extremely high altitudes the ink reservoir remains sealed air tight, but when fully extended for use at normal altitudes both the ink and air ducts are open. The pen is filled with a hydro-pneumatic trigger.

Collapse of Roof of Voice Box May Cause Bomb-Blast Death

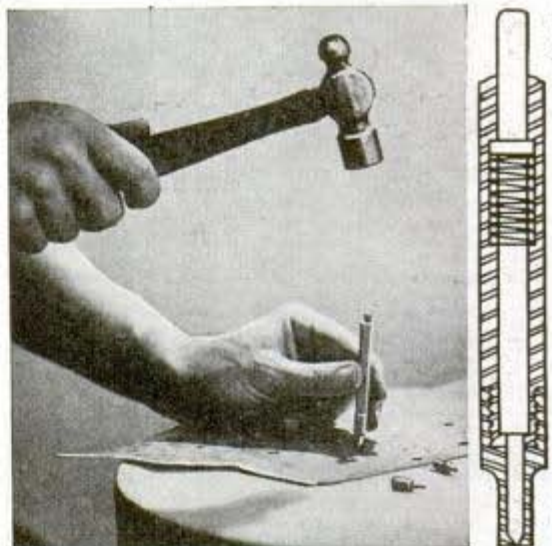
Untold numbers of persons have died in bombing raids without ever being touched by a bomb or its fragments. Death has been ascribed to blast, but exactly how it occurred is in dispute. Dr. F. E. Eve of Eng-

land believes death may be due to the forcible jamming shut of the epiglottis while the lungs are empty, with consequent suffocation. The epiglottis is the lid, or roof, of the voice box. When a bomb explodes, its high-pressure wave, in air or water, compresses the chest, forcing out some air, but the chest, being elastic, then expands, and air is drawn sharply inward. This inrush of air might slam down the epiglottis, and this effect would be reinforced by the low-pressure wave of the blast, which sucks the chest walls outward just as it sucks glass out of windows. If the lid of the voice box is jammed shut this way, when there is only a little air in the lungs, the victim cannot force it open, because he has not enough air in his lungs to provide sufficient pressure. Nor can air enter his lungs, so the victim swiftly dies. To answer the objection that blast victims show no sign of suffocation, Dr. Eve cites three cases of sudden death due to food jammed in the upper part of the windpipe. Victims in these cases did not turn blue or show signs of choking. For possible prevention of blast death, he advises wearing a broad stomacher, which need not be very tight but must be elastic.

71475

Punch Slides Inside Metal Sleeve To Locate Center of Hole

Centered within a sleeve that fits snugly in a template hole, an aircraft worker's transfer punch locates the exact center of the hole. It is claimed to be a boon to the inexperienced operator. The punch also eliminates wear of the template holes since there is no friction between the tool and the hole. After being struck with a hammer, the punch withdraws automatically and is in position for the next punch.



After hammer blow, punch withdraws automatically

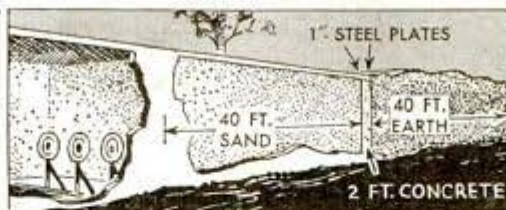
Andrews Pen Co.
 14 35 W. 25 St. N.Y.
 New York City

Giant Firing Range Has Glass-Floored Turret

71458
Wm. W. Hutter



Observer looks through glass floor of booth on roof and reports on the quality of flashing tracer bullets



TWO BLOWERS, ONE AT EACH END, CLEAR RANGE OF GAS AND SMOKE



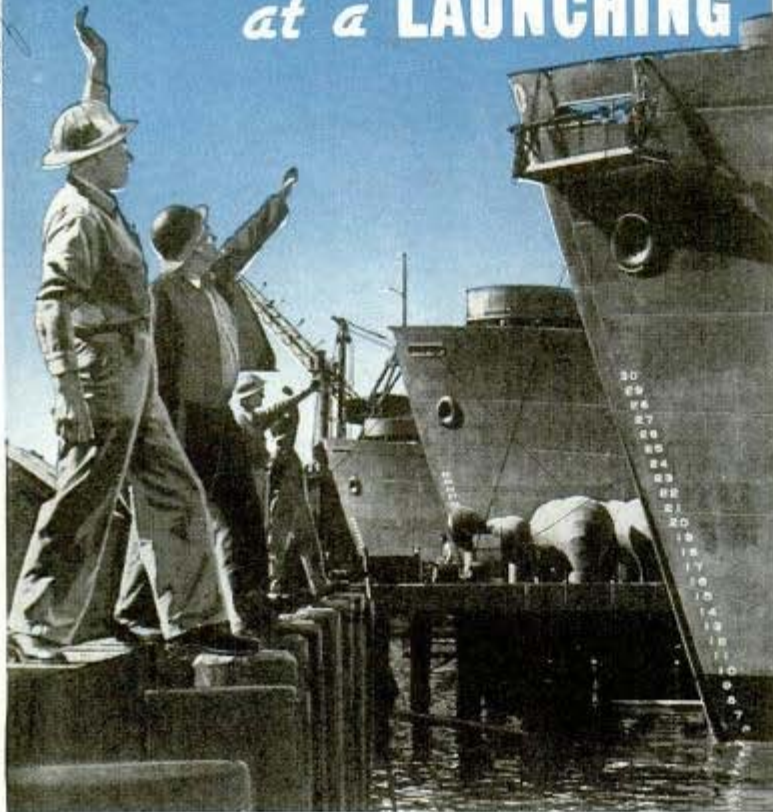
Built of concrete, the world's longest enclosed firing range is 1,800 feet in length. Above, firing ports close automatically when door leading into firing range is opened by maintenance men

Thousands of ball, tracer and armor piercing cartridges are tested daily in an 1,800-foot soundproof firing range constructed by the Remington Arms Company near Bridgeport, Conn. It is believed to be the longest enclosed firing range in the world. An unusual feature of the range, which is built of solid concrete, is its three tracer observation turrets spaced at 125, 250 and 500-yard intervals. Through a bul-

letproof glass floor, observers study the fiery trail of the bullets and make their reports by telephone. The range, designed to meet exacting standards of the armed forces, gauges accuracy and velocity for every caliber of small arms ammunition from the .22 rifle to the .50 caliber machine gun. The .50 caliber bullet strikes the target 1,800 feet away in slightly more than half a second after it leaves the gun.

By: Jack Adams, Public Relations Manager
California Shipbuilding Corp., Terminal Island, Calif.

BEHIND *the* SCENES at a LAUNCHING



Though they're safely in the water now, each of these Liberty ships gave launching master endless headaches before they charged down the ways

IT TAKES 100 tons of dirt, \$14,000 worth of timber, and a deep sea diver, among other items, to launch a big Liberty ship. It takes a whole lot of things that the spectators who witness the launching ceremony at the bow never dream about. Mainly it takes timing and team work on the part of the launching crew.

To the spectators the launching of a ship is a thrilling event. To the launching master it is a time of anxiety. The ship might tear itself loose prematurely or it might refuse to move at all. The greased ways might catch fire from friction. Men might be killed by timbers spewed forth from under the ship. The vessel might turn over when it hits the water. All these things have happened in the past.

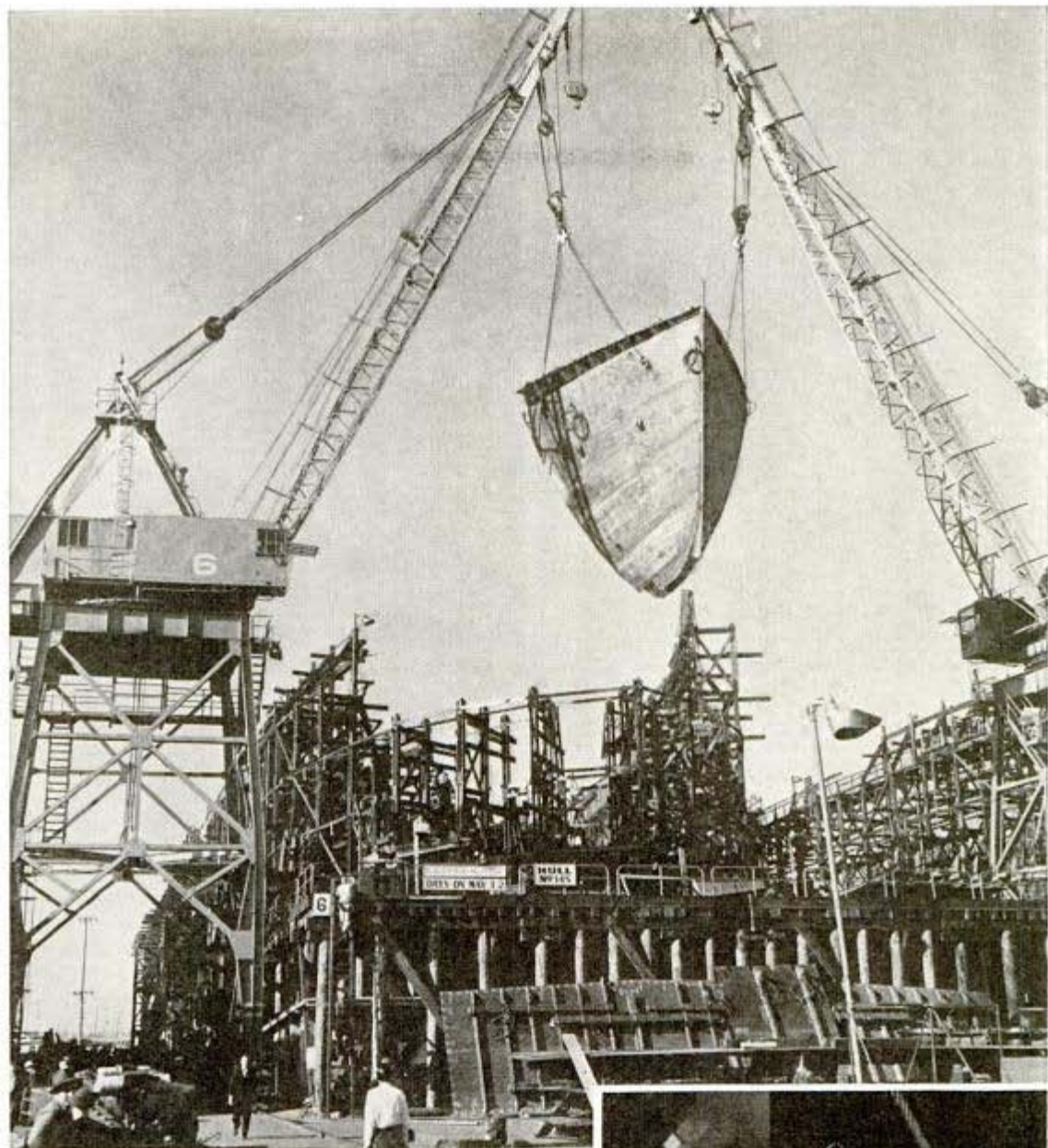
But not one launching accident has marred the record of the California Shipbuilding

are the only things that tie the ship to the shore. Then the plates are cut with torches, releasing the vessel.

In spite of its great bulk and tremendous weight, the imparting of life and movement to a new ship is an extremely delicate



As a variant on launching procedure, a sponsor belts cartooned Fuehrer's nose



Gantry cranes above lift completed ship's bow into place on ways. Right, applying a grease coat to permanent way

procedure. Jim Lewis, CalShip's launching master who has personally supervised the launching of every vessel built at the yards, begins his task a good four days before a new ship is ready to enter the water.

To begin with, the ship was assembled above two permanent ways, or tracks, that have a 15 degree slope toward the water. The whole ship was built at this angle. During the first stages of construction the keel and bottom were supported a number of feet above the permanent ways by frames which were later replaced by shoring as the ship grew. The launching master's job is to place sliding ways under the ship, resting on the greased permanent ways, so that the ship and the sliding ways can slide down to





At time of launching, only two steel plates hold ship to shore. Burned apart, they free ship for its plunge

the water. Likewise, he attaches drags to the ship so that it will come to a stop after it has been launched.

Jim Lewis begins the launching process by installing heavy wooden cribbing under the ship to support its weight, then removes the shoring that had held it up. Next the permanent ways are greased with a coat of thick grease topped off with a slip coat of lighter material. Two tons of grease go into the five-eighths of an inch layer.

Now the flanged sliding ways, that will serve as a sled to hold the ship, are laid on top of the greased permanent ways and are attached to the ship by cables and wooden contour blocks and packing. The shore end

of each sliding way is bolted to its burning plate. A wooden mask is built out from each side of the vessel's stern to act as a drag when it hits the water.

In wide timber troughs along each side of the ship, chunks of chain weighing up to 14 tons each are connected by steel cable, one end of each cable being attached to the ship. These are the drags that will bring the ship to a stop within a few lengths after it enters the water. Tons of dirt are dumped into each trough to increase the drag of the chains.

Possibly 150 men in all take part in the launching procedure. The launching will be half an hour before high tide, no matter

whether this occurs at two in the afternoon, 11 at night, or three in the morning. An after-dark launching is one of the few occasions on which the American flag is flown by a ship after dark.

The launching crew has dozens of tasks to perform during the last few hours, and each job must be done according to a minute-by-minute schedule that is prepared ahead of time. Even one deviation might hold up the launching, forcing postponement



Below hull, launching party rams home wooden wedges that let the ship rest on the sliding ways

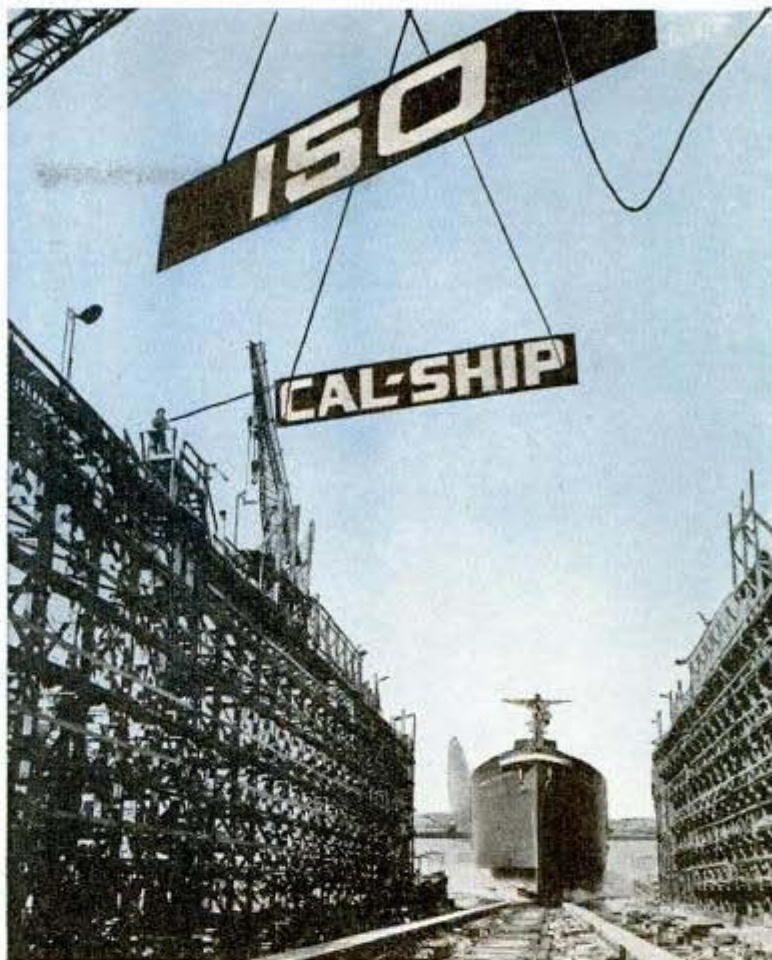
until the next high tide and thus delaying the start of construction of another ship.

While spectators are gathering under the bow to listen to the speeches and to watch the christening ceremony, teams of men are finishing their work. All electric leads and air hoses are disconnected from the ship, gantry cranes remove heavy tools and equipment from it, loose material on deck is lashed down, all hull openings are inspected to make certain that they are closed, and the launching party that will ride the ship, in charge of Leonard Radford, goes on board. Stowaways, if any, are routed out and sent ashore. All ramps and staging leading to the ship are removed.

By now, gangs of men under the ship have teamed up to swing heavy wooden rams that hammer big wedges into spaces above the sliding ways. These wedges do two things. They lift the ship up off the cribbing that supported it, thus placing its weight on the two sliding ways. The cribbing is removed, the two dog shores still attached to the hull are released, and now the ship is held to the land only by the steel plate at the end of each sliding way.

These plates have been partially severed by a line of holes drilled across each. The metal between each two holes is identified by a painted number. Cutting torches have been lit and at the command "Burn One!" the burners cut through the first section of metal. Port and starboard burners work in unison so that each plate is weakened at the same rate.

"Burn Two!" "Burn Three!"



Ships at launchings have been known to tear themselves loose prematurely, or even turn turtle; ways have burned; flying timbers have killed. But a perfect launching looks like that above, the 150th at Cal Ship, which has not had a launching accident. Below, welders at work in yard plate shop





One of the last tasks before a launching is the painting of the bottom of the hull, above. Right, hoisting broom to masthead marks the successful completion of the new vessel's trial run

The remaining metal snaps apart and the ship slowly begins its slide. There's a smell of champagne from the broken christening bottle, swung by the sponsor from a platform above the heads of the launching crew, and every whistle in the yard screams a salute to the new ship.

Out in the channel, the drag chains are bringing the floating hull to a stop and the tugs are nosing in to guide it to the outfitting dock where the work of installing the ship's machinery will be finished.

Sundry blocks and timbers that made up the launching sled are floating in the water around the hull and a debris boat comes out to gather these up. In the old days such timber was appropriated by beach combers but today this lumber costs \$14,000 and will be used again and again to launch other ships. At the outfitting dock, a diver is sent down to release any of the timber that might be caught under the bilge keels of the ship.

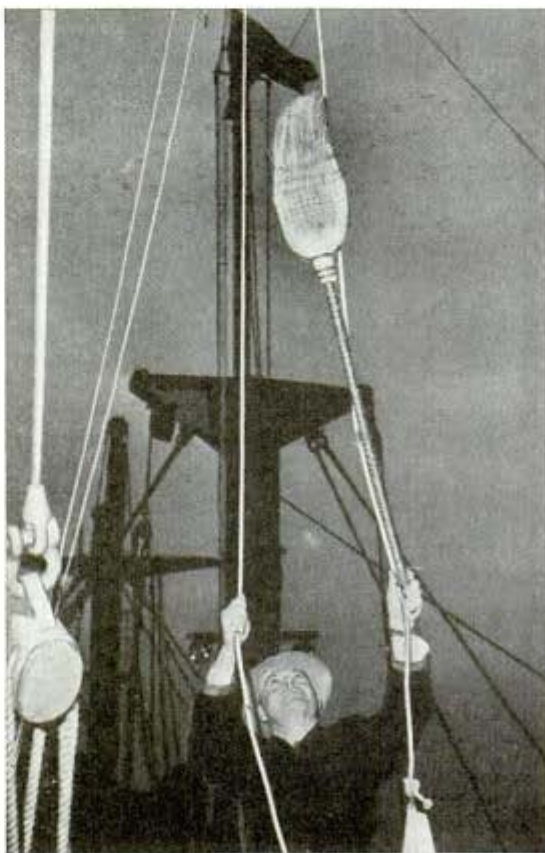
Among the things connected with the launching that had to be calculated and controlled was the top speed that the ship would attain in moving down the ways. A ship that slides into the water too fast may break away from its drag chains and run wild, damaging other vessels as well as itself. A ship that moves too slowly could break her back at the time the stern is sup-

ported by the water and the bow still rests on the ways.

At Cal Ship a launched vessel attains an average high speed of 20 miles per hour on the ways. It moves fastest if the temperature is moderate, slowest if the temperature is unusually hot or unusually cold. This is because a cold day stiffens the launching grease, while a hot day softens the slip coat of grease and allows some of it to squeeze out from the pressure.

Just because our Liberty ships are being mass-produced, don't think for a minute that they aren't staunch, capable vessels. They are big ships of 14,500 tons loaded displacement, able to hold their own in regular round-the-world service. Today they are plowing through every one of the seven seas, from the Arctic to the Antarctic.

By the beginning of 1944 Cal Ship as well as other yards will be in production on two more mass-produced types. One of these will be a tanker of moderate size, and the other will be the new Victory ship class, essentially an enlarged, improved, and faster version of the Liberty ship.



The "FORTY-NINERS" of '43



Dump cars laden with ore emerge from Benbow Mine, first of the chromite mines in the Beartooth range of Montana to begin war production. Ten cars are drawn by battery-driven locomotive

CHRONIUM turns up in the most inconvenient places. Hard rock miners fighting blizzards 8,000 feet up in the Beartooth mountains of Montana say "Any place we get it, chrome's way up in the air. It runs to altitude."

But any place in America would be convenient to find the ore right now, for chromium stands second in the list of strategic minerals essential for war. Once the shining metal of your automobile trim and the alloy that hardened steel for tools, dies, and fatigue-resisting gears and springs, chromium today is the stuff of battleships, cruisers and destroyers, of armor-plated tanks and of armor-piercing shells, of airplane crankshafts, truck axles and big guns.

The outlook until quite recently was not nearly so bright as the metal itself. Our chromium requirements have tripled since 1939. In 1940 we consumed 657,689 tons, but produced only 2,666 tons from domestic ore. Of the 1,000,000 to 1,300,000 tons of world production before the war, Russia produced 20 percent in 1936; Rhodesia led with 275,000 tons in 1937; Turkey was top producer in 1938 with 213,000 tons and in 1939 with 191,000 tons. Philippine production reached 194,000 tons in 1940. Now

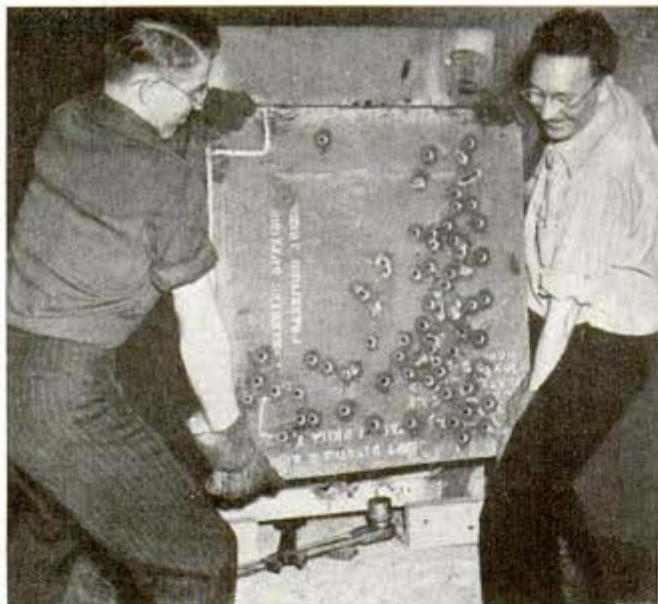
these sources are cut off completely or made dangerously remote by the hazards of war at sea.

Fortunately the miners in the Beartooth range, and others working the low-grade deposits in California and Oregon, are winning America's fight for chromium. Production in 1943 may equal prewar imports.

The fight has not been easy. The miners and mill workers are doing a tough job, in typical pioneer fashion, working and living in high Rocky Mountain country that until now has seen only an occasional prospector or hunter after deer or elk or bighorn sheep. The chromium operations are owned by the United States government and managed at the government's request by the Anaconda Copper Mining Co. The most important mining levels are more than a mile and a half above sea level. The deep snows of winter clog the passes through which miners and engineers must travel, until summer has arrived in the plains below. In August, 1942, there were not four days without snow. In July there was a six-inch fall.

Supplies for the miners, all the materials and heavy machinery for the operations, must be trucked in over steep new roads,

*Sr. R. P. Myers, Director
Bureau of Mines.*



Chrome-steel armor plate nearly an inch thick is pierced by high-velocity .50-caliber chrome-steel bullets at 200 yards

treacherous with ice, snow and rock slides. The men who cleared the way and started camp construction worked sometimes in waist-deep snow at temperatures 30 below zero. America had to have chromium.

The original Beartooth claims were staked out nearly a half century ago by a veteran prospector, Thomas Benbow, but the low-grade chromite ores were not regarded as commercially workable until the war came along and the government assigned to Anaconda mining engineers the job of exploring the deposits, devising fea-

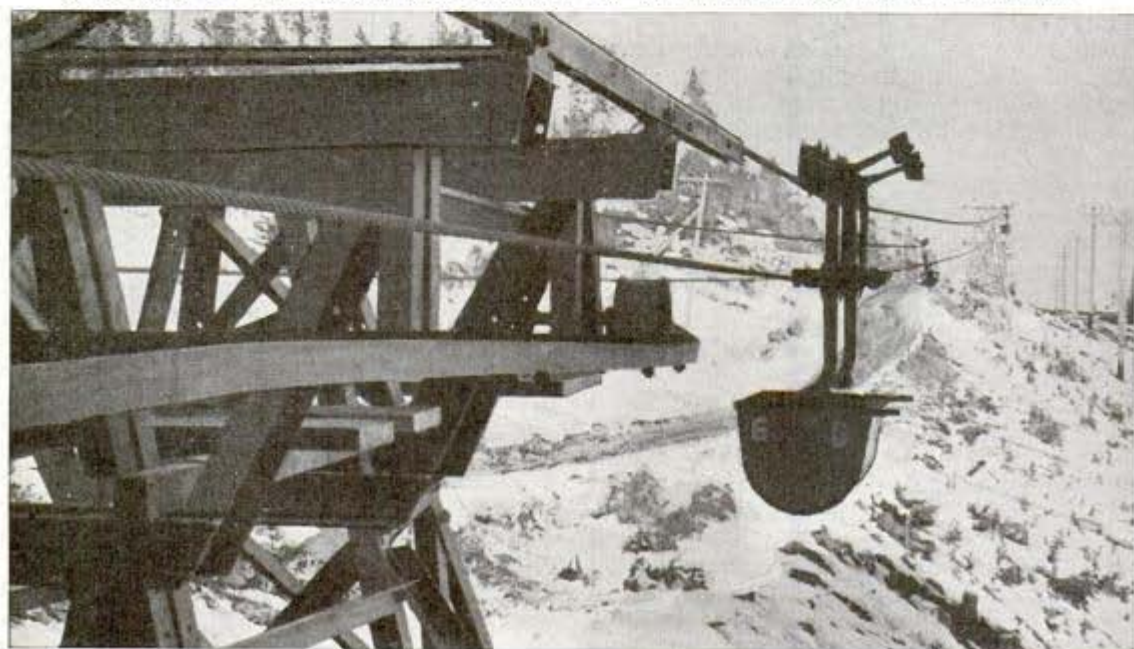
ible methods of mining and concentrating the ore, and then building and operating the plant.

In its crude form, chromite—the ore of chromium—is black, and filled with glittering, light-catching crystals. Crushed and concentrated, the chromite resembles a fine black sand, and contains about 40 percent chromic acid in combination with iron oxide. In producing some steels, this 40 percent chromic oxide concentration can be used as it is. In making ferrochromium for higher grades of tough, shock-resistant steels, the chromium content is further concentrated in relation to the iron content by fusing the ore with lime in electric furnaces, leaching with water and using the product of the leaching to treat other 40 percent chromic oxide concentrates.

Some of the deposits in the Benbow mine lie 8,500 feet above the sea. From the mine and the first crusher, the ore rides an aerial tramway on a dizzy journey over peaks and down valleys to the mill, two and a half miles away and 2,500 feet lower. It travels in buckets carrying 1,200 pounds each, and sometimes a repair man will stow away aboard one of the buckets for a dizzy, swaying ride, part of the time swinging through space a thousand feet above a valley floor.

The miners and engineers may keep their feet on the ground, but their approach to the upper camps is almost as dizzy.

An ore bucket filled with chromite travels by aerial cableway from tram house at Benbow Mine to the mill, two and one-half miles distant by air line and 2,500 feet down the mountain



Ford Motor Co., Dearborn, Mich.



Here chromium plays its essential wartime roles as a toughening alloy of steel. At top, the new amphibian jeep and a 16-inch coast defense gun. Center, an army glider takes off from Ford airport under tow; at right, an M-10 tank destroyer ready to test its chrome-steel hide. Below, the U.S.S. Pennsylvania firing a broadside



Roads just carved from the mountain sides climb grades as high as 25 percent; Caterpillar tractors can make the pull with heavy loads, as can ten-wheel-drive trucks. Passenger cars can make it in good weather, but it snows every month.

Metallic chromium was first produced in 1791, was first alloyed with steel in 1821, but only the metallurgical research and experimentation of the last generation gave

it importance. In the years before the war chromium became a vital hardening agent. Better drills, chisels and files were made of chrome steel than had ever been made before. It became the basis of harder dies, of chrome steel springs and gears that wore longer. Chromium cast iron proved more abrasion-resistant and had more thermal stability than most other ferrous metals. Steels made stainless by the addition of

*Iron
mine*

Dave Ferguson



Raising an 18-inch cap timber in a tunnel of the Mouat mine

chromium were used wherever acid-resistance was a factor, as in food handling and chemical plants. Its brightness as well as its resistance to weathering, and the fact that chromium steels are easily fabricated by welding or spinning, gave the metal its vogue in architectural trim, tableware and automobile brightwork. It was used in surgeons' instruments because of its ability to hold an edge and resist oxidation.

Chromium also serves as a refractory, in electroplating, in chemicals for dyeing, in tanning (chrome leather) and in paints and pigments.

But chromium is in uniform, now. The shafts that drive the tanks, the gears that turn the tracks, the armor that protects the crew are all made of steel hardened and toughened by chromium. The cams that drive the battleship, the heavy walls that shield gun turret and fire control centers are of chromium steel. The castings and

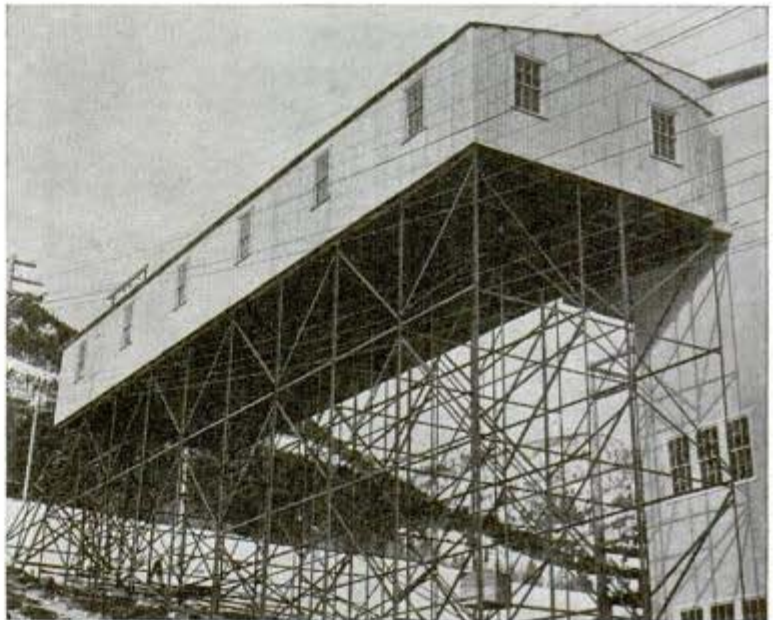
At this tram house at the mill of the Benbow mine the buckets carrying 1,200 pounds of ore end their two and a half mile journey over aerial cableway

pistons and the light armor that saves our fighter plane pilots are all of this tough stuff, and the hardened tools that drill and shape the materiel of war are chromium steel, too. A steel foundry in India has developed a super-hard alloy of iron, chrome and molybdenum, a sheet of which, .39 inch thick, will stop a bullet fired 131 feet away with a velocity of a half mile per second. Of such stuff, shell-resistant tanks could be built lighter, saving material and fuel, and vital changes might be made in the design of planes and ships.

In the past, less than one percent of the chromite used in the United States was produced here. The war has changed that.

Unfortunately Japan now controls the great Philippine mines that once provided one-fourth of our needs. Those mines alone are adequate for Japanese needs. Germany has depended on Turkey and other foreign sources, and now controls low-quality ore in Yugoslavia and Greece.

Some ore may still reach us from Turkey, South Africa, Cuba and New Caledonia, but it is the hard rock miners of our own west who are digging out the bulk of the glittering stuff that toughens the hide of our new battlewagons and stiffens their 16-inch guns. They are tackling and beating as tough a job as was the conquest of the Klondike, and it was the ingenuity of American engineers in finding processes for refining this low-grade ore that made their job worth doing.



*James S. Cobb, Jr.
Delta Air Lines
Atlanta, Ga.*

N 462

"Venetian Blinds" for Cockpit Aid in Training

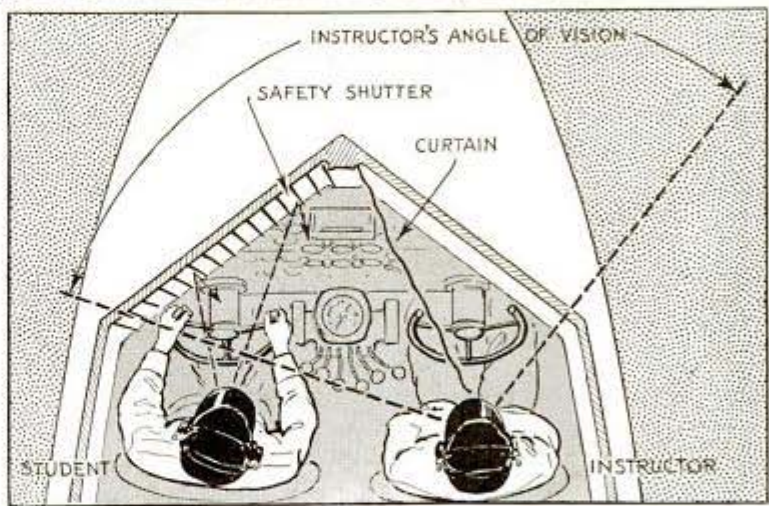
Practice in blind flying has been admittedly hazardous because frequently the device used to cut off the student pilot's vision also blinded the instructor. Thus, the plane flew without any lookout to guard against collisions. Delta Air Lines has offered the armed services a development of a senior pilot, Capt. Edward F. Smith, which eliminates that hazard. It is a series of shutters, installed in the cockpit window on the student pilot's side in such a fashion that he cannot see out, but the instructor, sitting beside him, can. A vertical cloth curtain is hung near the instructor between the two seats, with an opening for his head. This blocks the student's view out of the other window, but not the instructor's. In effect, the pilot is forced to fly "on instruments," while his instructor has virtually unobstructed vision out of both sides of the cockpit.

H. J. B. Furbush

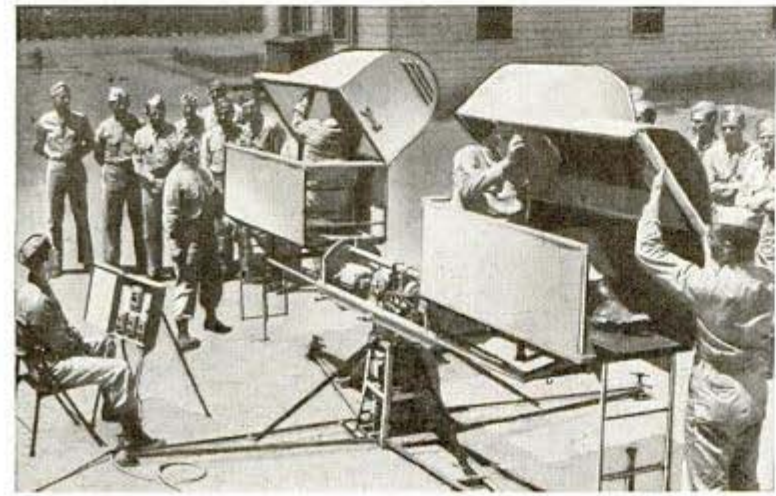


*Captain Edward F. Smith
Atlanta, Ga.*

Safety shutter in window of cockpit shuts off vision of student, but not instructor



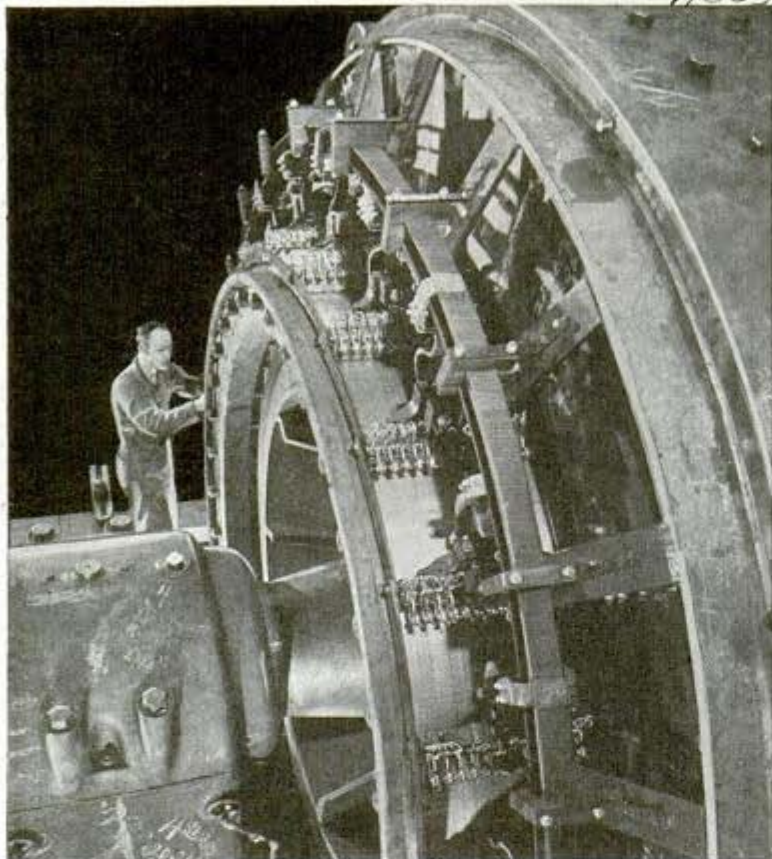
Soldiers Ride Seasick Machine to Help in Search for Cure



"Martyrs" to science are the soldiers at an eastern camp, who volunteered to become seasick (on land) by riding a machine that reproduces the pitch, roll and yaw of a vessel on the ocean. Though many developed all the symptoms of mal-de-mer, they did it in a good cause, for out of the experiments the Army has developed anti-seasickness capsules. These "motion-sickness capsules" are given to amphibious troops an hour and a half before they embark.

At the turn of a switch, these machines pitch and roll like boat at sea

500,000-Pound Motor Reverses Itself In Just a Second and a Half



In reversing giant rotor, nearly 900,000 pounds of energy are released

One of the largest direct current motors ever built, weighing 500,000 pounds, is destined to drive a blooming mill to produce wartime steel. By means of a special control, the motor, product of the Allis-Chalmers Manufacturing Co., is capable of reversing itself in less than a second and a half. In reversing the 190,000-pound rotor, nearly 900,000 foot pounds of energy are released and then reabsorbed from the flywheel on the supporting motor-generator set. At peak, the motor can produce 19,000 horsepower, and in normal operation, 7,000 horsepower.

Resin Impregnates Cement To Halt Winter Scaling

Concrete highways and runways at airports tend to develop surface scale, caused by freezing, thawing, and the application of salt to remove ice. To halt these unfavorable reactions to winter weathering, Hercules Powder Co. has developed a pine wood resin which,

60 Hercules Powder Co.
Wilmington, Del.

when added to sacks of cement, increases resistance to such scaling. Surface scale, affecting the top quarter-inch of a concrete road, has always presented an engineering problem, but this has been magnified in recent years because the use of chemical compounds, usually chlorides, to remove ice has quickened the deterioration of road surfaces.

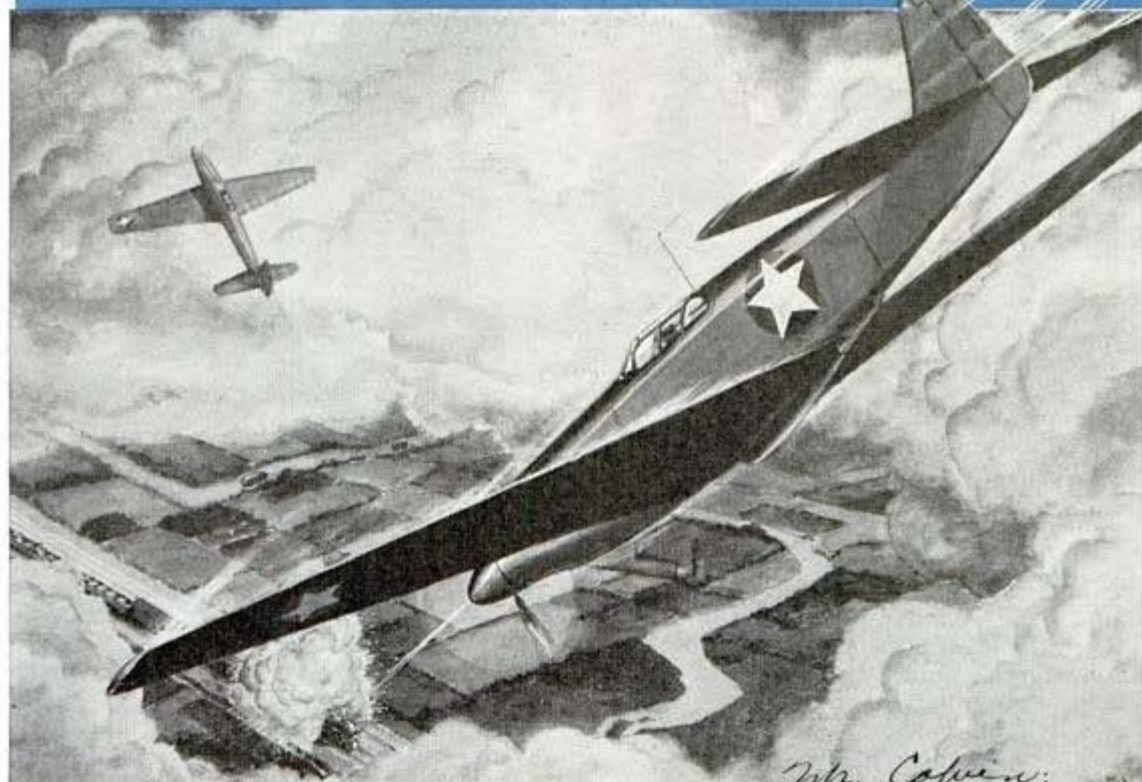
Armored Jackets Protect Fliers From Flak

As in medieval times, when "must" equipment for a warrior included a suit of mail, Uncle Sam's modern warriors of the skies are being equipped with body armor as a protection against bursts from antiaircraft guns. Such missiles cause a majority of wounds. The thin steel plates, which weigh about 20 pounds are slipped into pockets of a new sleeveless jacket that resembles a baseball catcher's chest protector. They protect the crewman front and back from neck to hips.



Gunner's sleeveless jacket is "lined" with thin steel plates

WILD HORSES of the SKY



P-51 Mustang, called the "outstanding fighter of 1943" dives to destroy an enemy locomotive

FOR the debut of a plane that was to win acclaim as the "world's outstanding fighter of 1943," the first appearance of a North American P-51, or "Mustang," over continental Europe was what its R.A.F. pilot might have called a "black," or a "floperoo."

There he was, zooming almost over the heads of the Hun batteries, in one of the hottest planes to come off a Yankee drafting board; wagging insults with his wings above enemy fighter fields—and nothing happened. The Nazis didn't even look twice.

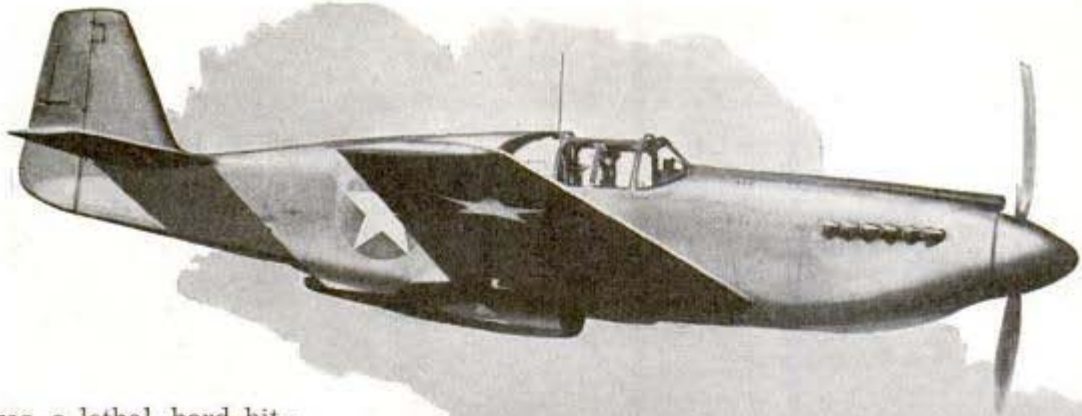
The R.A.F. pilot got mad. He dived and cut loose with his .50-calibers on an exposed German ground position. There was a fateful pause—and the whole area erupted with anti-aircraft fire. The Mustang took its pilot safely back to Britain, but

Fuselage of Mustang lowered into place on its famous laminar flow wing, one secret of speed

the flier was still confused—until British anti-aircraft batteries began firing at Mustangs, too.

Then the puzzle was solved. The Mustang, new to both sides, looked to both like the standard Nazi fighter, the Messerschmitt 109. But it wasn't long until both belligerents recognized it for what it really





was, a lethal, hard-hitting pack of streamlined power.

British and American pilots, quoted by Maj. Thomas Hitchcock, United States Assistant Attache for Air in London, were responsible for the prediction that the Mustang would be the "world's outstanding fighter of 1943." Capt. Eddie Rickenbacker, hero of two wars, added his acclaim of Mustangs in these words:

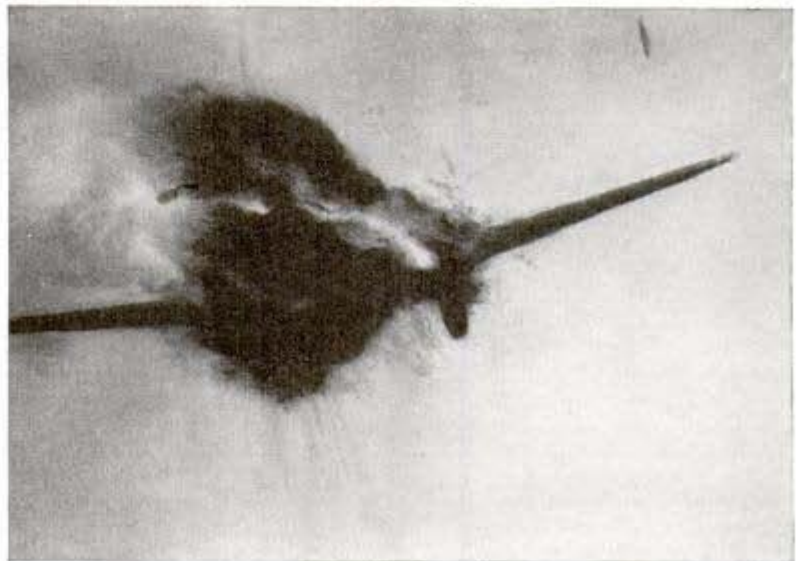
"In my travels throughout the hell holes of the world, and my associations with the boys that are flying and maintaining them, I find that it is the outstanding fighter plane anywhere in the world. I saw comparative tests with the German Focke-Wulf, their latest fighter type, and frankly the Mustang outperformed it."

Such tribute from the men whose lives depend upon a plane's performance is gratifying, but no surprise, to the men of North American Aviation who designed this wild horse with wings.

For even though they built the craft, from design to prototype, in 100 days; even though they were working under the additional pressure of Hitler's advance through the Low Countries and France; even though they pioneered new structural designs



Built, from design to prototype, in just 100 days, the Mustang was meant to incorporate improvements suggested by first months of war. Low-level attack (above) and destruction of enemy planes (below) are its specialties



*Geraldine Mellon
Inglewood, Calif.*

that had never before been tried, and even though they feared at times their brainchild would be a failure, they built quality into every sleek line of this needle-nosed, power-packed speedster.

It was in the spring of 1940, when the Nazis were feinting with whole divisions on the western front, like a boxer drawing his opponent off bal-



Above: Test loading machine gun at North American, which builds Mustang. **Below:** So fleet it is seen almost before it is heard, Mustang can pounce upon enemy installations and be away before ground guns can train on it

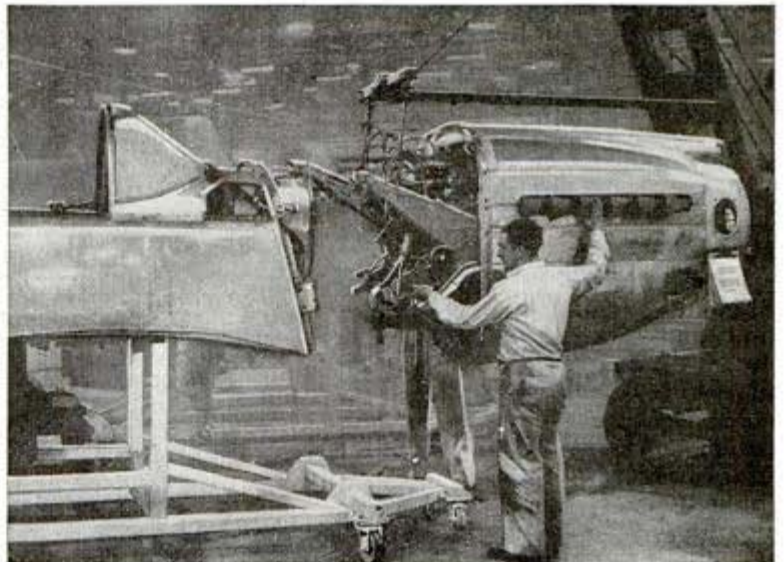


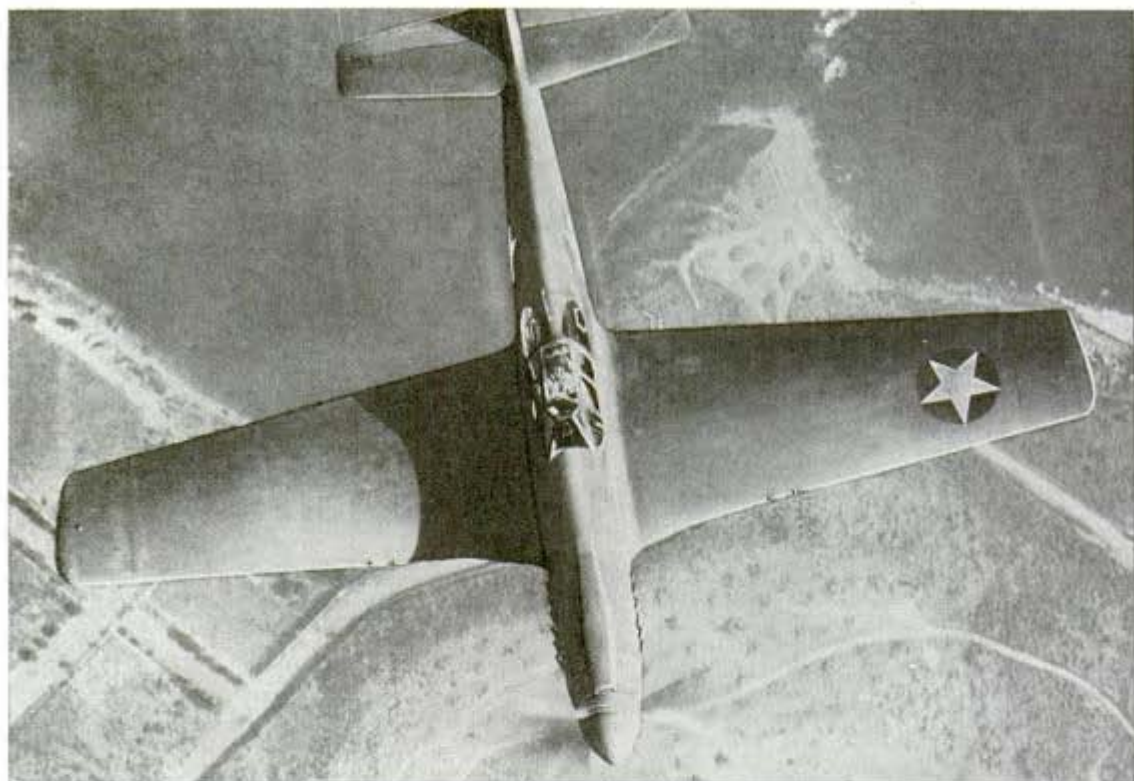
ance, that the British Purchasing Commission asked North American to produce a type of fighter then already in production elsewhere.

That model didn't fit well into the company's methods of simplified quantity production, so J. H. "Dutch" Kindelberger, president of the company, suggested that instead North American design and build a totally new type, incorporating all the lessons learned in the first six months of the war.

The British gave the company a list of requirements that the new fighter must meet, and assigned it just 120 days to

Fuselage of the Mustang is the smallest cross-section area ever placed behind an Allison engine, and so gave many headaches to designers who had to find space for its furnishings. Below, installing Allison motor





Sleek, needle-nosed and deadly, Mustangs have won their spurs as fighters and dive-bombers, designated A-36

complete the design and the prototype airplane. In spite of near-tragic difficulties, that schedule was surpassed; actually, the time was 100 days.

In those 14 weeks, North American's offices must have resembled organized chaos in a madhouse. In all, more than 2,800 original drawings had to be made. These were divided among specialized engineering groups—power plant, electrical, hydraulics, landing gear, armament, aerodynamics, radio and instruments, for example.

The instant any data could be released it was sent to the experimental shop, to be incorporated in the full-sized wooden "mockup" or replica of the ship; to the wind tunnel group that was carving a \$20,000 quarter-size model out of laminated mahogany; to the loftsmen laying out the full-scale drawings from which templates, or patterns, were made, and to the machine shop, sheet metal department and other factory units aiding the experimental shop in building the first Mustang.

Haste, but not waste motion, marked the growing pains of the "NA-73," as it was designated in the factory. A casting that should have taken three weeks was peeled out of the mold in two days. When it was found that a conventional tail shock strut couldn't be delivered in time, North American engineers designed a new and simplified one that has been used ever since. To determine the actual external lines of the

new plane, two engineers devised, in effect, a method of determining by mathematical tables the best possible streamlining between two points.

The Mustang's fuselage, smallest cross-section area ever placed behind an Allison engine, created so many problems in spacing furnishings, controls and instruments that one engineer remarked: "It was like taking the insides out of a bomber and trying to pack them into a fighter."

Even the now famous "laminar flow" wing (laminar flow meaning parallel or undisturbed flow of layers of air) caused its moments of suspense. This type of airfoil had never before been used, though research on it had been performed by the National Advisory Committee for Aeronautics. Their engineers had concluded that it was possible to design a wing that would reduce the drag as much as 50 percent below the drag of a normal, conventional wing.

In spite of the time limit, North American engineers won permission to test the laminar flow theory on the new Mustang, with the stipulation that if they failed a conventional wing would be designed and built within 30 days.

Because the Mustang was being designed for diving velocities approaching the speed of sound, it was imperative that the new wing have high lift and low drag. Engineers knew that shock waves greater than

any theretofore encountered would be built up at such extreme speeds, with destructive results if the wing were imperfect.

First wind-tunnel tests of the new wing indicated failure. The drag was the lowest on record, but silk tufts glued to the wing surfaces fluttered in danger signals—the stalling characteristics were bad. The wing was revised and a new model built in a week. Again, seeming failure.

But now the engineers suspected the model was too large for that tunnel, so they loaded their wing into an airliner and flew it to a larger wind tunnel. There it passed all tests in short order. There were sighs of relief mixed with shouts of jubilation.

Always operating under the pressure of the British deadline—pressure that increased as the Nazis pressed on to the very Channel that was Britain's last bulwark—the North American engineers met and conquered two more problems by "guess and correction."

The carburetor air intake wasn't right; at high speeds the engine simply cut out, and at other speeds there developed a peculiar pulsating effect. Having encountered similar trouble in the radiator scoop the engineers simply lengthened the carburetor air scoop until the intake was just aft the propeller, the longer duct apparently picking up "clean" air before it had set up any pulsations.

The aerial mast had its bugs, too. At high speeds it would simply snap off. It was determined that the mast set up a sidewise lift, almost as though it were a vertical wing. This lift caused the mast to vibrate until it flew away. A flattened steel tube mast worked, and cost the loss of only one-half a mile an hour in speed.

Any resemblance of the Mustang, ready for its motor in just 100 days, to the Messerschmitt 109 was only incidental. With the laminar flow wing, the squared wing tips and tail surfaces that make it resemble the German craft gave the most efficient performance.

That wing is no mere, cloistered darling of the laboratory, either. One R.A.F. pilot officer proved that when, strafing the Nazis in northern France at "zero feet," a favorite stunt with Mustangs, he clipped off half a wing on a cement telegraph pole. Without flaps, he landed without injury, chiefly by skidding in on the plane's nose.

A Canadian pilot, flying low-altitude cover for the Commandos in the Dieppe raid, reported to his base:

"Here I come. Get ready. No landing gear, no flaps, no nothing." He came in with only half his landing gear down, balanced the machine briefly on that wheel until it slowed, then nosed it over. He came out

(Continued to page 154)

NOVEMBER, 1943

Mid-States Equipment Co.
2429 N. Michigan
Chicago, Ill.

Saw Fits on Electric Drill To Cut Metal or Plywood

71535



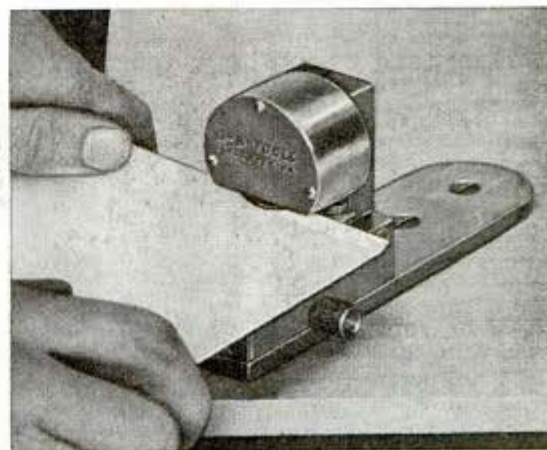
This "drill saw" can be used on either metal or wood

Stainless steel, monel metal, or plywood can be slotted or notched with a new attachment for an electric drill. The unit, which uses broken hack saw blades, serves as either saw or file. It will cut directly into wood without first drilling a hole. Blades from one-fourth to three-fourths of an inch in width can be used with any size teeth, depending on the material to be sawed. For filing, the saw blade holder is removed and a file holder inserted.

Hand-Operated Metal Crimper Mounts on Bench or in Vise

71428

With a compact crimper weighing only four and one-half pounds, metal of varying thickness may be crimped by hand. In addition, the tool is adjustable to the width of the crimp desired. For permanent installation, the crimper may be mounted to a bench. It also may be used in a vise.



Tool is easily adjusted to width of crimp desired

C-B Tools
Laurel, Pa.

65

Материал, защищенный авторскими правами

KID STUFF *for* GROWN-UPS



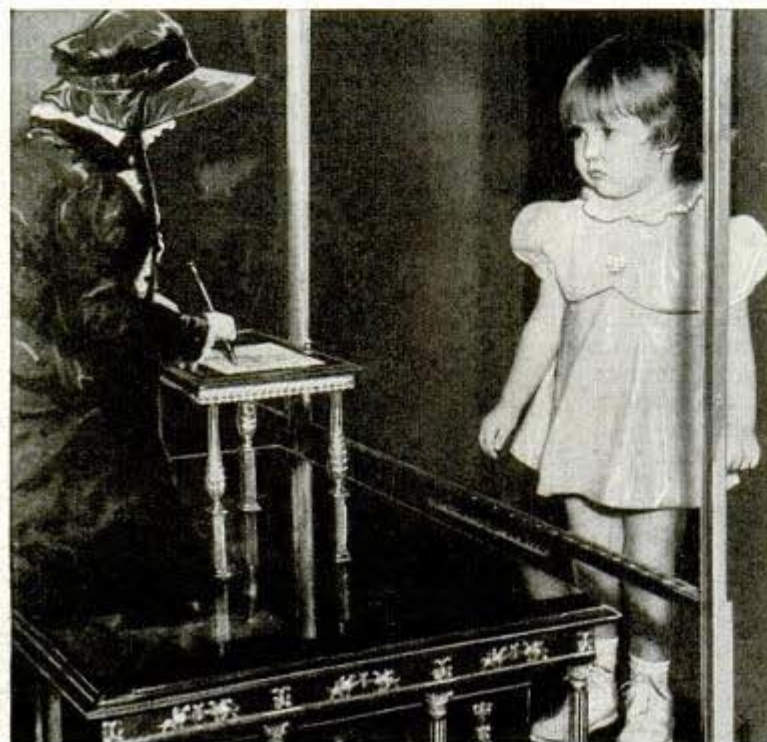
On a model yacht basin at Franklin Institute a radio-controlled ship maneuvers as operator dials transmitter

Mr. Scout
TH**ERE** are no suppressed desires at the Franklin Institute in Philadelphia. Inhibitions are checked at the door. Men who are on their dignity the rest of the week break down into boys again and pump the handles of a railway handcar, play in scientific sand piles and crawl behind the stick of an airplane.

Here in one room is a press from Benjamin Franklin's printing shop, in another the largest technical library in the United

States, and here the beginnings of the steam engine. But this is no museum of dead things. The place is alive.

It is alive with boyhood dreams come true. Small boys and business men clamber over a modern steam locomotive and scramble up the ladder into the cab to grasp the throttle that drives it along a 16-foot section of track, and they discover that the uniformed attendant is getting as big a kick out of it as they are. You become an amateur scientist, yourself, as you go about pushing buttons that start chemicals reacting in test tubes. Everything works; in fact about the only things that are not laid bare to expose their operating parts are the brains of the Institute scientists, many of whom are working behind locked doors just now on war research projects unknown even to their close associates. It is no surprise to find the Franklin Institute performing a service for the government. From its beginnings 119 years ago the Institute has been perpetually "on assignment" for city, state or nation.



The Automaton, which can write three verses and draw four pictures, baffles a young visitor

Before it was a museum or a planetarium or a physical research foundation, the Franklin Institute was a society "for the promotion of the mechanic arts"; in short, a school. Philadelphia in 1824 had no high school, and Samuel Vaughan Merrick, aged 22, had a job and needed mechanical training for it. Seeing the need, he enlisted influential citizens and together they founded the Institute, whose first business was to establish popular lectures, a library and exhibits, and promote inventions. Almost immediately its Journal was founded, one of America's first scientific publications, and when the U. S. Patent Office records were lost by fire the Journal files became the sole source of information on early patents. In 1830 the Institute made a study of steam boiler explosions for the government. Monthly weather reports were begun in 1831, and today the Institute has as complete a weather reporting service as any government bureau—plus a living exhibit of meteorological instruments. You can see the stars by daylight or view the spots on the sun through refracting and reflecting telescopes on the roof. And if an occasional group of visitors is found

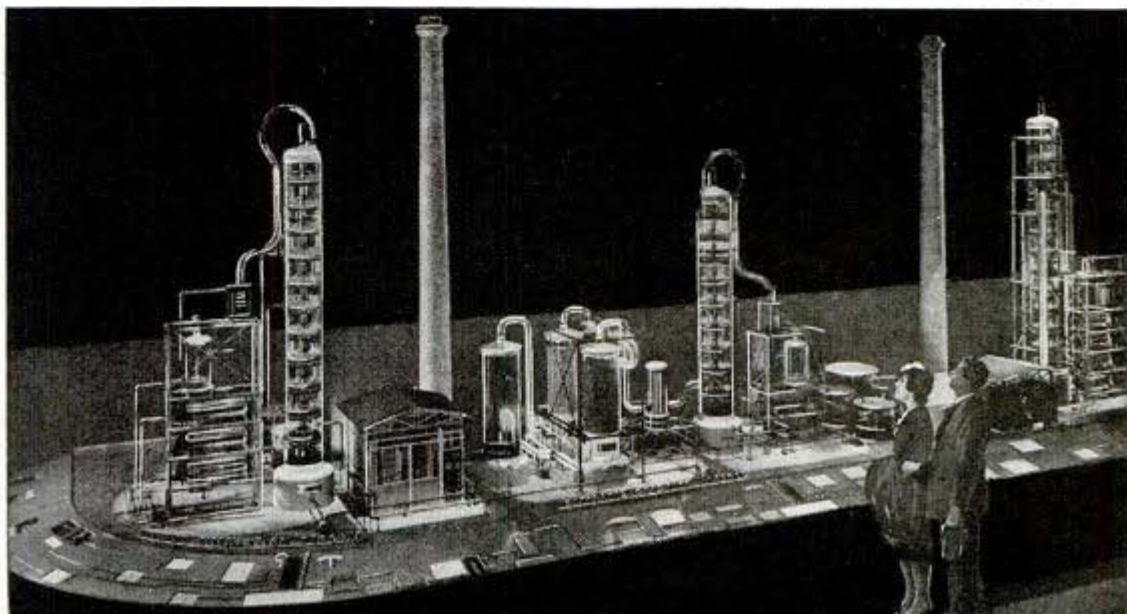


Spinning faster on rotating seat as she pulls weights in with her arms, this girl is demonstrating the law of conservation of angular momentum

spinning the wind vane for a lively game of roulette, it is only a passing annoyance to the scientists.

Standardization of nut and screw threads was first proposed by a president of Franklin Institute in 1864. Its staff introduced the asbestos curtain to prevent theater fires, investigated highway pavements, studied the smoke nuisance as long ago as 1887, examined water pollution, conducted navigation and radio schools for the army

Sun Oil Company's working model shows refining of gasoline, kerosene, naphtha and oils from petroleum





Visitors watch a visitor demonstrate operation of telephone switchboard

in World War I and is currently helping to train Navy navigators and meteorologists, to whom the Planetarium is both school and playground.

Lecturers on the stars love to listen for the gasp of visitors as they throw the glowing image of the cross on the dark horizon of the Fels Planetarium during an Easter lecture, or send the planets swirling backward through time to where they stood over Bethlehem on the first Christmas.

Easily the most popular item on the museum bill of fare is the big Baldwin locomotive which came to rest at the Institute after a 100,000-mile tour of American railroads, and almost didn't get in.

Engineers had carefully gone over the blueprints of the 100-foot iron horse, standard railway bridges were built in the basement to support its weight—350 tons in working order—and a hole was knocked in the wall to admit the giant. By the blueprints, they figured No. 60000 could roll into the room with eight inches of head room. But when she got her nose in the opening the engineers let go a "hold everything!" The stack was all but scraping the ceiling. Where were those eight inches of leeway? It turned out that the blueprint measurements indicated height when loaded.

Without coal and water, the locomotive stood about seven inches taller. No. 60000 got in, but with only an inch to spare.

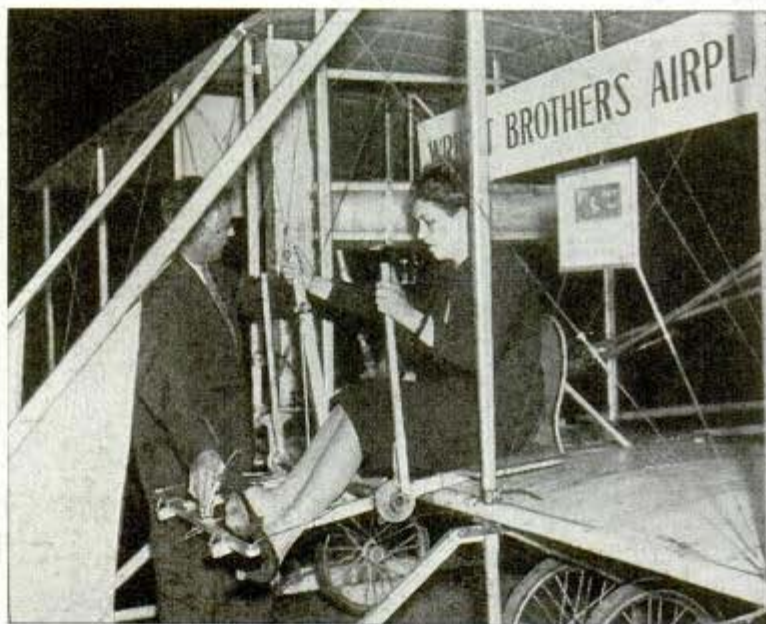
Contrasting with this railway goliath is one of the tiniest engines ever built, a half-ounce steam engine constructed in 1849 by a 16 year old boy from two gold and silver teaspoons. It works, too—its $\frac{1}{16}$ -inch cylinder and $\frac{3}{16}$ -inch stroke capable of delivering 3,000 revolutions per minute.

A solution to your gasoline rationing problems is seen in the "septet"—a bicycle built for seven. This 1896 model is part of a historical exhibit of bicycles, appropriately a door-opener to the aviation section, for most of the pioneer airplane builders grew out of the bicycle trade.

The novice can try his flying ability in a Link trainer, study the effects of streamlining and airfoils in a pushbutton wind tunnel, and inspect such famed relics as Amelia Earhart's transatlantic monoplane, the first American autogiro, and the Wright Brothers' 13th airplane, rebuilt and flown by two boys in 1934 and the only Wright plane capable of flight today.

In the marine hall an attendant will proudly dial a shortwave transmitter controlling a model yacht cruising in its basin,

Wright Brothers' 13th plane, first flown in 1912, is the only Wright plane which is still capable of flight. It was rebuilt and flown again in 1934

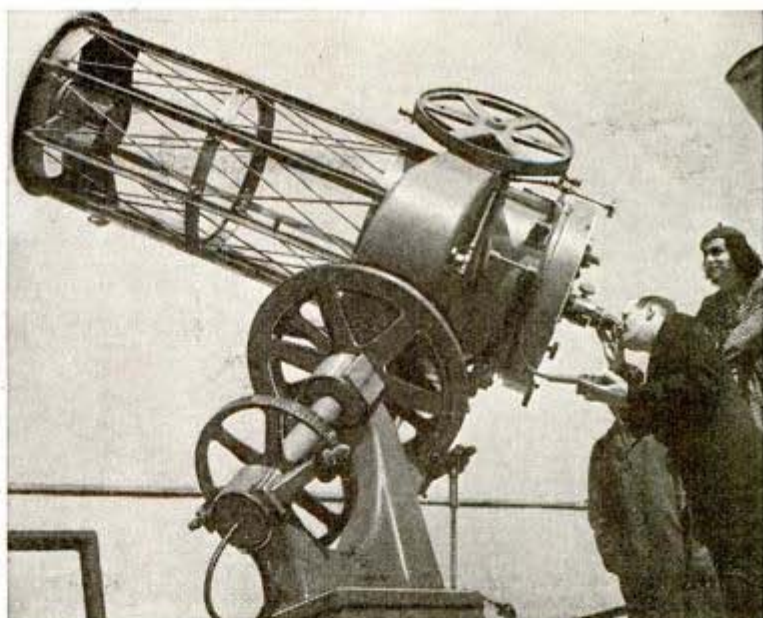


You can take a look at today's sunspots through this telescope on the Franklin Institute roof

and you can get a land-lubber's thrill by turning the wheel and engine-room controls on a fully equipped ship's bridge. Incidentally the Institute is a stickler for accuracy if iconoclastic, and it presents side by side mechanical models of Fulton's "Clermont" of 1806, popularly regarded as the first steamship, and the "John Fitch" of 1786, actually the first steamer in American waters, which plied the Delaware river at Philadelphia at eight miles an hour and logged 1,000 miles.

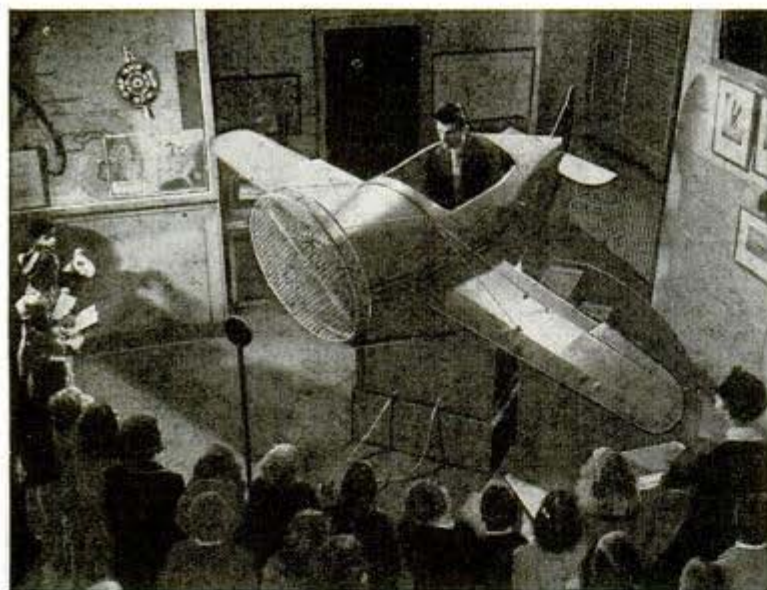
If you are a camera fan you can bring your own little black box and shoot pictures in a studio provided with professional lighting, and there is a display of matching photographs taken by a \$320 camera and a

19-cent camera which indicates that human skill has as much to do with the result as expensive equipment. You can also see the first successful attempt at motion pictures—a revolving sequence of stereoscopic



Men play engineer at the throttle of this 350-ton locomotive, running on a 16-foot track in museum





If you have aerial ambitions, try banking, climbing, turning and diving this captive trainer

it will after you have watched a sand-filled pendulum lay patterns as it swings. A bimetallic thermostat makes sense as you blow in response to the sign: "How hot is your breath?" Physics lessons come easy as you play tunes on glass tubes enclosing gas flames, send music over light beams and spin dizzily in a chair demonstrating the law of conservation of angular momentum.

The Institute likes to be practical. Some time ago the practicality of television

photographs seen through the "kinematoscope" invented in 1861 by Dr. Coleman Sellers, one of the Institute's distinguished presidents.

Typesetting and printing of some of the Institute's publications are performed as a "working" exhibit, and some of the very paper used is manufactured from pulp in a miniature Fourdrinier paper-making machine, rolling five feet of paper per minute.

If the composition of simple periodic motions at right angles means nothing to you,

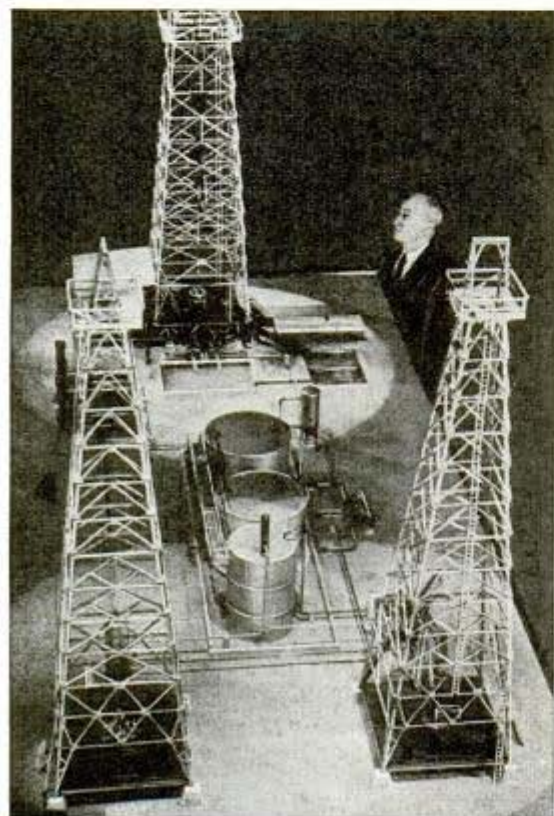
television was given realistic demonstration by putting "on the air" the principals in a kidnapping case then under investigation.

Sometimes the scientists become over-demonstrative in their desire for realism, as in the case of the radio program that backfired. In the chemical room one push-button experiment demonstrates the electrolysis of water. Electric current separates a quantity of H_2O into its hydrogen and oxygen components, and for a startling climax the hydrogen, captured in a small glass cell is exploded by an electric spark with a sharp bang. The effect is not calming to the unsuspecting guest accustomed to mummy museums.

They put the experiment on the air for radio listeners one day. To be sure the hydrogen would be ready for its cue, they started the electrolysis a little early. When the lecturer pushed the button for the spark, there were nine minutes' worth of hydrogen instead of the usual two-minute supply. The resulting blast jolted the studio controls and knocked the program right off the air. They were back in a few seconds, but plenty of anxious inquiries came in on the studio telephone.

The beautiful memorial to Benjamin Franklin may itself be sufficient to hold your interest. You may want only to watch a half-million-volt surge generator split a block of wood, or record your voice on a magnetic steel wire and hear it talk back.

But the chances are fairly certain that sooner or later you will succumb to that alluring sign above the red fire box in the communications hall: "Come and ring a fire alarm." Even great scientists are sometimes small boys.

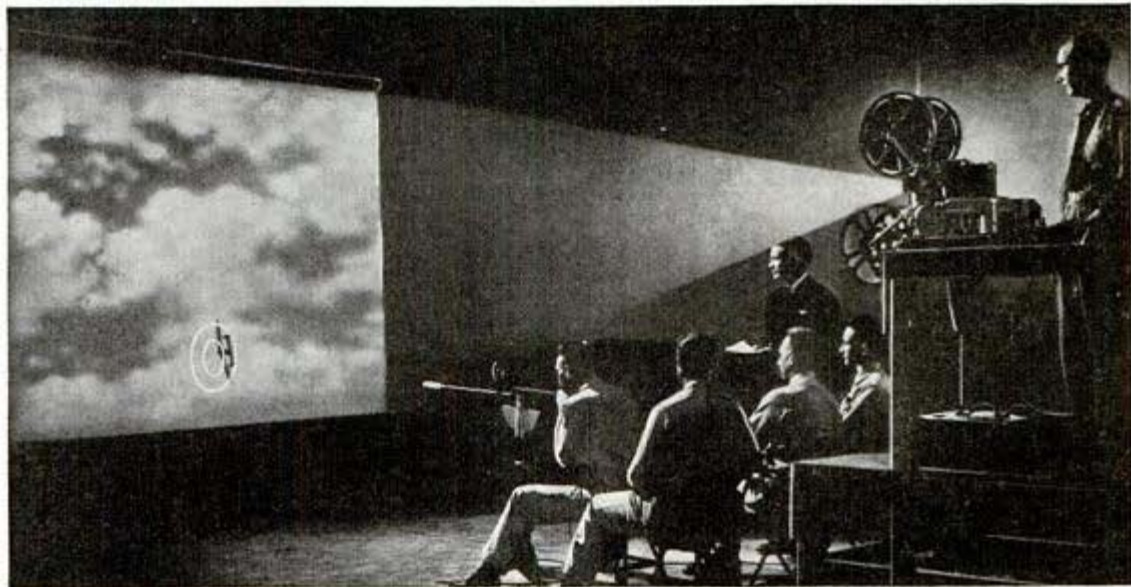


Drills and pumps of a model oil field reach down into a cutaway section of earth

*Ampro Corporation
28 34-51 N. Western Ave.
Chicago, Ill.*

N 512

Shadow Enemy Teaches Gunner Combat Firing



To train airplane gunner in battle realism, pictured "enemy" goes through all the maneuvers of air warfare

Attacking enemy planes don't stand still and give aerial gunners a set-up target like those they are accustomed to riddling in practice. One Navy radioman and gunner realized this, with a sinking feeling in the pit of his stomach, when his plane sustained its first attack. The enemy interceptors were looping, diving, barrel-rolling; they moved in and darted away, and his own plane was maneuvering as violently. There was no time for the leisurely marksmanship of the target range. His own reaction, and that of other gunners, pointed up the need for training in the kind of target-shooting one needs for actual combat—practice in split-second firing at an enemy that in the next second may be out of range. The Navy's response is a

gunnery trainer developed by Lt. Comdr. D. L. Hibbard of the Special Devices Section of the Navy's Bureau of Aeronautics. It provides machine gun practice under conditions closely resembling actual battle. Against a silver screen is projected the moving figure of an enemy plane, that goes through all the contortions of attack and evasion that a gunner may expect when he is in the cockpit over an enemy base. With the moving image is heard realistic sound of airplane motors. The gunner blasts away at the dipping, rising, swerving images on the screen to learn the technique that will make his gun deadly when the chips are down. Ampro projectors are used in the equipment, which is made for the Navy by the Jam Handy Organization.

Flanged Holes Punched With Press and Two-Part Tool

N 427

Flanged holes may be cut in metal, and the edges of the holes straightened to their original plane, by use of a punch that operates in conjunction with an arbor press. A small hole is drilled into the metal to permit insertion of a guide pin. By putting the halves of the punch together and clamping them in the arbor press, a pull of the handle cleanly cuts the hole of the diameter desired. Holes of five sizes from 1 to 3 inches in diameter, may be cut with the device.



Tool cuts flanged holes in metal, straightens edges

Write to the firms listed in the Where-to-Buy-It index, page 4A, to learn more about products described in this magazine. Say You Saw It in Popular Mechanics.

*C-B Tools
Lancaster, Pa.*

Ernst

N 273



**WHITE
MAGIC**

Side-shearing—cutting a vertical slot from top to bottom of a salt vein before blasting with explosive

*J. N. Mathews, Inc.
122 E. 42nd St., N. Y. C.*

MOST people regard salt as a very tasty condiment for touching up the end of a stalk of celery. It is. But that doesn't explain what happens to the 20 billion pounds of salt produced in this country every year.

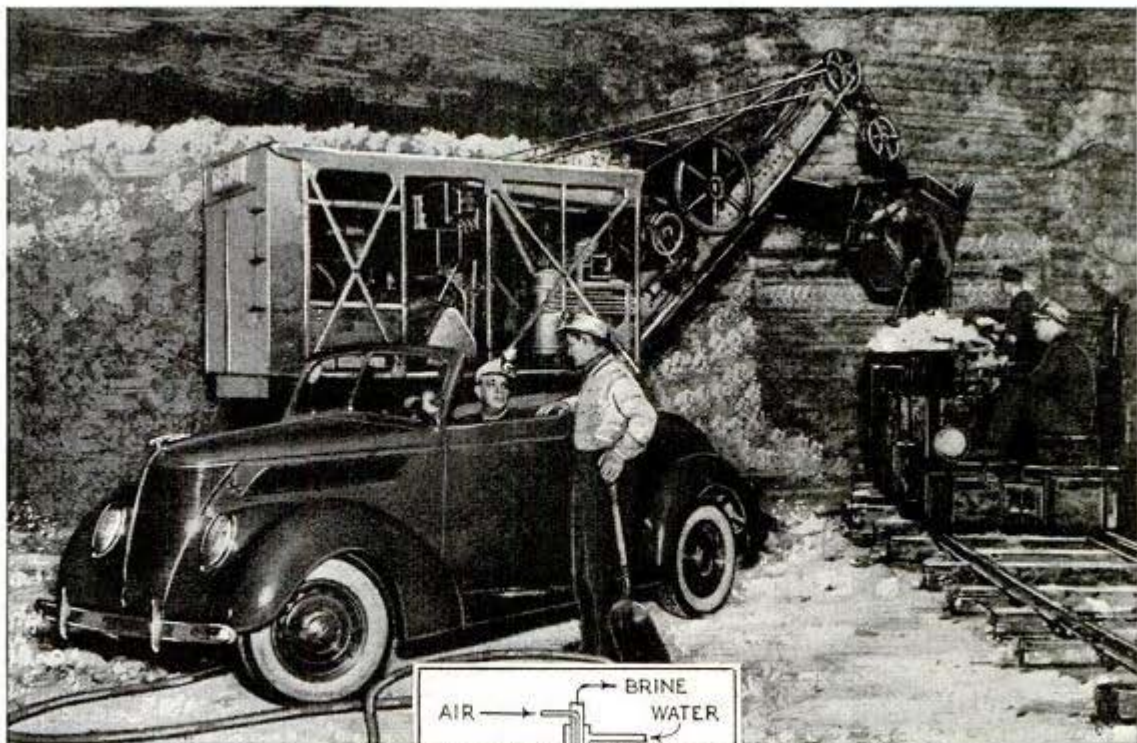
Without salt your body chemistry would cease operations, a fact which probably stems from the time when your remote ancestors wore furs and inhabited the briny deep, and which explains the wars fought around the saline Dead Sea from the dawn of history. Roman soldiers collected part of their pay in salt, whence cometh our word "salary," and Indians who followed animal trails to salt licks termed it "white magic."

If you ate your 150-pounds per capita share of our salt production last year, however, you are undoubtedly pickled and this article is beyond your interest. Assuming you didn't, you are entitled to an explanation of where your pile of salt went.

Some of it whitened the collar of your shirt. Some tanned the leather of your shoes. Some bleached the cotton liners for smokeless powder, and some was the basis of high explosives and of chlorine gas, or of the cyanides used as fumigants and insecticides. You recognized it on pretzels and in salt mackerel and ham, but salt was also present incognito in the fast colors of your sister's print dress, in the white paper of this magazine, in soap and window panes and sodium vapor lamps.

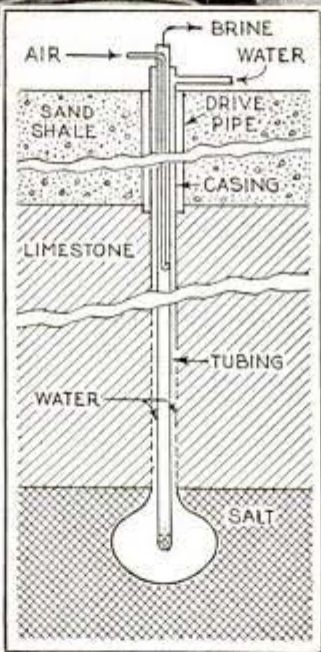
Power shovel loads "ore" cars on underground railway at Retsof Mine of International Salt Company, Inc., at Retsof, N. Y.





Our chemical industries have a far greater appetite for common salt than we, whose lives depend upon it. Mineral salt ranks fifth, brine seventh among the most important chemicals. As the basis for all of the sodium compounds and most of the chlorine compounds, it enters directly or indirectly into the manufacture of a majority of the everyday commodities we use and has earned the designation of a heavy chemical essential to national defense.

If it will relieve you of worry, there is believed to be enough salt in Michigan to supply mankind's needs for 200 million years. Michigan, New York, Ohio and Louisiana are our chief producers. Eleven hundred feet beneath the streets of Detroit is a 200-acre salt mine whose office is built of rock salt. The International Salt Company's mine at Retsof, N. Y., covers 1,000 acres and a dozen electric locomotives haul hundreds of "ore" cars through 120 miles of subterranean passageways. The hemisphere's oldest salt mine at Avery Island, La., developed by the blockaded Confeder-

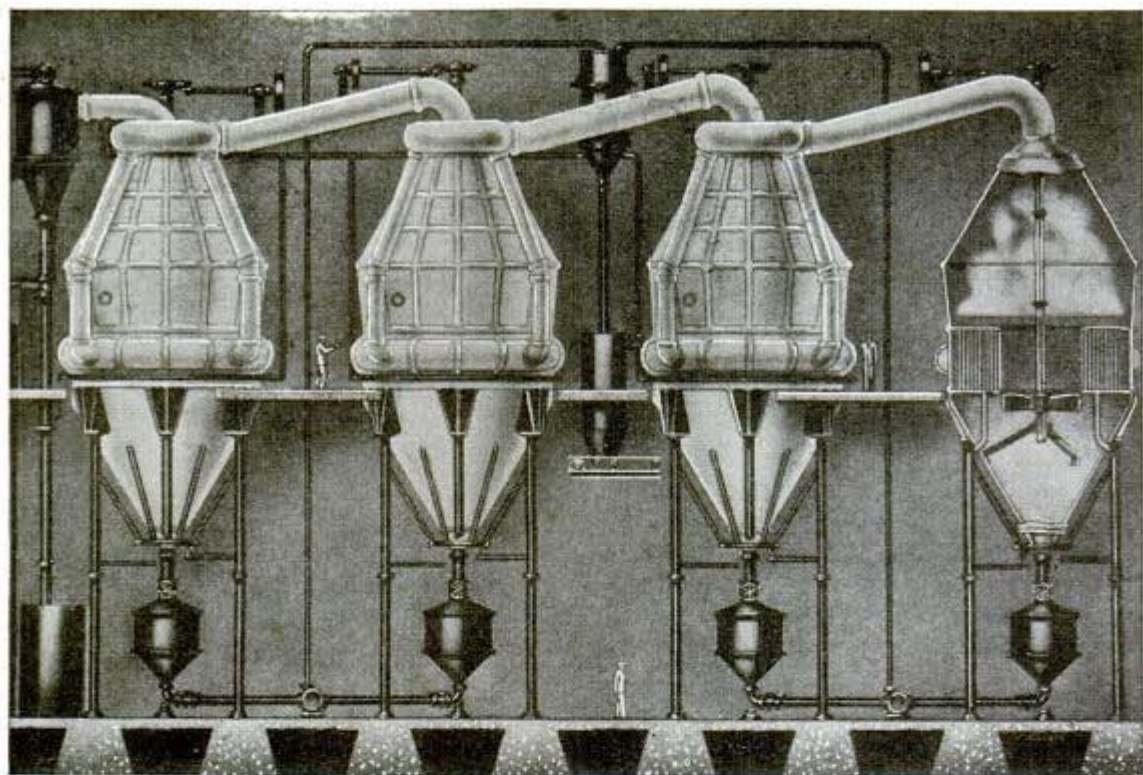


International Salt Co. photo
Thousands of tons of rock salt are produced yearly in this mine under the city of Detroit. The workings are large enough to permit the mine foreman to drive around in his car

Diagram shows how water driven into salt well dissolves rock salt and forces it up central tube as brine

Sodium vapor lamps—the sodium being derived from common salt—are said to consume only half as many watts of power per lumen of light output as incandescent lamps





Vacuum-evaporated salt is produced in these "vacuum pans," from which the salt is periodically removed

acy during the Civil War, is today a vast cavern whose crystalline roof is supported by pillars of salt more than 60 feet high, dwarfing the power shovels that bite into 25,000-ton mountains of rock salt blasted from the walls by powder men. The Avery Island vein is a gigantic dome of salt, mushroom-shaped, formed geological ages ago by pressure that forced a deep well of brine upward to within 12 feet of the earth's surface. Drills have explored the dome beyond the 2,200-foot depth without finding a bottom of the solid salt.

Salt is obtained by mining, by evaporating salt lakes and ocean water and surface beds, and by drilling wells, thrusting double tubes into them and pumping water down the outer tube to dissolve the rock salt and emerge from the inner pipe as brine, which is then evaporated.

The ultra-refined salt for your shaker is evaporated from brine in enormous vacuum pans which are, in effect, double boilers. As the crystals sink to the bottom they are removed periodically, pumped to filters to remove excess moisture, then to rotary driers where 350-degree heat sterilizes and dries the salt ready for packaging.

Eighty percent or more of our salt is needed by industry, and with American industry geared up for war the output of salt was stepped up by a quarter of a million tons last year. It has been estimated that every ton of magnesium produced requires

the use of five tons of salt. We are using a million tons of chlorine per year, and this calls for 1,750,000 tons of salt. The uses of chlorine for bleaching, for water purification, for poison gases are well known. Not so transparent are the facts that chlorine is essential in the making of synthetic rubber, of carbon tetrachloride for cleansing fluids and fire extinguishers, of lubricants, of degreasing solvents. One ton of chlorine is expended in the building of every tank, two tons go into the manufacture of every plane. And consider these paradoxes: salt is elemental in the manufacture of magnesium used in most incendiary bombs, and plain salt is one of the most effective agents for smothering the bomb; chlorine is an ingredient in such deadly war gases as phosgene, mustard and Lewisite and screening smokes, while the principal decontaminating agent used in fighting poison gas is chloride of lime, another derivative of salt.

It is electric power that divorces the partnership of salt (NaCl) into its constituents, sodium and chloride. Positive and negative electrodes are immersed in great tanks of brine, and the sodium ions gather at the negative electrode, the chlorine travels to the positive side and is piped off as gas. In the Castner electrolytic cell employed by the Mathieson Alkali Works, metallic sodium discharges into a pool of mercury which forms the cathode, and as

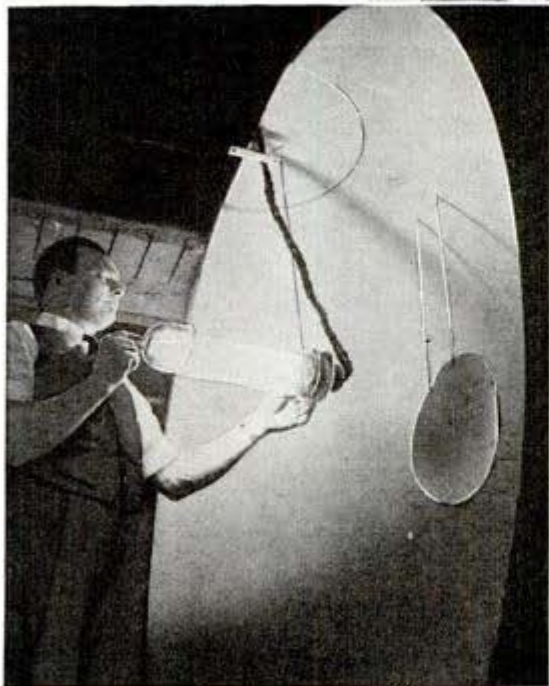
the cell rocks back and forth the silvery-white metal reacts with water to form caustic soda solution and hydrogen gas, which are continually withdrawn. It was only in 1909 that Mathieson began commercial production of liquid chlorine. Synthetic ammonia, too, is an outgrowth of the electrolysis of salt. Nitrogen separated from the air by compression and cooling is combined under pressure and with the aid of a catalyst with the pure hydrogen obtained from the electrolytic cell, and the result is pure ammonia gas. Dry Ice (frozen carbon dioxide), bicarbonate of soda, baking powder, soda ash used in glass manufacture, synthetic salt cake used in paper mills, and caustic soda (NaOH) are some of the major products of the breakdown of salt. Caustic soda finds its way into more industries than any other derivative—among them, foods, drugs, rayon manufacture, cleansers and disinfectants, aluminum, gasoline, explosives, soap and paints and machine tools.

Sodium is a capricious silvery metal that burns under water, weighs one-eighth as much as iron, is a good conductor of electricity and a versatile

Right, drilling holes for dynamite in a Louisiana salt cave. Below, a General Electric engineer tests a sodium vapor lamp



Firing a mortar shell filled with gas made from salt



servant of man. Easily alloyed, essential in making bronze and brass, it is used—like its partner, chlorine—in tetraethyl lead for antiknock gasoline; as sodium peroxide it is a bleaching agent, as sodium perborate a tooth powder, as sodium cyanide a fumigant and insecticide and the means of case-hardening automobile gears.

Salt and its byproducts have invaded many new fields in recent years. Caustic soda is highly important at the moment for recovering tin from used cans; it dissolves tin from the sheet steel, and the tin oxide precipitated can then be reduced and cast into pigs. Sodium vapor lamps, first applied to traffic lighting, now are used in examining metals for flaws. A pinch of sodium— $\frac{1}{80}$ ounce—is sealed in a tiny "bomb," placed in the vacuum bulb, and vaporizes when exploded by heat. The vapor, when activated by the electric arc,

(Continued to page 148)

Bicycle "Path" Inside Dam Serves for Maintenance

77453



Inspector pauses on tunnel tour in Grand Coulee dam

Within the great masonry structure of Grand Coulee dam are miles of tunnels that lead to intricate machinery and thermostats. These tunnels are used by inspectors and maintenance men, many of whom travel by bicycle. They average about 12 miles a day. Because of the war, the tunnels are closed to the public, but postwar visitors will be allowed to tour the depths of "the biggest thing on earth."

Stop Nut for Plywood Airplanes Leaves Outer Surface Smooth

77526



Approved by the Army Air Corps for use in the manufacture of plywood airplanes, a self-locking fastener anchors nuts securely and leaves the outside surface smooth. It is similar to the elastic stop nuts used on metal planes, but has a special basket that locks into the plywood and holds the nut securely. Four prongs at the

corner of the basket sink into the surface of the wood, and spring fingers at the top clasp the nut after it is seated. It can be used on plywood ranging in thickness from one-eighth inch up. The nut, which was developed by the Elastic Stop Nut Corporation of America, requires no special tools. Installed from one side of the work, it can be driven in with a hammer, forced in with a press, or drawn in with a bolt.

76 Elastic Stop Nut Corp. of America, Yonkers, N.Y., Levitt, N.Y.

corner of the basket sink into the surface of the wood, and spring fingers at the top clasp the nut after it is seated. It can be used on plywood ranging in thickness from one-eighth inch up. The nut, which was developed by the Elastic Stop Nut Corporation of America, requires no special tools. Installed from one side of the work, it can be driven in with a hammer, forced in with a press, or drawn in with a bolt.

"Electric Eye" for Blind Worker Is Attached to Sewing Machine

77485

Blind workers can safely operate a sewing machine with an electric eye attachment that stops the machine if their fingers approach dangerously near the needle. When the beam in front of the needle is broken, the photoelectric cell operates an amplifier which controls a relay disconnecting the driving motor. At the same time an electromagnetic brake is applied to the fly wheel. Buzzers also warn the blind worker when the thread runs out or breaks. It was developed by the American Foundation for the Blind.

Hot Metal Is Sprayed Like Paint To Patch Galvanized Unit

77420

Galvanized metals that are burned by welding or otherwise marred can be patched by spraying with a molten alloy consisting mostly of lead. The special sprayer melts the alloy at 500 degrees Fahrenheit and sprays it on welds or worn parts like paint. The new coating saves regalvanizing an entire unit, adheres evenly despite the smoothness of the surface and forms a good paint base.

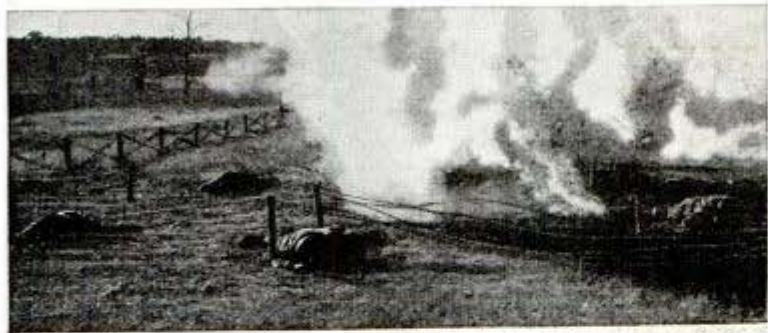


Spraying marred galvanized metal with molten alloy

POPULAR MECHANICS
Alloy Sprayer Co.
2040 Park Center Bldg.
Detroit, Mich.

Live Ammunition Gives Yanks Preview of Battle

71 460



Real death-dealing bombs, high explosive shells, grenades and mines are exploding on the soil of the United States—not invasion of our country, but rehearsal for invasion of enemy shores. Use of live ammunition has become an integral part of the training of men who are going into battle. It gives them a foretaste of war before they actually have to face it. How a man will behave in battle is often unpredictable; by simulating conditions beforehand, instructors can correct errors in behavior that might later be fatal. Men of a tank destroyer battalion above are crawling through wire toward their objective, as land mines explode around them. Timing of the explosions is, of course, carefully controlled, so as to avert injury to the men. Upper right, men in landing rehearsal dash ahead, while mammoth explosion showers dirt and stones down around their route



Under conditions such as are shown above, men rapidly learn to keep their heads down and to hug the earth. They are members of a tank destroyer unit, and are negotiating a barbed-wire course while real tracer bullets whistle over their heads. Left, successful landing is made by men in training despite the eruption of mud and water from explosions on the beach. Accident and injury in this type of training are rare, and men who have seen battle say training with live ammunition will undoubtedly save many lives at the front, for it teaches soldier in advance the tricks of self-protection

*members in rehearsal x
Camp Archer, Ala. by S. Div.*

Mr. Allen Warren Elliott
7 Sunn Park Ave
N. Y. N. Y.

71306

MINE KILLERS at WORK



Two members of a mine disposal squad of the Royal Canadian Navy tow a big one filled with nitroglycerin toward shore. Its "horns," or exterior detonators, have been removed, but it is still dangerous to handle. Crews are composed of volunteers who risk their lives daily and get no extra pay. The photographs on these pages are the first to be made of this hazardous operation along American shores.

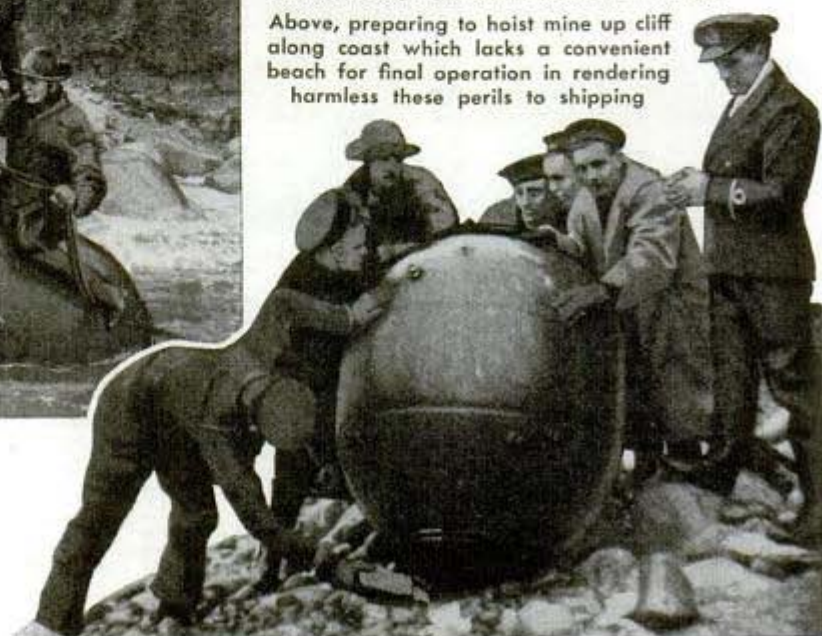


Photos courtesy of Canadian National Film Board

Above, preparing to hoist mine up cliff along coast which lacks a convenient beach for final operation in rendering harmless these perils to shipping



It takes nerves of steel to ride this lethal monster of the sea ashore. Pulleys are attached to lift it to rocky beach. Right, rolling mine gingerly into position for next operation. No onlookers are allowed in the vicinity



After the detonators are removed, the mine can be tapped with a hammer but the lieutenant in charge makes sure his men take no unnecessary risks in handling load of nitroglycerin powerful enough to blow a warship out of the water. Every man is alert, and sometimes the crews go 24 hours without sleep on assignments that are tough. One slip in handling the spheres of steel may mean death



Left, removing internal detonators and caps of TNT container. Then the surface of the explosive is roughed up before setting fire to it. The crew calls this operation "teasing" a mine



With a sharp instrument, lieutenant in charge (above) scratches surface of the explosive. It is set on fire from a safe distance and burns (left) furiously. Only when the last spark is out is the mine harmless. Sometimes mines are exploded instead of burned, depending on locale

Witchamaker Optical Co.
Providence, R.I.

N 482

Goggles Fit Over Glasses Giving Full Protection

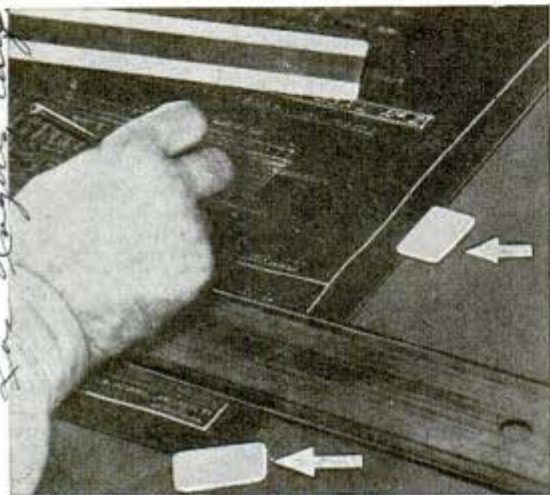


Plastic goggles have shatterproof Plexiglas lenses

With lenses made of the non-distorting and shatterproof Plexiglas used in the "greenhouses" of big bombers, an all-plastic goggle fits snugly over a worker's spectacles. The full frame which weighs only one and three-fourths ounces gives protection from sides, top and bottom. Snap-in filters are available to reduce glare in torch-welding or cutting.

"Dry" Stickers Hold Blueprints To Eliminate Thumb Tacks

Paper thin stickers that require no moistening are used to hold drawings and blueprints to drawing boards, thus eliminating



Stickers hold blueprint without leaving gummy mark

Arvey Adhesive
487
Los Angeles, Calif.

*G. W. Sherin, Director
Chemical Specialties Div.
C. I. du Pont, Inc.
Wilmington, Del.*
bothersome thumb tacks that sometimes interfere with a draftsman's free movement of T-squares. The stickers are easily peeled off without tearing the drawings or leaving gummy marks. Because the adhesive does not come off, the stickers can be used many times.

Chemical Reactivates Antifreeze To Prevent Motor Corrosion

Last winter's antifreeze solution, saved over for this year's use, may be reconditioned by the addition of a chemical inhibitor. Saved-over antifreeze solutions in some instances lose their rust-inhibiting properties, and become acid after extended use. If they are replaced in an automobile cooling system without being treated again with an inhibitor, they may cause corrosion. A chemical inhibitor manufactured by the Du Pont Company may be added to any standard antifreeze solution, the makers say. It does not contribute to antifreeze properties, but merely neutralizes any acid formation and restores the lost rust inhibitor.

Iron Box Keeps Matches Safe In War Powder Plant



Box is opened by lifting the spring lid with finger

Safety matches are carried in a special cast iron box at the Hercules Powder Company's Badger Ordnance Works at Baraboo, Wis. The box has a spring lid attached to the handle. The matches are used in the powder plant by welders who light their torches under the watchful eyes of safety engineers.

To learn where to buy commercial products described in these pages, see the index.

Shrubs POPULAR MECHANICS
Wilmington, Del.

Jeeps and Pick-a-Back Seats Carry Wounded



Jeep-ambulances above carry four stretchers. Right, seat for wounded man leaves carrier's hands free

By use of highly mobile equipment, members of a motorized medical battalion are able to erect, equip, and put their various stations into action within an hour of arrival at an appointed sector of a battle line. When casualties are located, they are transported to medical clearing stations with the greatest dispatch, since speed in treatment saves lives. Of especial value is the famed jeep, which is fitted with well-sprung racks holding stretchers in position. These midget ambulances essay any terrain, and can transport four or more wounded men. Another method of transporting a casualty is the "Green carrier," or "pick-a-back seat." It is a framework slung from a bearer onto which the wounded man is strapped so he cannot slip to the ground, while the bearer's hands are free. Such motorized medical battalions can dismantle their equipment and be off to another battle sector in half an hour.

Cory A. Wilcox, Sumberville, Md.



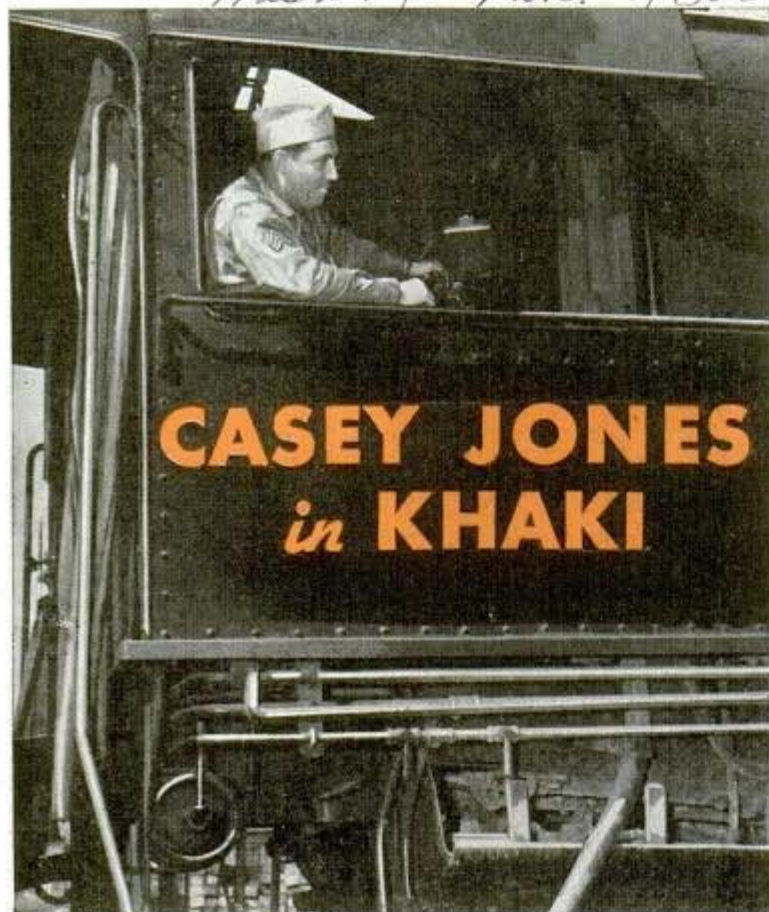
*A. Beevin
North Bergen, N.J.*

Limiting the Length of Hairpins Saves 5,000 Tons of Steel

71542

By limiting the length of women's hairpins and bobby pins to two inches, the United States was able to conserve 5,000 tons of steel in one year. This is one example of how curtailment of size and standardization of type saved raw materials and diverted them to war uses. The length of household matches was reduced $\frac{1}{16}$ and $\frac{1}{4}$ inch, and as a result 7,000,000 board feet of lumber were conserved. Re-

ducing the number of sizes of automobile batteries from 100 to 17 saved 16 million pounds of secondary lead, over 17 million pounds of primary lead, and over 1,250,000 pounds of secondary antimony. By reducing types and sizes of auto chains, 21,000 tons of carbon steel and smaller quantities of other metals were conserved. Making one cookstove model and curtailing use of metal saved 350,000 tons of iron and steel.



Sergeant-engineer (above) one day may be at the throttle of the first train into Berlin. He wears insignia of Transportation Corps of Army Service Forces, trained for railroading in war zones. Below, a uniformed welder



By James Colvin

EXCEPT for the background, it might have happened anywhere in the American Midwest—just another freight double-heading in on time.

The engineer was from Breckenridge, Minnesota. The fireman was from Muscatine, Iowa. The locomotives were Baldwins. Stamped on the steel of the freight cars might be seen the name of another familiar American manufacturer. But the incident marked far more than just a routine freight haul.

The place was Teheran, Iran—ancient Persia. The train crew all wore American Army uniforms, and the insignia of the Transportation Corps of the Army Service Forces. The freight had just steamed 650 miles from a port on the Persian Gulf, with supplies for Russia—made in America by Americans, landed at American-built docks from American-built ships. It marked the first delivery of a complete United States war train to bolster the fighting forces of the Soviet. From Teheran north, an all-Russian crew took over.

Soldiers don't just happen to learn to run railroads. Behind that incident were months of training, and often back-breaking work.

The engine crew and train crew, the signalmen, dispatchers, section hands—all the hierarchy of railroading necessary to take that all-American freight train from the Persian Gulf to the junction with the Russians—had a background of military railroading similar to the one the Southern Railway has helped to give to two whole railway operating battalions.

The American Civil

Soldiers learn every job in railroading, from dispatching to switching. A yard crew, riding engine



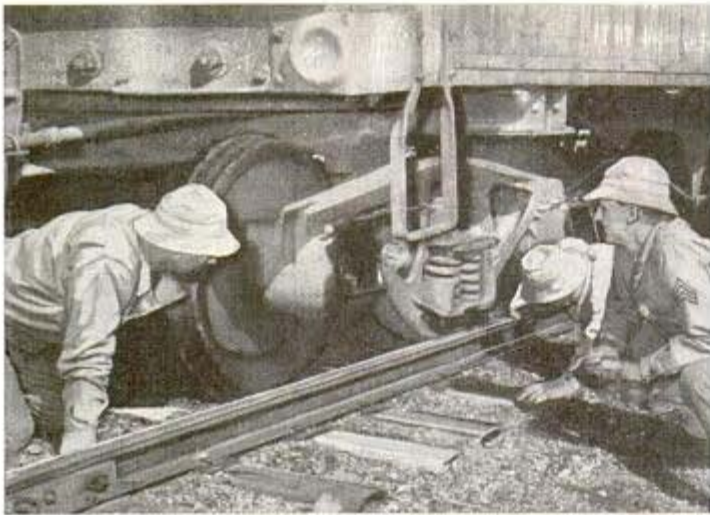
War established for all time that control over railroads and their running stock is essential to continued operations in a battle zone. Control of a rail line was a central point in one of the first big campaigns of that war, the one in 1861 that resulted in the adherence of West Virginia to the Union. And Lee abandoned Richmond after Grant cut his rail lines.

In this war, British-flown Mustangs and Mosquito bombers make almost daily sorties against trains carrying men and materials for Germany—and fliers say a blown-up locomotive makes a most satisfactory explosion, when the locomotive is the enemy's. American Flying Fortresses have given persistent attention to great railway centers of Western Europe.

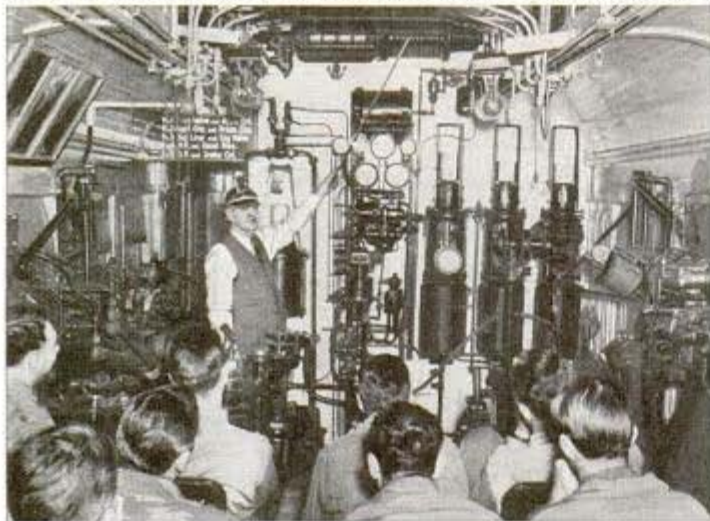
There are stories that Hitler never properly

Back on the caboose, conductor and switchman are learning to combine arts of railroading and of war





Sergeant at right (above) supervises two soldiers rerailing a box car—vital knowledge to men who will handle rail lines under fire



Above, a group of uniformed engineers receive instructions in the operation of air brakes. Below, a soldier section gang in training. Note uniform puttees, slouch hats, canteen on man at left
Photos courtesy Southern Railway



evaluated railroads; that he allowed Germany's to fall into disrepair while he was using his steel to forge a mailed fist threatening the civilized world. We think better of our rail lines; and now we have to think of the ones Hitler has, too—we may have to operate them one day.

Down on the New Orleans and Northeastern, part of the Southern Railway System, railroaders in khaki are an old story. It's there, on the route from Meridian, Miss., to New Orleans, that two battalions have learned what they will need to know to take over and operate entire divisions in some theater of operations.

Under the tutelage of men who have made railroading a career, these khaki-clad minions of the Iron Horse have studied everything from how to get whiskers (frost) off the rails and pick up orders on the fly to the proper way to lay track and dispatch trains. The goal was the training of self-contained units that could take over friendly or captured railway lines and keep the men and materiel moving to the front, the American way.

When the War Department asked the Southern to train the first of these battalions—the Transportation Corps' 727th Railway Operating Battalion—there was little past experience upon which the

Southern could draw, for no such unit had ever before been trained by a common carrier. But the Southern executives and workmen were as willing to teach as the soldiers were willing to learn.

Harry A. DeButts, vice-president of the Southern, wrote the men of the New Orleans and Northeastern:

"We have every reason to be proud that we are to have the privilege of helping our boys in uniform prepare for the vital task of operating some military railroad on which our fighting forces will be depending for ammunition, materials and supplies.

"We will make available our 'trained and experienced personnel' (this means you) to teach and demonstrate to these soldier railroaders the duties they will be called upon to perform when they operate a military railroad. This training will neither displace nor reduce your duties and responsibilities, nor affect your compensation."

Executives and men alike on the N.O.&N.E.said, in effect, "Okay!" Workers held a meeting and suspended certain union rules in order to help out. Beginning from scratch, executives proceeded on the assumption that a battalion operating a railroad in a war zone might have to use every sort of makeshift to keep 'em rolling, and, largely even without a suggestion from the army, set up equipment for the soldiers, side by side with the road's regular equipment.

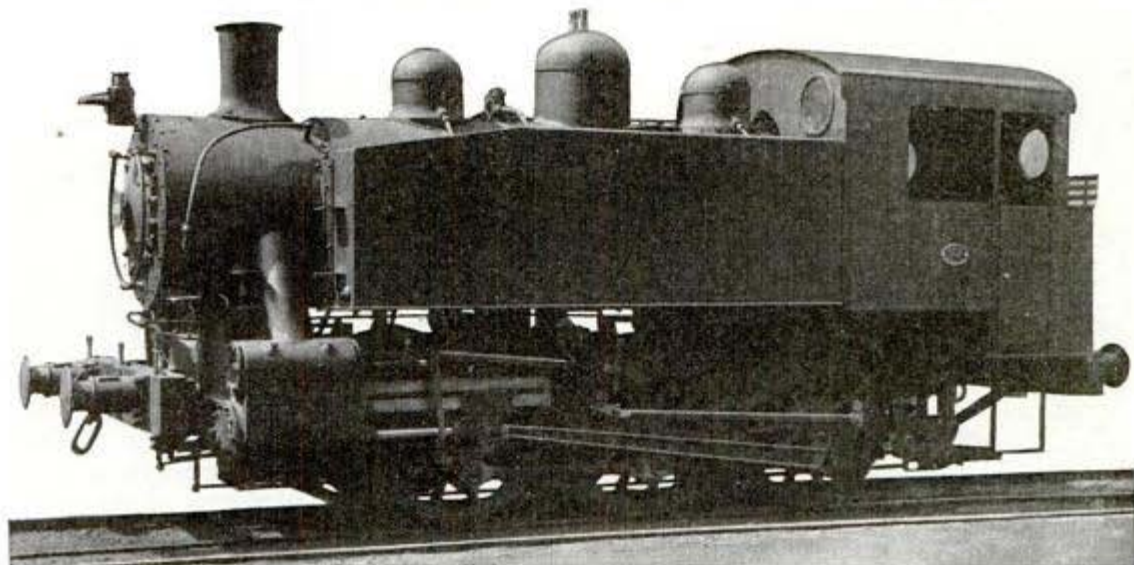


Trained to take his locomotive through, in spite of bombs or shells, is this engineer of a U. S. railway operating battalion

How the program suited the army is told in the words of Brig. Gen. Carl R. Gray, Jr., general manager of the United States Military Railway Service Transportation Corps, in a letter to the Southern:

"Never has there been in my knowledge of railroad service more cooperative, coordinated, unselfish and thoroughly competent help given anybody than the officers and men of the Southern Railway System

Side-tank type locomotive is a war baby, made in Pittsburgh by H. K. Porter Co., Inc., for use by the United Nations. It can haul equipment to battle zones, or work near docks or supply centers





Soldiers in Mississippi shops learn to change wheels of a tank car

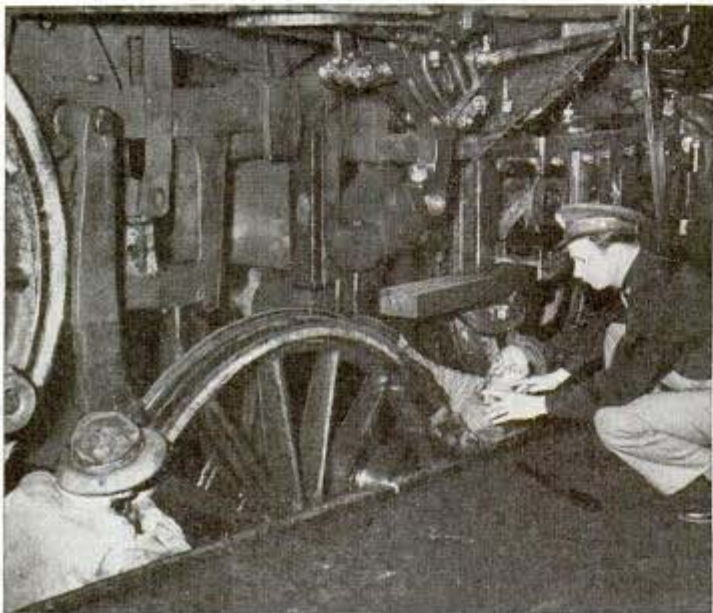
have given in the training of the 727th."

Even though the line was transformed into a laboratory for war, the N. O. & N. E.'s trains still had to go through. Service on the line from Meridian to New Orleans operated as usual. The only difference was that two men were present on each job at all times, one the Southern's and the other the army's.

As the soldiers became better acquainted with their new jobs, they gradually took over, but civilian employees stood watchfully by.

Since the soldiers would be railroading under handicaps, they were trained the hard way. At a war front, for instance,

Learning to be grooms of the Iron Horse are these soldier-mechanics



of fixed sources of power an enemy might also destroy.

At the battalion's Hattiesburg headquarters the Southern set up an office car for the commanding officer; two camp cars converted into offices and emergency sleeping quarters for other officers; two kitchen and mess cars and three others equipped with double-decked bunks for men. Dispatching, telegraph, telephone and light and water equipment were installed in the office cars.

On the far end of the division, swinging north from New Orleans in the rocking cupola of a caboose in which your partner would be a trainman-sergeant, you would see, as the cars began to grind over the long trestle across Lake Pontchartrain, a gang standing to one side to let the freight pass through. They would be soldiers, too—bridge gangs and operators billeted in one of the camp cars converted for army use.

Farther along you might pass soldiers of the section gang, men who work as section gangs have in all railroading history, except that these would be outfitted in army work clothes, with canvas puttees and slouch-brimmed army hats, with perhaps a canteen swung at the hip.

A soldier is at the throttle of your locomotive, and another is shoveling coal across the grates; at a stop for water a soldier walks along, watch-

ing for hot boxes; a soldier hands up the orders at a dispatching point, and a soldier-conductor reads them.

At the end of the run are other camp cars converted as barracks for transportation personnel. In Hattiesburg is an air-brake instruction car, equipped with all the fittings needed to show soldiers how to use and maintain this vital equipment, with an air-brake expert from the Southern as instructor. Another Southern veteran is on loan to teach soldiers operating rules.

At the shops in Meridian, an officer is supervising a private first class in a lathe operation. Head of a crew rerailing a box car wears chevrons on the sleeve of his work jacket.

Officers of the 727th were largely railroaders from the Southern itself, as the officers of the 715th, the second battalion to train on the N. O. & N. E., were largely recruited from the Illinois Central. Enlisted men generally had a railroading background.

But railroading in peace and in a theater of war call for different techniques. On the peacetime road, you proceed on the theory that the right of way and rolling stock are in good condition and safe. Under war conditions you presume they are unsafe—but you proceed anyway.

That is also the philosophy of instruction for railway operating battalions subsequently trained by the Pennsylvania, the New York Central, the Santa Fe, the Southern Pacific and the Missouri Pacific.

Railroading has never been known as a snap job. America's history is full of the song and story of the perils and discomforts of laying the rails that bound broad wildernesses into a nation. The addition of military discipline, and danger of enemy fire, doesn't make railroading any easier.

But Transportation Corps men—these railway operating battalions, and the civilians who help teach them, all have the same idea: Some day they or the men they taught may be in the crew of a train carrying United Nations generals with the terms of peace to the war criminals of the Wilhelmstrasse, or, if not in the crews, in the dispatching offices, or signal towers, or along the right of way, speeding along the emissaries of victory.

Stoves Made Out of Baked Clay Pinch-Hit for Metal Heaters

To offset the shortage of heating stoves, ceramic heaters have been designed at Ohio State University's engineering experiment station. Successful stoves require a careful blending of raw clays, and more than one type of mixture is needed to make the heater complete.

Aeroservice
45 W. 45th St.
21. 4. 19. 71. 4. 71570

"Sliced" Disk Points to Spot For Sound-Effects Pickup

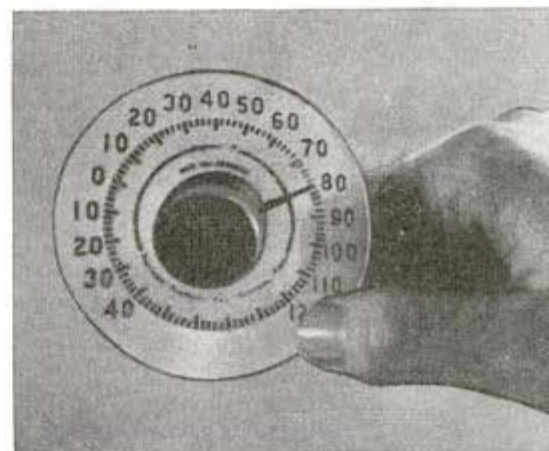


Graded scale shows exact spot to place the needle

Timing of sound effects and music with precision is possible with a "Spot-O-Graph," scaled to show exactly where to place the needle to find a particular sound on a recording. It is designed in the form of an ordinary record, but with a cone-shaped partition down the center. On each side of this gap is a minutely graded scale.

Easily-Read Disk Thermometer Is Cemented to Window

Squinting at window thermometers is eliminated with a transparent circular dial on which markings stand out in bold relief. A thermo-coil with pointer attached indicates the temperature. The base is cemented to the window glass on the outside.



Markings stand out clearly on the transparent dial

Precision Products Co.
87
Waltham, Mass

71492

Inch-Thick Kit for Aviators Holds Emergency Supplies



Snug fitting kit is worn under pilot's flying suit

If a Royal Canadian Air Force pilot is forced down in the wilderness or at sea, his chance of survival is increased with a new personal emergency kit. It is only an inch thick and is worn under his flying suit. The kit contains rations for three days, fishing tackle, first-aid kit, compass, clasp knife, a supply of matches in a waterproof container, a plastic whistle, and a signaling mirror.

71539

Shoes and Bedsprings of Nylon Predicted for Postwar Era

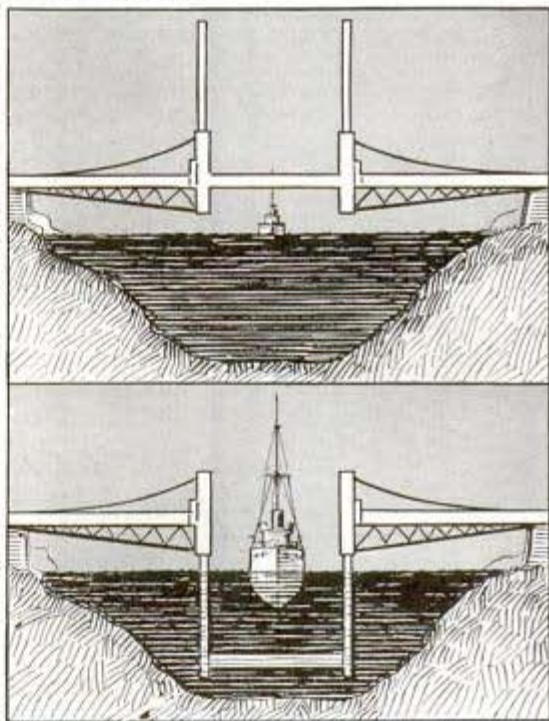
Consumers accustomed to thinking of nylon as the gossamer threads that make flattering hose might gape at the plans E. I. du Pont de Nemours & Co. have for utilizing the material after the war. Currently, most nylon is being used in parachute cloth, bomber tire cords and glider rope, in brush bristles and surgical sutures. But nylon plastic is also being used for secret military purposes. Nylon in this form is a thermoplastic, meaning that under heat and pressure it can be reshaped and reformed any number of times. But it has an extremely high softening point—450

degrees compared with the average of 160 degrees for other thermoplastics—and because of this approaches the nature of the other type of plastics, thermosetting materials. The latter cannot be remolded, once they are formed under heat and pressure, even though heat sufficient to char the material is applied. Nylon is also one of the lightest-weight plastics; it burns slowly, undergoes little or no deterioration with age, resists oil, grease, solvents, alkalis and weak acids and is readily machined. Bearings of nylon plastic were made before the war, and the company foresees its use to make these other products: Zippers, vacuum packages, handbags, luggage and shoes, industrial coil springs, rattan for furniture.

71468

"Ducking Bridge" Lowers Span To Permit Ships to Pass

Faced with the continuing threat of monsoon gales, an Indian Army engineer charged with building a drawbridge in Iraq decided against erecting the tall towers that would support the raised roadway of an ordinary drawbridge. Instead, he designed a bridge that actually "ducks"—its span submerges beneath the water to permit vessels to pass. The bridge is built across the confluence of the Tigris and Euphrates Rivers, which form the Shatt-el-Arab. Its central span of 30 yards is the movable portion, which lowers the bridge's roadway and a light railway enough to let a ship pass.



Bridge span lowers enough to give clearance to ship

Wilmingtn, Del.

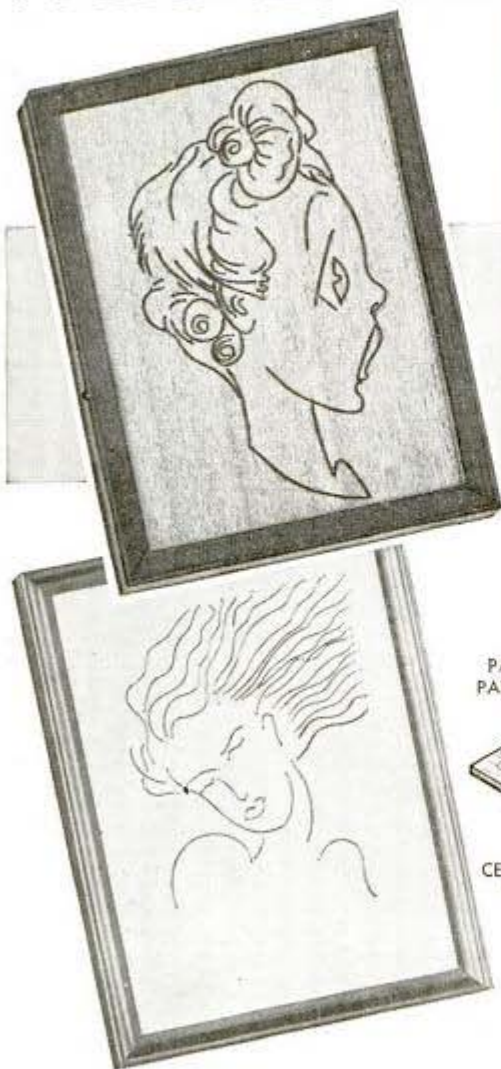
Brig. Lyford, Del.

The



CRAFTSMAN

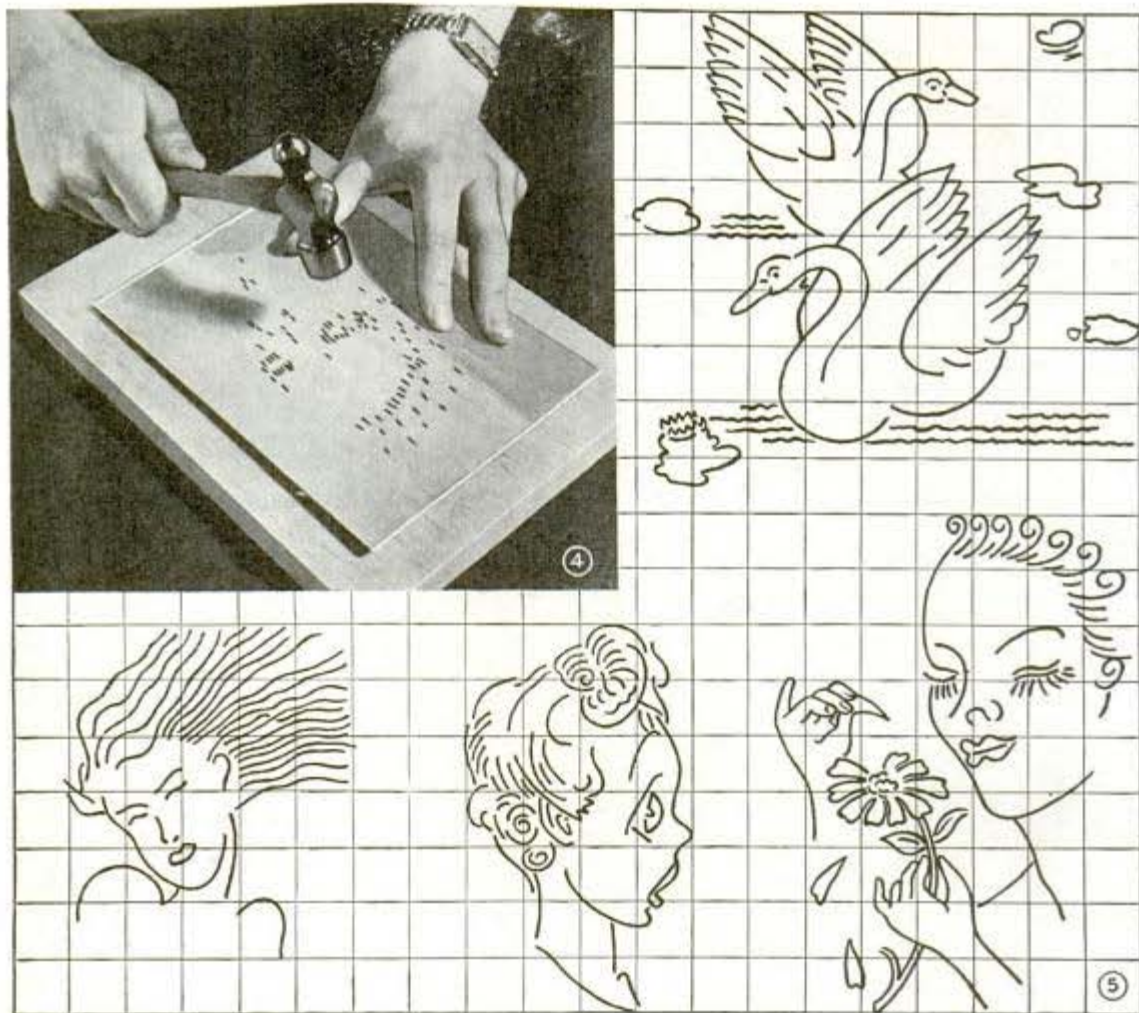
PICTURES "Embroidered" in WIRE



By Herman R. Wallin

HERE'S something new in wall pictures which are distinctively different from the usual run. They consist of bright wire attached to framed panels of fancy wood against which the wire picture casts a slight shadow to make it stand out boldly and produce a pleasing effect. All you need to





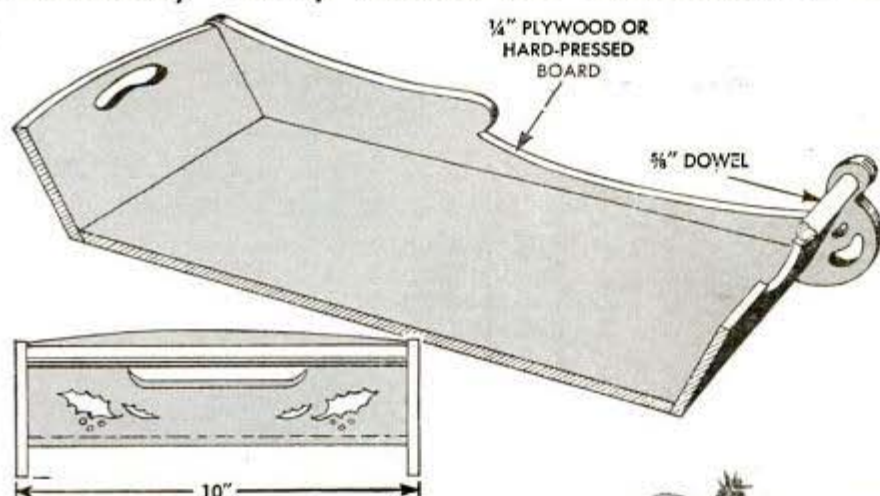
make these unusual pictures are pliers, a small hammer, an awl, some old wire from discarded radio coils and a few pieces of thin wood. Magazines and newspapers provide an excellent source for suitable pictures to copy. Look for those made up mostly of outlines such as the ones shown in Fig. 5. In tracing the picture, break up the lines into short lengths and avoid continuous lines. The wood should be selected to give the most pleasing contrast to the kind of wire used. Copper or enameled wire stands out nicely on light-colored woods, while brass or tinned wire looks best on darker woods. You can use fancy veneered plywood $\frac{1}{8}$ to $\frac{1}{4}$ in. thick in walnut, mahogany and maple, or the top and bottom of a cigar box will do. The wood is first sanded smooth and finished by staining and waxing, or by leaving the wood natural and applying wax or linseed oil.

Center the tracing on the wood so that there will be about 1 in. or so of margin all around to allow for framing and hold it in position with a few tabs of cellulose tape as in Fig. 1. Now, with an awl or a sharply pointed nail, make a prick mark at the be-

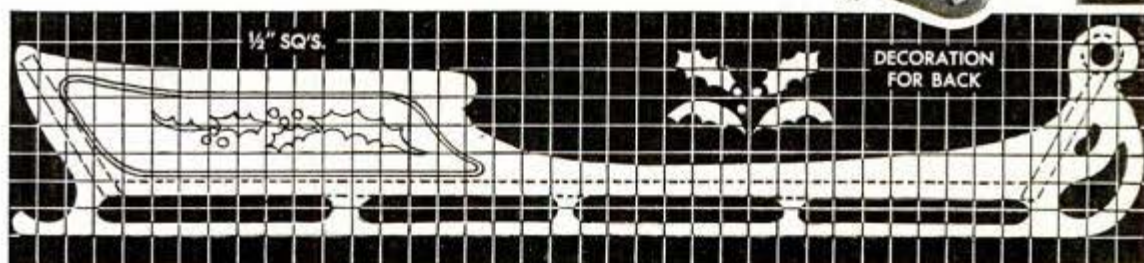
ginning and end of each line as in Fig. 2. After this, remove the tracing and with the same tool, or with a small twist drill if the wood is $\frac{1}{4}$ in. thick, make a hole through the wood at each mark. The size of the holes is governed by the size of wire used. A No. 22 or 20-ga. wire is about the right size. If the wire needs straightening, you can do so by drawing it over a dowel or other round surface. When all the holes are drilled, sand the front and back of the wood lightly to remove the rough edges.

From now on, it's just a matter of bending the wire to conform to the contour of each line of the pattern, which is done by laying it over the line to be copied and forming it with the fingers to correspond. At the ends of each line, the ends of the wire are bent downward with pliers to pass through the wood and extend about $\frac{1}{4}$ in. on the back. This procedure is followed until all the lines of the pattern are completed, after which the projecting ends are clinched as shown in Fig. 4 by turning the picture face down on a soft-pine block and hammering the wire down in the direction of the grain.

Holiday Tray Adds to Christmas Decorations



Although intended especially for serving guests during the holiday season, this appropriate sleigh-shaped tray also can be filled with fruit neatly arranged to provide an attractive table centerpiece. Identical sides of the sleigh are clamped or tacked together while jigsawing them to shape, after which the bottom, back and dash are assembled as indicated by the dotted lines in the lower detailed drawing. Finishing consists of enameling the outside white and trimming with red stripes, red berries and green holly leaves



Flannel Gun-Cleaning Patch Cut With Sharpened End of Tubing

Instead of tearing pieces from old rags for cleaning the bore of your rifle, use round flannel patches of the proper diameter and avoid the danger of wedging the cleaning rod in the barrel, which might necessitate harsh measures to remove it. To cut a supply of these patches quickly, first soak a square yard of cotton flannel in water and iron it smoothly after it has been stretched and dried. This tends to increase the flannel's absorbing qualities for oils or cleaning solvents. Then, fold or stack several thicknesses of the material on a smooth, hardwood block and punch out the patches with a tool made by sharpening the end of a length of tubing or pipe. Patches $1\frac{3}{4}$ in. in dia., are correct for .30-caliber bores, while $1\frac{1}{8}$ -in. patches are

right for cleaning .22-caliber firearms. For best results, patches should fit the bore snugly, requiring a firm pressure to push them through, but they must not fit so tightly as to have a tendency to bind or stick.—Clyde Baker, Oakland, Calif.

Nonflammable Grease Remover

A quick-acting solution, which combines the detergent action of soap with the grease-dissolving ability of solvents, is made by mixing rapidly together diglycol oleate, 1 oz., and water, 1 oz. This mixture is poured into another mixture consisting of butyl cellosolve, 1 oz., isopropyl alcohol, 10 oz., and carbon tetrachloride, 14 oz., while stirring. Before using this nonflammable solution, one should test its action on the dye in the fabric as some dyes may be slightly affected by it.

Checker Boards for Servicemen Fold Into Small Packages

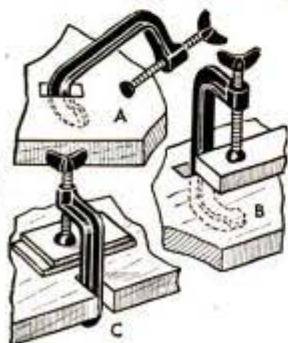


Photo courtesy of W. T. Mellarky, Gallup, N. M.

A group of volunteer workers of Gallup, New Mexico, known as the "USO Troops-in-Transit Project," is distributing checkers and boards to servicemen in transit who highly appreciate them as they can be folded into small packages and carried in the pockets of their uniforms. The boards are made by painting squares on oilcloth, or by utilizing oilcloth already printed in squares, and the checkers are made by sawing off thin disks from old broomsticks and mop handles, which are gathered by the local children. Small cloth bags having drawstrings to close them are made to hold the checkers, which are dipped in paint, a small nail being driven temporarily into each checker to serve as a finger grip while dipping it.

—Mrs. P. J. Vidal, Gallup, N. Mex.

Making C-Clamps More Useful



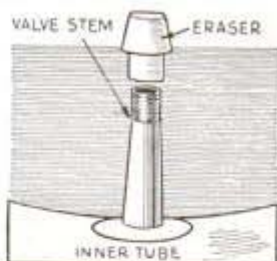
Here are a couple of methods of using C-clamps that one home workshop owner found useful. In the first method, a rectangular opening is made in the bench top to receive the clamp, which is inserted as shown at A, and then turned at right angles as at B. This method provides a bench clamp for which you will find many uses. The second method consists of cutting a slot in the edge of the bench top to receive the clamp as

shown at C. This method provides a handy arrangement which will be found useful for holding small work when gluing it, or for holding work when sawing it with a coping saw, or while planing, etc.

—A. H. Waychoff, Phoenix, Ariz.

Pencil Erasers Are Used as Caps To Cover Tire Valve Stems

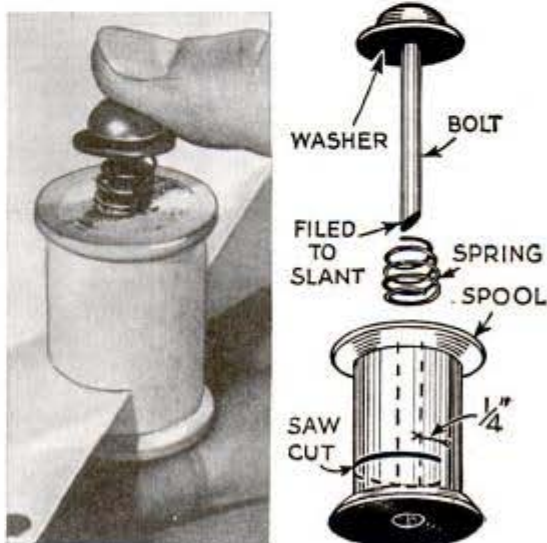
If you are unfortunate enough to lose the dust caps off of your tires and cannot obtain replacements, pencil erasers of the slip-on type will make good substitute caps. These can be obtained at your local drug or stationery store and are of suitable diameter to slip snugly over the end of the valve stems.



—James Vick, Church Road, Va.

Paper Punch Made From Spool And a Small Bolt

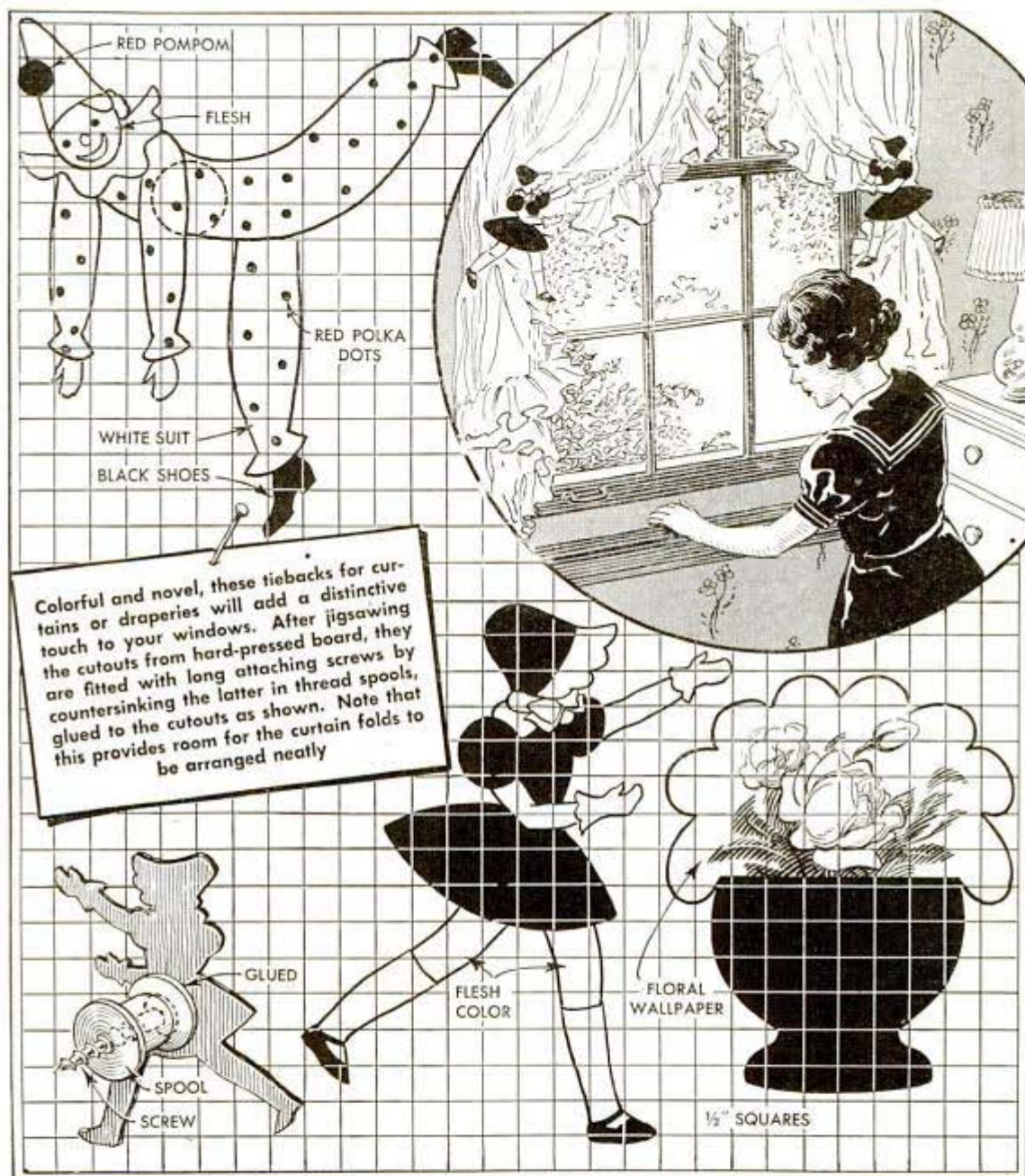
For an occasional job of perforating paper or light cardboard, a punch can be made from a small bolt, a spring and an empty thread spool. First, make a saw slot



a little more than halfway through the spool near one end. Then, select a bolt of a size to provide a smooth sliding fit through the hole in the spool. File off one end at a slant or bevel. Put a coil compression spring under the bolt head and insert the bolt into the spool. In use, slip the paper to be punched into the saw slot of the spool and push down the bolt.

—W. C. Wilhite, Carlinville, Ill.

Novel Curtain Tiebacks Add Color to Windows



Colorful and novel, these tiebacks for curtains or draperies will add a distinctive touch to your windows. After jigsawing the cutouts from hard-pressed board, they are fitted with long attaching screws by countersinking the latter in thread spools, gluing to the cutouts as shown. Note that this provides room for the curtain folds to be arranged neatly

Proper Care Will Greatly Increase Life of Bicycle Chains

Probably the chain is the most neglected part of a bicycle, yet it should have frequent attention. It must be cleaned at regular intervals, and oiled correctly. Most chains have a connecting or snap link that can be removed to take off the chain without removing the rear wheel. However, these links should not be pried apart with a screwdriver or other similar tool. Instead the chain should be slackened and grasped on each side of the link, after which the latter is bent sideways gently,

causing the two connecting link pins to approach each other. With the pins in this position, the cover plate can be removed with the index finger. After cleaning the chain in kerosene, it should be lubricated with a light-bodied oil, brushed on or applied with an oilcan to the upper edges of the side plates. Then the chain should be laid aside until the oil has penetrated the pin-bushing joints. Graphite sticks, grease or heavy oil should never be used on a chain as they will not penetrate the joints.

Solving HOME

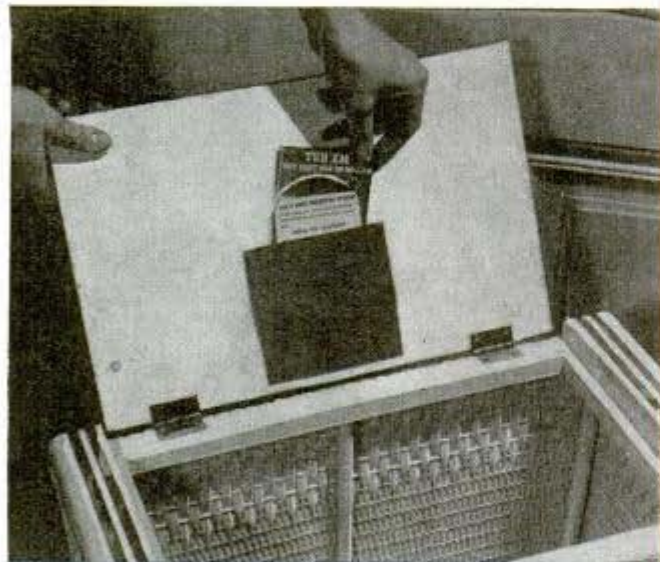


FLAT-TYPE CURTAIN ROD

After laundering a cloth belt, which must be stretched and held smoothly while drying, just slip it over a shortened curtain rod of the telescoping type



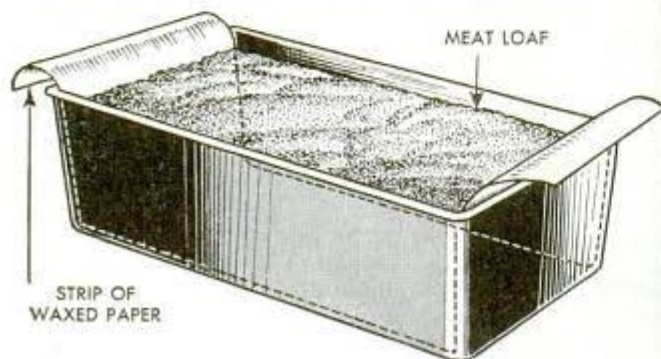
The nuisance of having a cloth slip from your fingers when straining juices or other liquids into jars can be overcome by using a sack for this purpose



When removing washing or cleaning directions from new garments, it's good practice to keep them in a heavy envelope glued to the lid of your clothes hamper



Before washing or dry-cleaning a garment, it's a good idea to sew around any large stained areas so they can be located easily when the cloth is wet

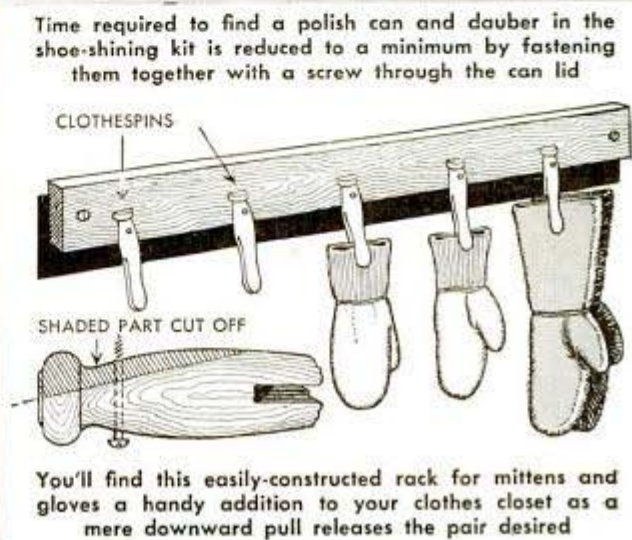
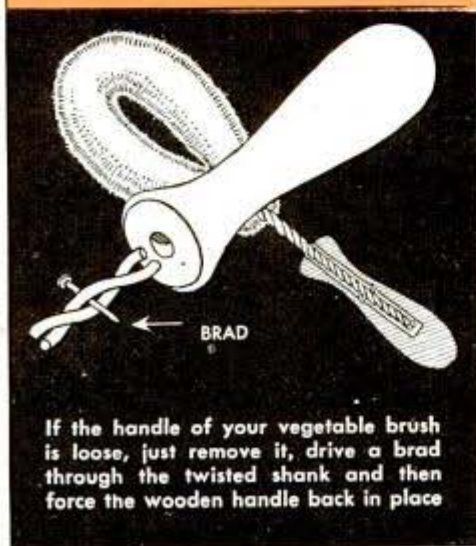
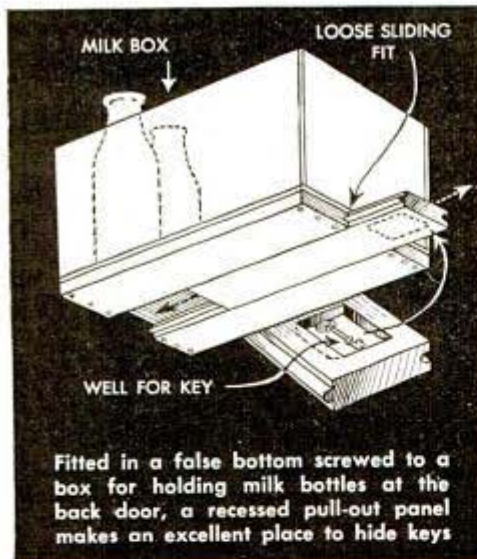


To simplify the task of lifting a meat loaf from the pan, one housewife places a strip of waxed paper in the pan so that both ends extend over the edges

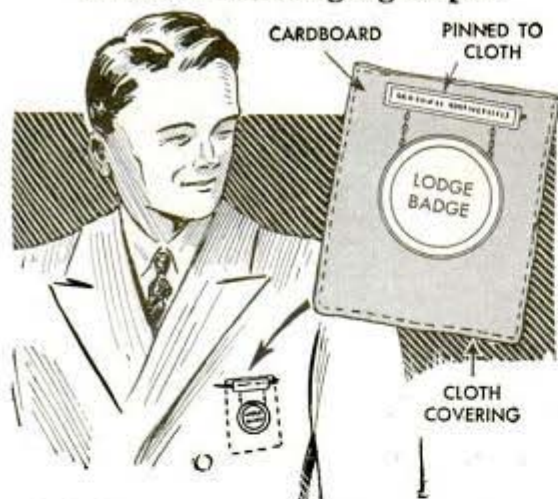


Place pieces of an old sponge in the bottom of your flower pots to help retain moisture and you won't have to worry about watering plants so often

PROBLEMS



Badges Worn on Coat Regularly Without Damaging Lapel



In lodges, conventions, etc., where badges are worn regularly, pinning them in the same position on a coat lapel or pocket soon tends to damage the material at these places. However, this can be avoided by attaching the badge to a cloth-covered piece of cardboard that fits snugly in the handkerchief pocket. Such a holder is hardly noticeable and the badge can be left attached to the cardboard permanently, if desired.—R. Boettinger, Englewood, N. J.

Substitute for Jack-O-Lantern From Sack and Flashlight



By painting faces on two sides of a large paper bag and slipping a flashlight into the mouth of the bag, one boy made a good substitute for a pumpkin jack-o-lantern. The bag should be made of thin paper for best results. The two

faces should have different expressions so that you can change from one extreme to the other merely by turning the bag.

Dash Signal Operated by Brake Shows When Emergency Is On

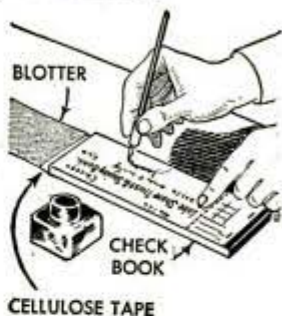
If you sometimes forget to release the emergency brake of your car before backing out of the garage or pulling away from a parking space, here's an easy way to hook up a warning light to show when the brake is on. First, secure a pushbutton switch of the type that opens the circuit when pressed, mount this directly in front of the emergency-brake lever so that the latter

presses the button when the brakes are released, and connect it to a small lamp fitted in the dash. Then, wire this dash signal through the ignition switch so that it operates only when the latter is turned on, thus avoiding unnecessary use of current when the car is parked.

—Richard Shafer, Pasadena, Calif.

Blotter Attached to Check Book Is Always at Hand

Instead of carrying a separate blotter to use when writing checks, I cut one to fit the check book and attached it with cellulose tape as shown. In this way, the blotter is always conveniently at hand



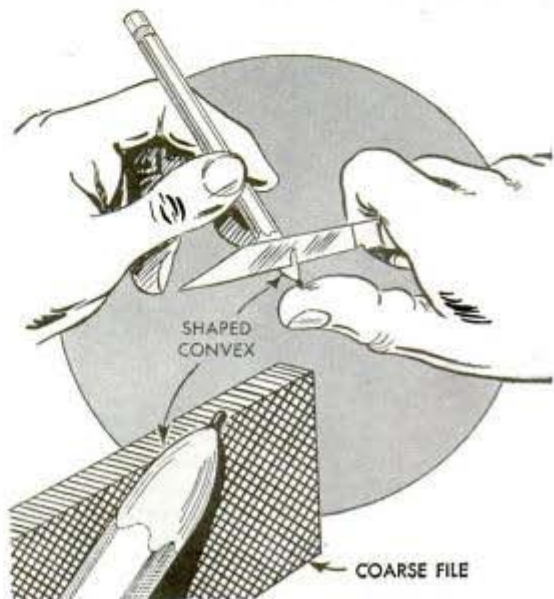
to take up excess ink without waiting for it to dry, thus saving considerable time where a number of checks are written.

—Paul Toomey, Bronx, N. Y.

How to Sharpen Common Pencil To Strengthen the Lead

The point of a regular pencil can be prevented from breaking easily when used on rough wood by shaping the point as shown. This method provides much stronger support for the lead than when the wooden part of the pencil is tapered more. If a sharp knife is not handy, a chisel can be used to advantage. In some cases, a coarse file is handy for shaping the point.

—J. Modroch, Danbury, Conn.

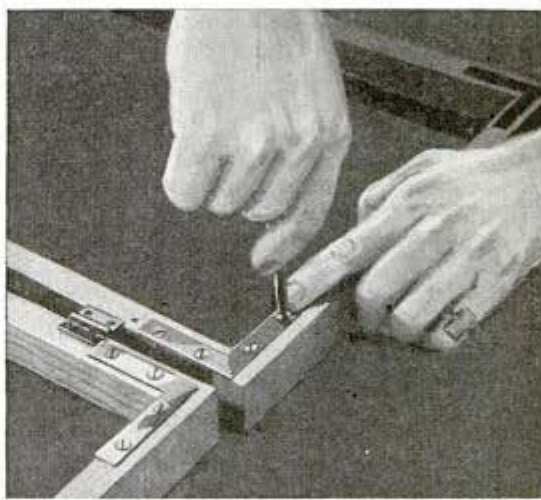




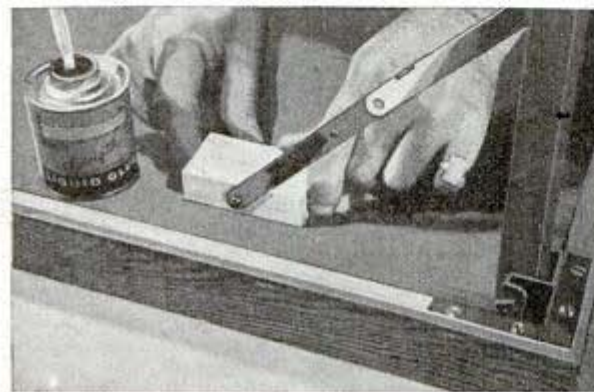
Suitcase-type CARD TABLE

THIS folding card table is carried like a suitcase and has space inside to hold several decks of cards, pencils, paper and even a set of poker chips—or a tablecloth for occasions when you wish to use the table for picnics. Also, the table can be adjusted for use as an inclined drawing board.

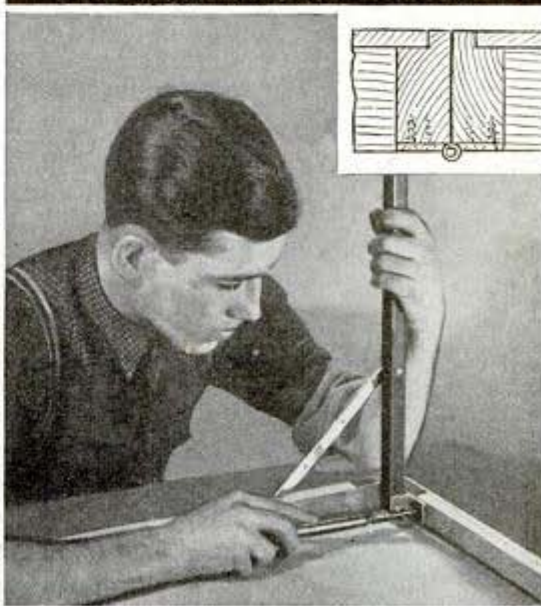
The legs and hardware of an old card table are used so that all you have to make is a new top, which consists of two equal parts to be hinged together. The rails must be wider than the thickness of the legs and the rail edges are rabbeted to take plywood or hard-pressed board, which is glued in place. Two of the legs—one in each part of the table—are set in from the corners, so that the pair in each half will lie side by side when folded. To provide support for the legs that are set in, the braces of these legs are screwed to wood blocks glued to the underside of the top. A friction clasp is provided to hold the halves of the top together when it is carried.



CORNER IRONS STRENGTHEN BUTT JOINTS

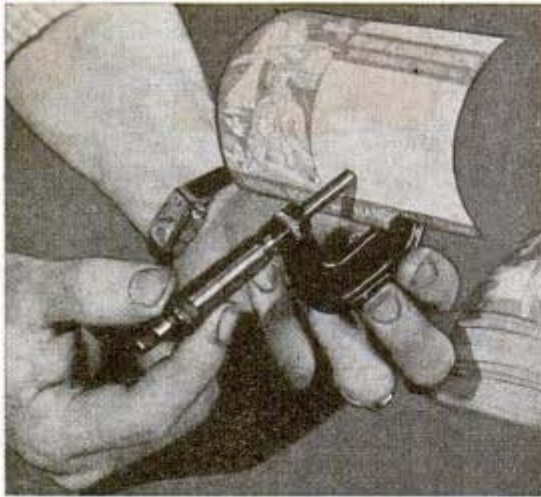


LEG BRACES FASTEN TO WOOD BLOCKS



LEGS AND HARDWARE USED FROM OLD TABLE

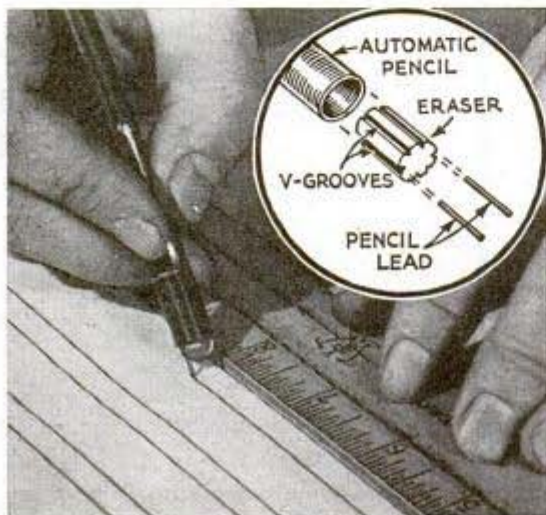
Micrometer Aids in Estimating Number of Labels on Hand



As it is often advisable to compare thickness of paper stock and check the number of labels, letterheads, etc., when purchasing such items, I have found a micrometer especially handy for doing this quickly. For example, the micrometer shows a label to be .0035 in. thick. By measuring the stack with an ordinary ruler, the number of labels in it can be estimated easily if they are printed on the same stock, as 3.5 in. will equal approximately one thousand labels.—Frank Shore, New York City.

Two Leads Held in Pencil Eraser To Draw Double Parallel Lines

When you have occasion to draw a number of narrow-spaced parallel lines, the job can be done rapidly by using the eraser end of a pencil to hold a couple of leads. The eraser is grooved at the sides, the leads placed in the grooves and the assembly slipped into the eraser ferrule, leaving the



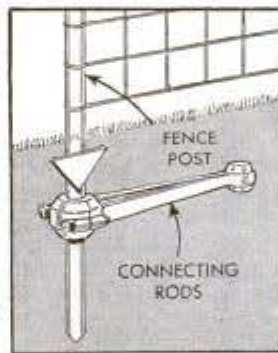
ends of the leads projecting a suitable distance. Cutting several grooves of different spacing will enable you to vary the spacing of the lines as desired.

Pocket Stitched to Hold Rule

After losing several folding-type rules because they could slip out of his overalls pocket easily, one carpenter had a portion of the pocket stitched shut as shown. This reduced the size of the pocket at the center to provide a snug fit for the rule, leaving the top with full opening so the rule could be inserted quickly.



Large Gate Posts Braced Easily With Old Connecting Rods

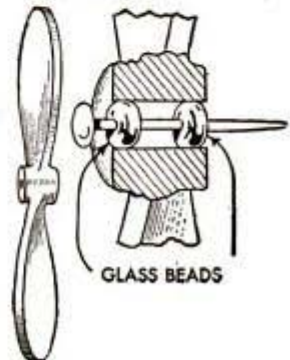


Invisible bracing for steel posts of a yard gate can be had by anchoring them through discarded auto connecting rods, which are buried in the ground. The rods should be just a few inches under the surface and should be located parallel with

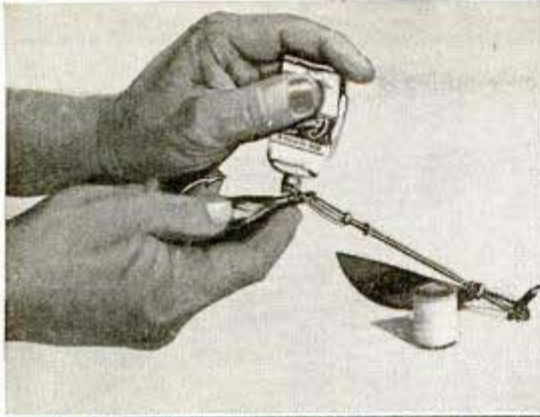
the fence. Two or three coats of paint applied to the rods before putting them in the ground will help prolong their life.

Glass Beads Provide Bearings For Model Airplanes

If you wish the wooden propeller of a model airplane to run freely, use a couple of glass beads as bearings. These are inserted into a hole in the center of the propeller with a press fit as indicated. A pin will serve nicely as a propeller shaft, and should be of a size to fit the holes in the beads with very little play.



Simple Methods of Preserving Fishing Tackle



① MODEL-AIRPLANE CEMENT SEALS AND PROTECTS THREAD BINDINGS ON CASTING FLIES

A little time spent occasionally on caring for your fishing equipment will be well worth while in making it last longer and give the best of satisfaction, especially on tackle that is difficult or expensive to replace. For example, your valued feathered baits will be less likely to disintegrate if a film of model-airplane cement is kept on the threads that bind the feathers, Fig. 1. This treatment also is good protection for the wrapping on gutted hooks. Another thing to keep in mind is the care of your casting rods. One of the most common causes of damage to tubular steel rods is rust inside them. On all rods of this type, except the telescoping ones, rust can be effectively checked by coating them inside with a film of linseed oil. On rods of open-end construction, the application is simple. Just hold your finger over the lower end while oil is poured in at the upper end to fill the rod as in Fig. 2. Then, by standing the rod up to drain, the interior will be completely coated and fully protected. Servicing the one-piece tubular steel rods is not quite so easy, but they can be protected by drilling a tiny hole through the side at a joint for the introduction of oil. After the inside surfaces have been coated thoroughly with oil, the hole should be plugged with solder. For preserving your



② USE OF LINSEED OIL INSIDE TUBULAR SECTIONS OF RODS WILL CHECK RUST



③ AUTO TOUCH-UP ENAMEL IN BRIGHT COLORS IS IDEAL FOR REFINISHING PLUGS

casting plugs, you will find auto touch-up enamels handy, Fig. 3. These are available, in many colors, at most auto-parts stores.

Baseball Clogging Basement Drain Removed Easily With Corkscrew

When a floor drain near the laundry tubs in my basement became clogged, I tried to remove the obstruction with a long flexible spring, as I was quite sure that the stoppage was due to a baseball which had rolled into the drain. Although the pointed spring prong seemed to reach the ball, this only caused it to turn, as the prong did not pierce the cover enough to get a firm grip on it. To solve this problem, I soldered a cork-

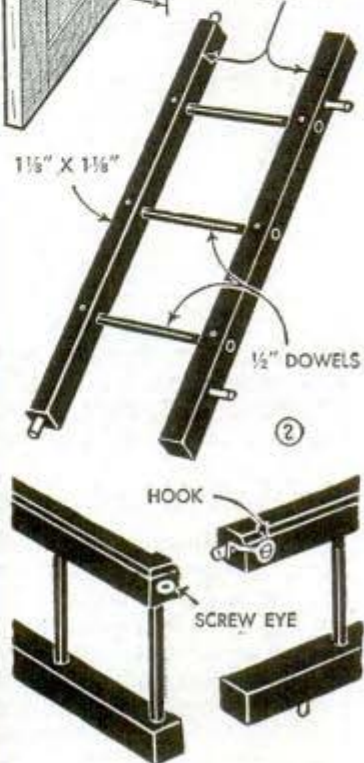
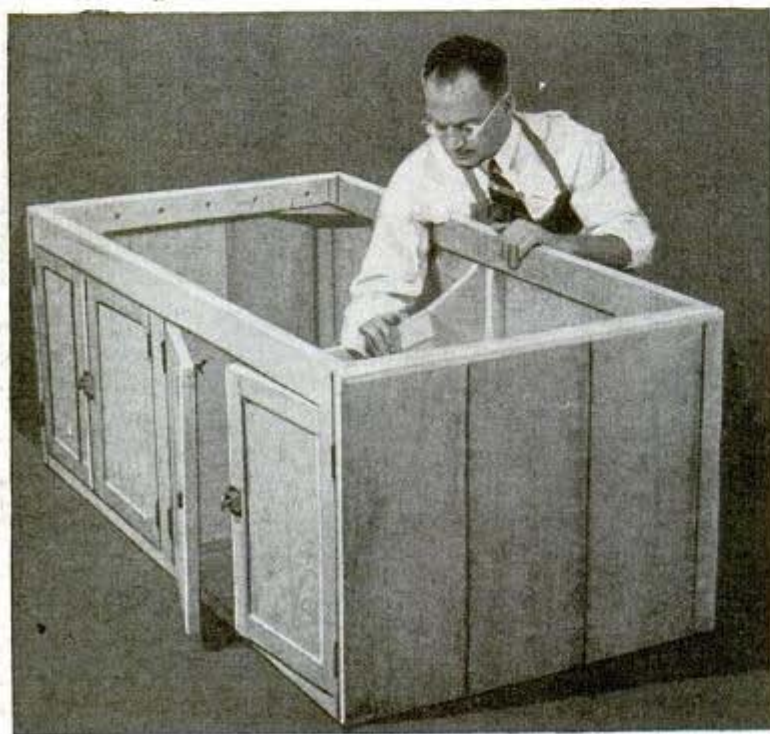
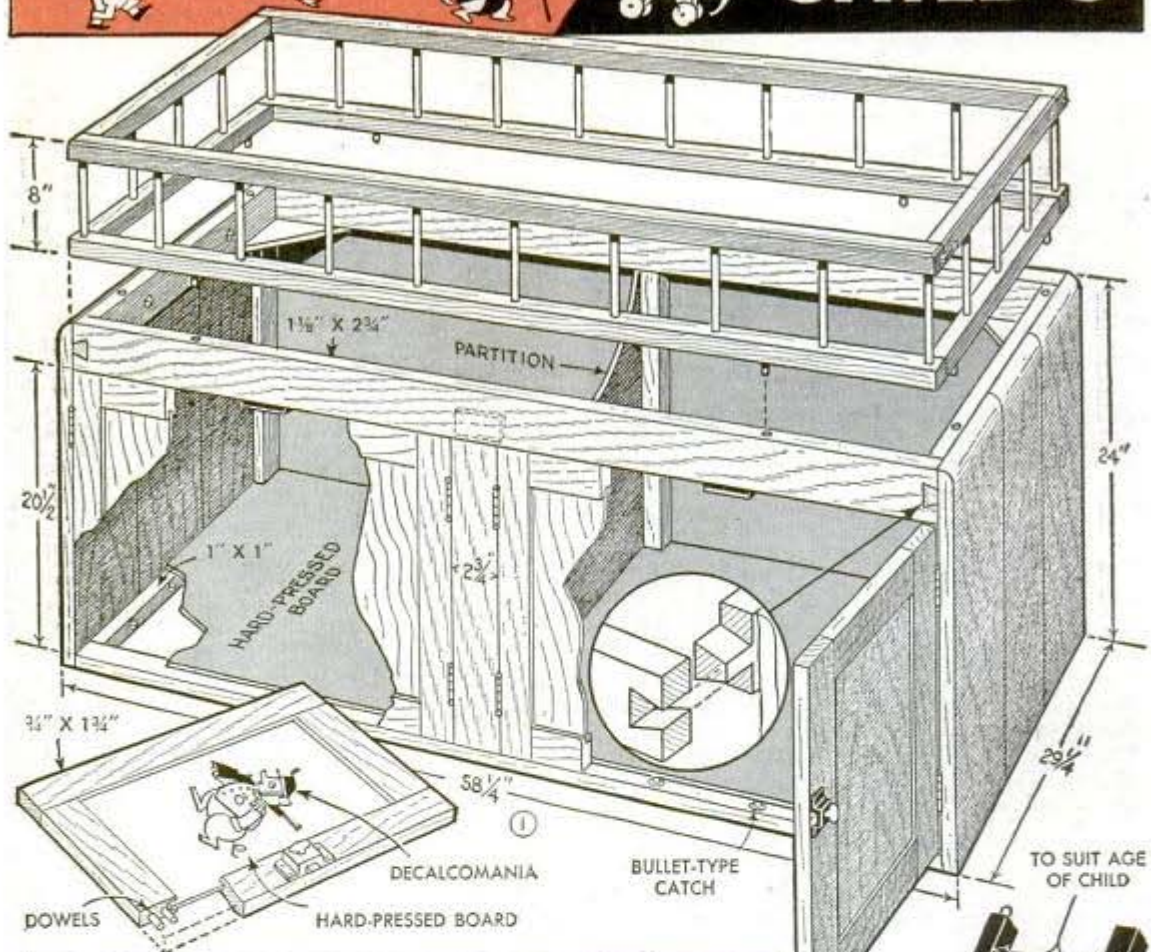
screw onto the end of the flexible spring and with this improvised tool removed the ball in ten minutes.

—Wm. A. Winters, Sr., Milwaukee, Wis.

☛ If you have trouble slipping a new windshield glass into the rubber weatherstrips when replacing a broken one, just squirt a little liquid soap into the weatherstrip grooves to serve as a lubricant.



CHILD'S

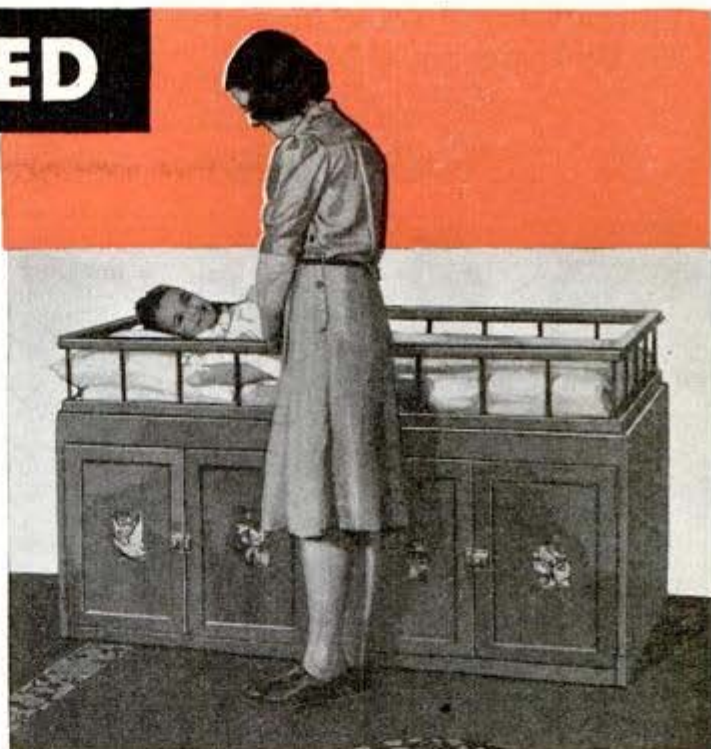


CHEST-BED

IN SMALL homes and apartments where it is impossible to furnish a room for the child, this combination bed and chest will be of real value, as it serves as a comfortable bed at night and provides storage space for extra blankets, toys and other household items. In daytime, removing the railings and covering the chest with an appropriate drapery converts it into a useful couch. If made higher than shown in Fig. 1, the railings can be removed and set up separately to form a child's play pen. When used in this way, however, a floor for the pen must be assembled and drilled for pegs to keep the railings in place.

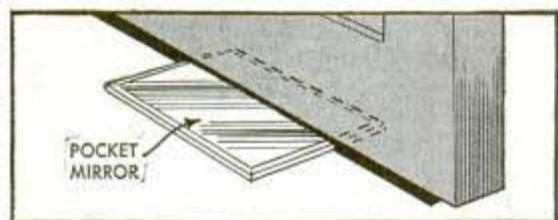
Before assembling the frame, have the springs at hand so they can be measured, as the exact size of the chest depends upon these dimensions. Corners of the frame are dovetailed and glued, with triangular blocks glued and screwed to the underside of the top members at each corner to support the springs. Note that the ends of the chest are built up of tongue-and-groove stock, glued and screwed to the frame. To improve the appearance, the outer edges of these boards are rounded at the top.

Note that the chest is fitted with a partition which is curved at the top to prevent the springs hitting it when they are pressed down by weight of a person sitting or lying on them. Railings are assembled quickly by clamping the upper and lower members together and drilling them both at the same time. The holes should be just large enough to provide a sliding fit for the dowels, these being held in place by glue and small finishing nails driven in from the sides. To prevent shifting of the railings, tapered pegs are fitted in the lower members to correspond with holes drilled at the top of the chest frame as shown in Fig. 2. End railings are also fitted with pegs which slip into holes drilled in the side railings. Hooks and screw eyes lock the railings together.



Doors are hung with hinges having removable pins for convenience in detaching them, in case the edges need planing to make them fit accurately. A stop block at the top and bullet-type catches in the bottom rail hold the doors shut. Or, you can fit them with elbow catches and cabinet latches, if desired. Although the bed is somewhat higher than cribs in general, this gives the advantages of adding to the storage space, Fig. 3, and facilitating making the bed with a minimum of stooping for the housewife. Low railings are also a convenience where the bed is made without removing them. Decalomania transfers are applied in the center of each door.

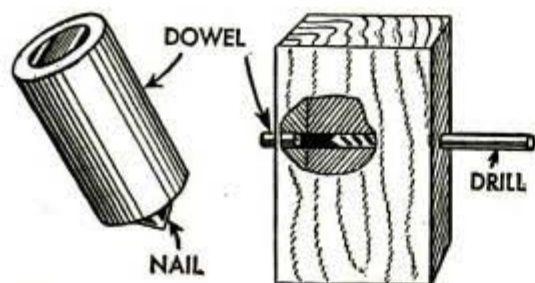
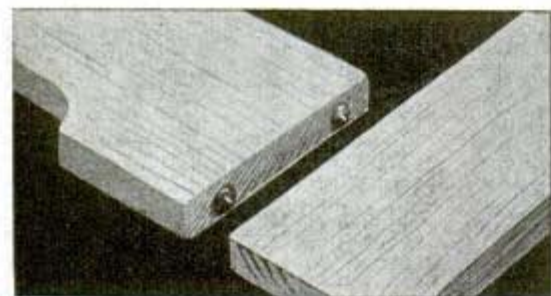
Bottom Edge of Door Inspected By Using Small Mirror



If a door binds and you suspect it is caused by moisture penetrating the bottom edge because it has not been painted, you can make sure without removing the door by using a mirror to look at the edge as shown. The mirror is also ideal when fitting a door to see where it should be planed to prevent dragging.

Inexpensive Set of Dowel Markers Assures Neat Joints

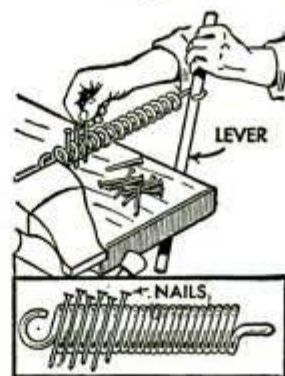
A handy set of dowel markers, which eliminate considerable measuring to fit doweled joints accurately, can be made in a few minutes by carefully fitting short dowels of various sizes with nails having sharpened points. In doing this, it's a good



idea to drill guide holes slightly undersize through the dowels to assure accurate centering of the nails and prevent them from splitting the wood. To center-mark the short dowels quickly, just drill holes, corresponding in diameter with the dowels, through a block of wood, tap the dowels in them and use the drill points for marking the ends as shown in the lower detailed drawing. Some sanding of the dowel sides will facilitate inserting and removing the markers, as stock dowels usually fit snugly in holes for which they are made.

Easy Way to Install Heavy Springs

After removing a strong coil spring from a restricted place, I found that it was impossible to replace because there was insufficient space to stretch it to reach the



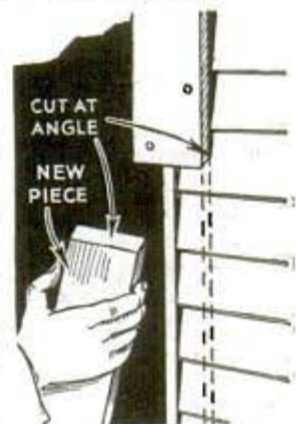
supports either by pulling or by means of leverage. After trying various methods, I measured the distance between the two supports that held the spring. Then I clamped one end of the spring in a vise and stretched it to the desired length by means of a

lever as indicated. While holding the spring in this position, nails were inserted between the coils to keep it extended. In this way the spring was hooked on its supports easily, after which a slight pull sideways from the center of the spring permitted the nails to be removed.

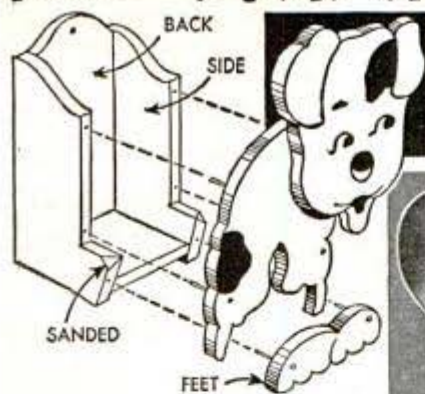
—I. H. Gaskin, Watertown, Mass.

Ends of Building-Trim Patches Cut at Angle for Good Fit

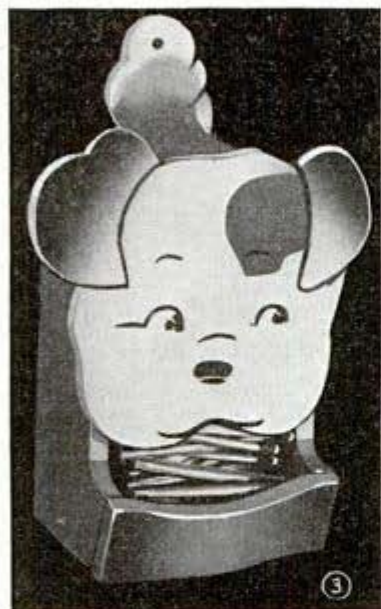
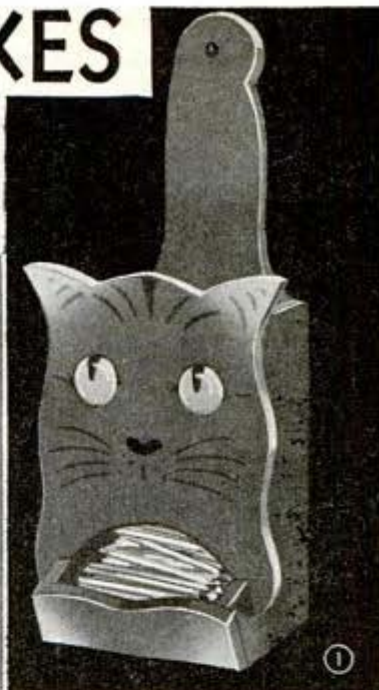
When you patch corner boards and trim on buildings, cut the joining ends at an angle as shown, instead of squarely across. The angle cut makes a neater fit of the patch piece. Paint the ends of the joining parts before nailing them in place so that water running down the corner board will drain away instead of soaking into the end grain of the wood.



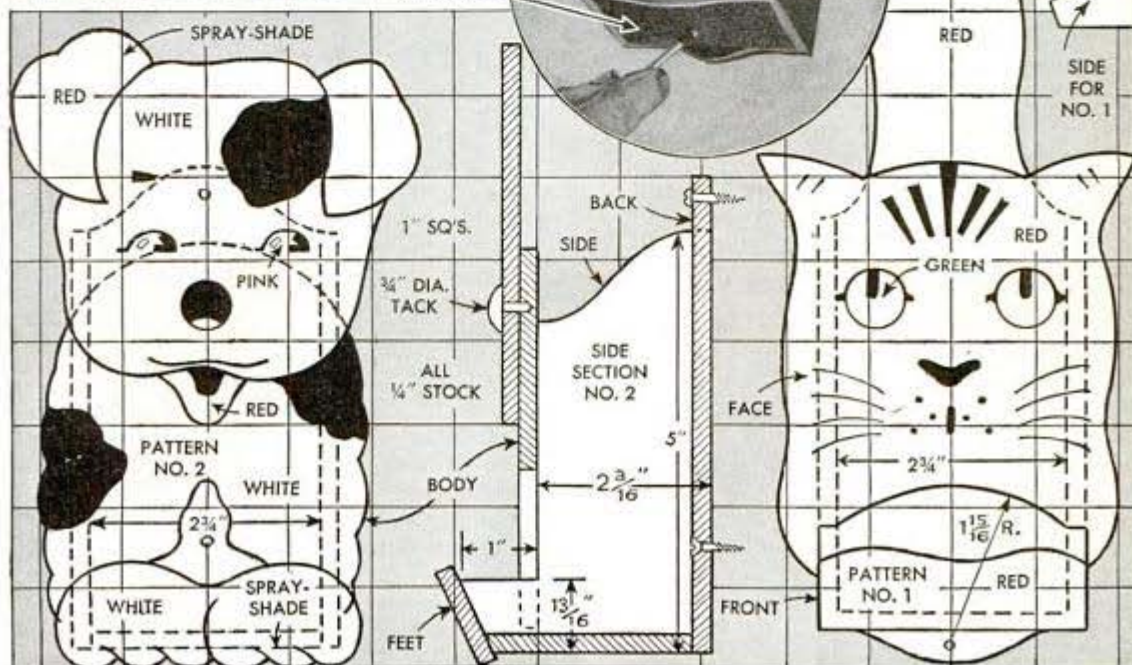
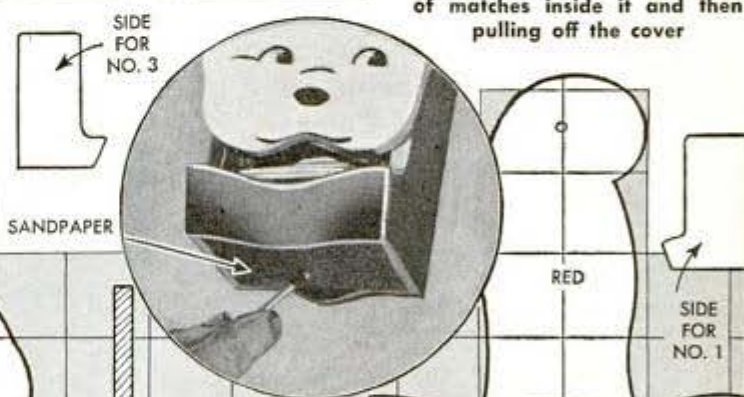
Novelty MATCH BOXES



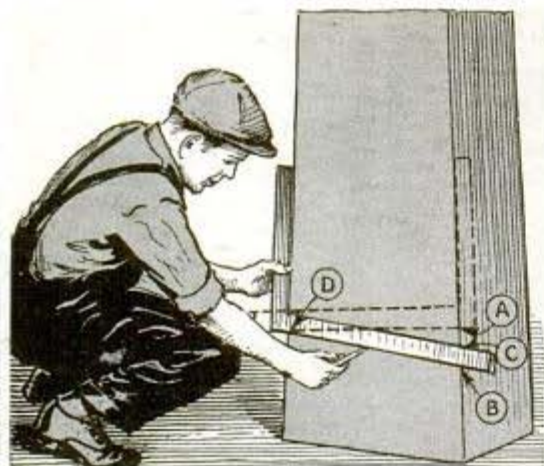
for the
Kitchen



You can use plywood scraps or solid stock for these boxes, which are mostly jigsaw projects. Each has a sandpaper striking surface on the bottom, and is loaded by inserting a box of matches inside it and then pulling off the cover

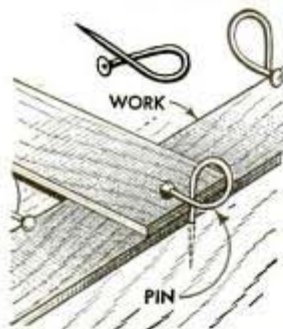


Squaring Tapered Wood Column For Accurate Sawing



The next time you have to fit a tapered column, such as those commonly used on porches, try this method of squaring the ends for accurate sawing. First, place your carpenter's square on one edge of the column as shown and make a dot at points B and D. Next, reverse the square to the opposite edge as indicated by the dotted lines and mark point A. Then, halfway between points A and B, mark position C, and draw a straight line from C to D. Follow this same procedure on all sides.

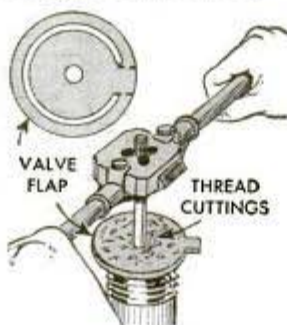
Bent Pins Provide Spring Clamps To Hold Model Parts



To hold small parts in model work for gluing or assembling, one modelmaker uses large pins. These are bent so that the heads will press on the pieces to be held when points are stuck in the bench.

Valve Leather Catches Cuttings While Threading Pump Rod

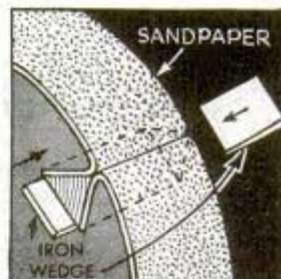
If it is necessary to recut the threads on a pump rod while the pipe and rod are still suspended in a well, there is always the possibility of thread cuttings dropping into the pipe and eventually injur-



ing the cylinder valves. To avoid this, one plumber made a simple cover for the pipe by cutting the flap from a discarded valve leather and enlarging the center hole so that it fits snugly over the rod as shown.

Sandpaper Is Locked on Drum Without Leaving Bump

Turned from a piece of straight-grained maple, this handy sanding drum is fitted with a triangular-shaped wedge which locks the ends of sandpaper strips in place and eliminates the



usual bump at this point. To cut the wedge opening, just drill two small holes at the inside corners and remove the piece with a jigsaw. Then drive tapered pieces of metal under the wedge to tighten and force it against the sandpaper ends as shown.

—Harold Bulmore, Newfane, N. Y.

Danger in Cleaning Auto Motor To Be Avoided

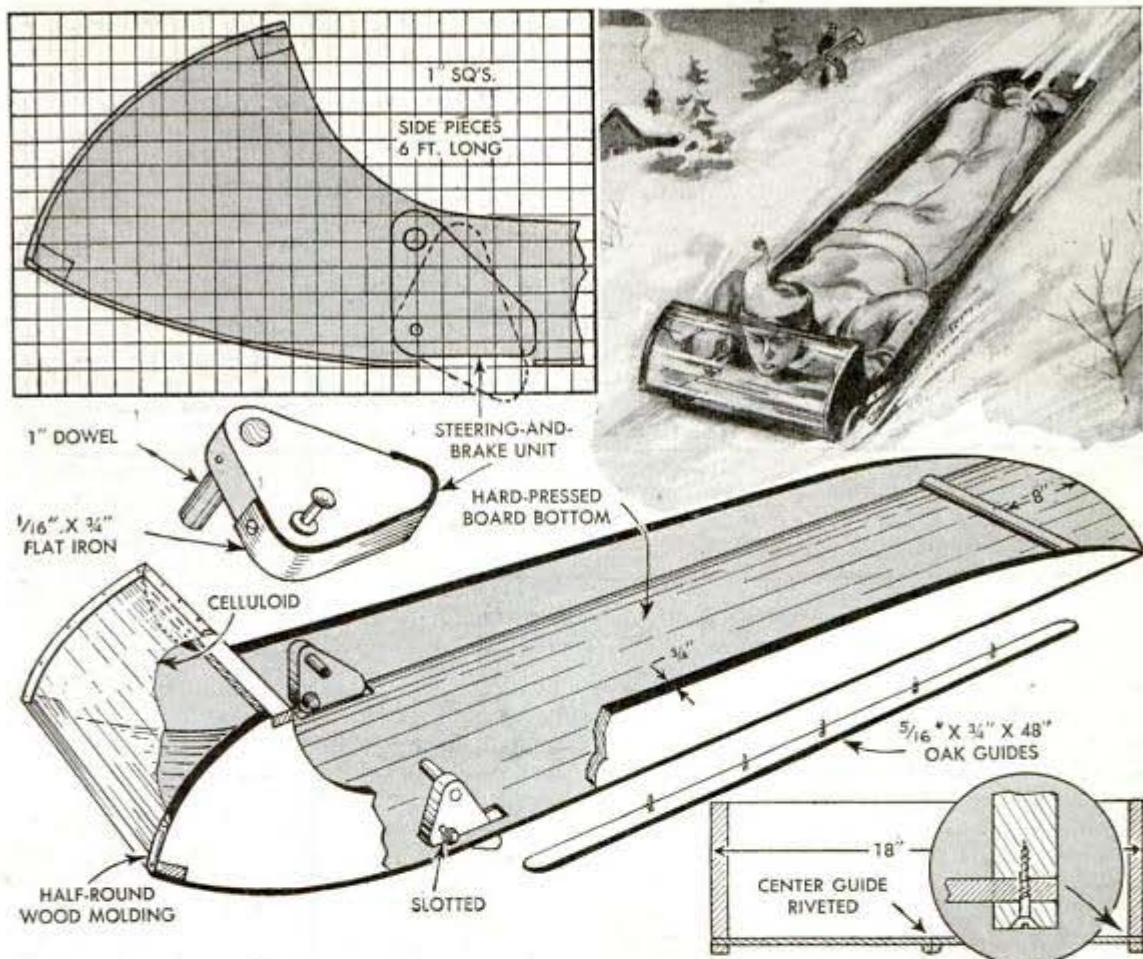
Before using inflammable solvents and ordinary paintbrushes to remove dirt and grease from a car motor, always disconnect the battery leads. This eliminates one danger of serious fires when doing such work, especially where brushes are used that have metal bands around them, as these might cause a short circuit accidentally and ignite the solvent.—L. C. Fry, Atlanta, Ga.

Food Grinder Serves as Clamp When Gluing Small Parts

When several small pieces of wood are being glued together and regular clamps are not readily available, it is often difficult to apply adequate pressure on the pieces while the glue dries. However, if an ordinary food grinder is at hand, the clamp on it can be used for the purpose. It's best to dismantle the grinder entirely so that the handle will not interfere with screwing it onto the work.



Coaster Has Sides and a Built-In Windshield



Icy winds will not sting your face when you ride this coaster because it has a celluloid windshield. And, instead of wearing out the toes of your shoes in guiding it, steering is done by means of two iron-shod blocks, which are forced down through slots to cause a drag that turns the coaster to one side or the other. When both blocks are forced down, they act as a brake. The

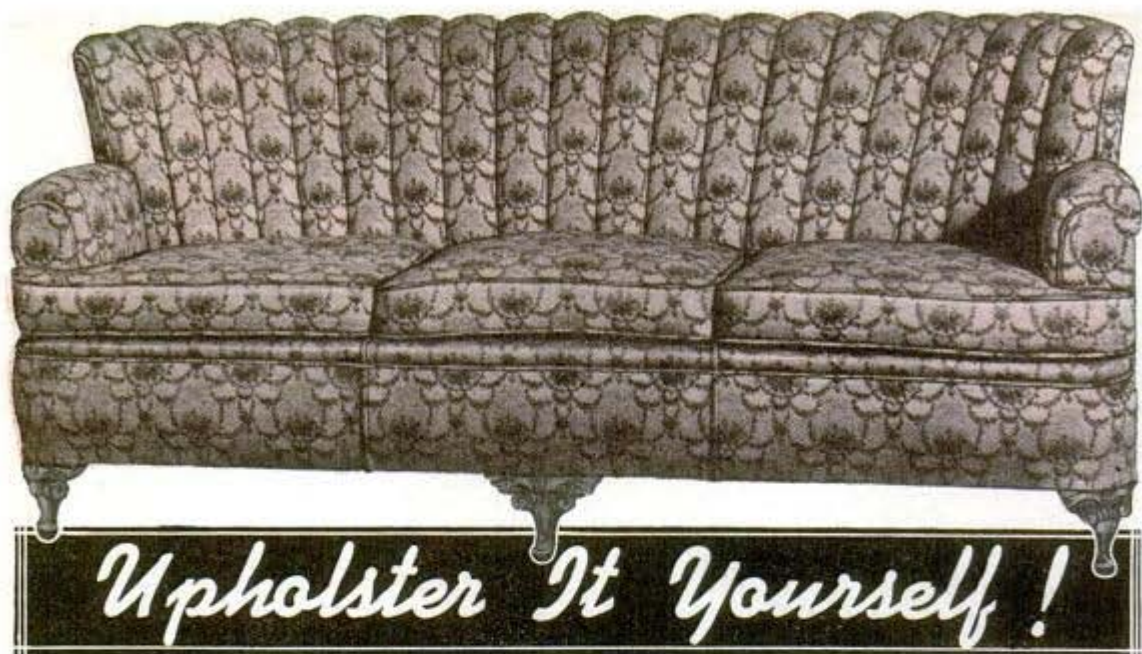
side members are notched for two cross-pieces at the forward end. The bottom of the coaster is made of tempered hard-pressed board glued and screwed to all contacting surfaces. Three guide battens keep the sled on a straight course, the center one being riveted to the bottom, the outer two attached with screws driven through the bottom into the side members.

Keep Your Flashlight Clean to Get Maximum Battery Life

Keeping a flashlight in good working order is important if you are to get maximum service from the battery. The cells are not always at fault when a flashlight burns dimly. There may be a resistance to the passage of current caused by corrosion in the switch or other parts. Or, the trouble may be caused by poor contact between the cells. When this is the case, a metal disk, preferably copper, placed between the cells as indicated usually clears up the trouble.



(T)o move a refrigerator easily, wet the linoleum under it and rub on cake soap. This will make the refrigerator slide easily.



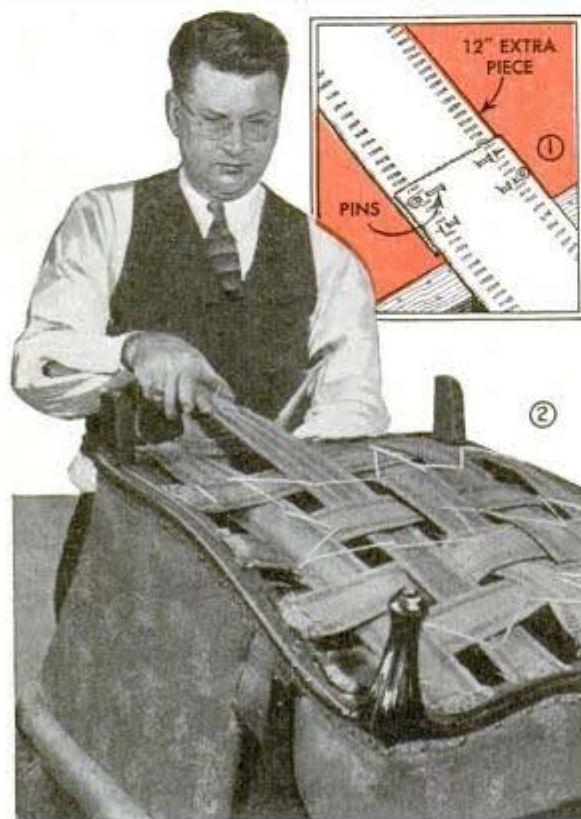
By Charles E. Troutt

UPHOLSTERING old living-room furniture to renew it and give it many additional years of service requires only a few inexpensive tools. You can cut the new covering without worrying about it fitting, as the original material, if removed carefully, will provide a perfect pattern. Other than the covering selected, there will

be little new material needed, the old springs, stuffing, webbing and burlap being reused to cut down cost. In some cases, however, additional stuffing such as hair, moss, fiber, etc., may be required. In all cases, a small amount of layer cotton will be needed. These items are available from upholsterer's supply houses and most large department stores and mail order houses.

For upholstering furniture successfully, the following tools will be needed: A pair of scissors, ice pick (used as a regulator for shifting filling in stitched edges), tack hammer, a dozen upholsterer's pins, one 7-in. curved upholsterer's needle and one smaller curved needle (size from 3 to 5 in.). If the piece of furniture to be recovered has a web base, you will also need a webbing stretcher, which can be purchased or made easily in your own shop. These tools are shown in Fig. 3.

Removing old cover material: As this will be used as a pattern for cutting the new cover, it should be removed carefully. A screwdriver and wooden mallet or hammer are satisfactory for this purpose. In removing tacks, place the screwdriver under the material, next to the frame and against the tack as in Fig. 4. A few light taps with the mallet, and the tack is out. Do not pry the tacks out by twisting the screwdriver, as this will damage the wood. Label each piece of the old cover as it is removed and make any notes which might help you in fitting the new cover. On some pieces of upholstered furniture, it is necessary that

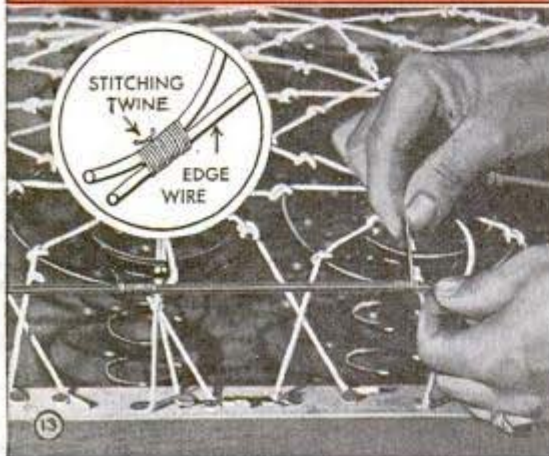
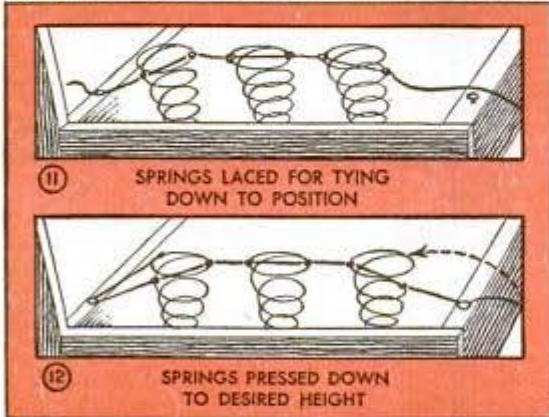
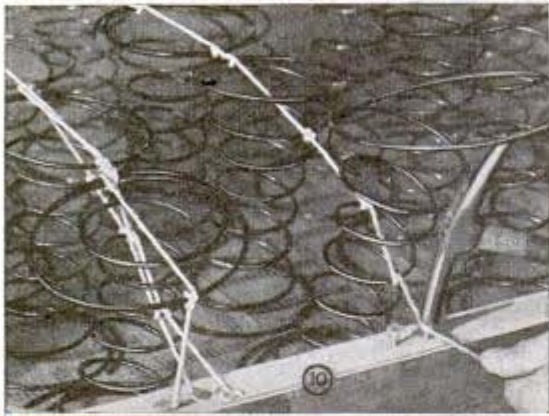
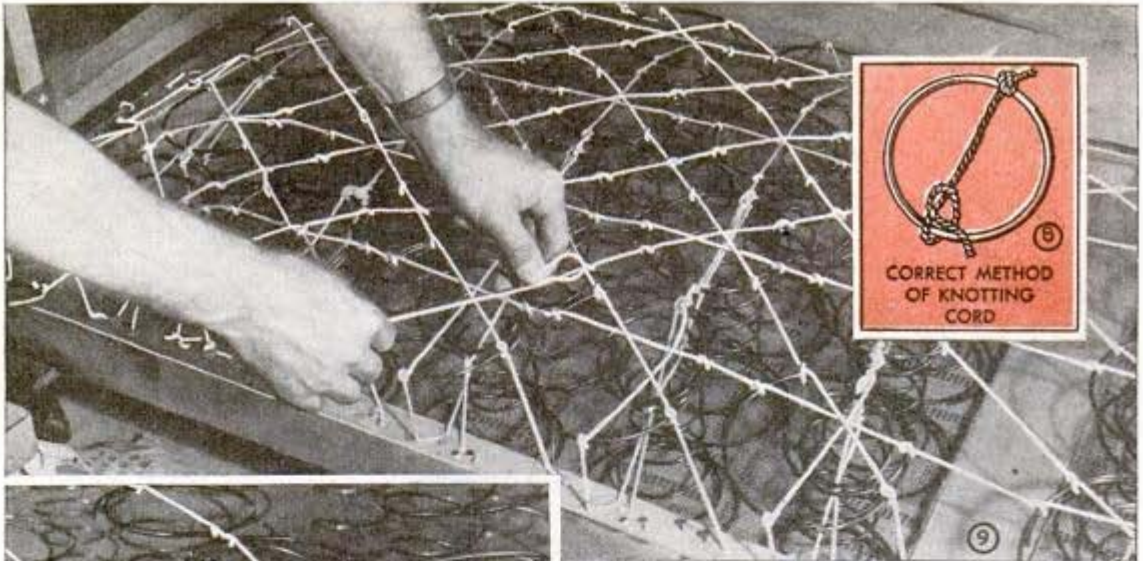




the arm covering be put on before covering the back. Sometimes the reverse is true. Note also whether the back cover material is tacked to the inside or front of the back leg. If your divan has a piped back like the one at the top of the opposite page, the position of these pipes should be marked on both the top and bottom rails as the cover is taken off. The burlap or other spring covering should be removed also, as in most cases it is necessary to straighten and retie the springs. After all cover material and filling have been removed, the frame should be examined for loose joints and repaired, using glue, new dowels, corrugated fasteners, hardwood corner blocks or other means to strengthen it. Any exposed wooden parts such as legs or top back rail in need of refinishing should be done at this time.

Repairing web base: If your furniture has bar springs (springs mounted on metal bars), examine these for loose nails. Bent bars should be removed, straightened and renailed. If the piece has a web base, check for sagged webbing. In case this needs repairing, first remove the tacks from one

end of a piece of webbing. Then, pin a piece of this material to the loose end, making the lap the length of the piece turned over on the old webbing as in Fig. 1. This extra piece (about 12 in. long) is pinned to the old webbing to facilitate the use of a webbing stretcher as shown in Fig. 2. If the webbing is too frayed for the pins to hold sufficiently, it may be necessary to clamp two hardwood blocks over the joint and draw them up tightly with a C-clamp. Stretch one piece at a time and tack with four or five tacks (6-oz. size). Remove the extra piece of webbing, fold back the end of the piece you have stretched and tack with an additional six or eight larger tacks (12-oz. size). If new jute webbing is not available, a heavy cotton webbing will be entirely satisfactory in the event you pre-



fer to renew the old webbing completely. New webbing is laced as shown in Fig. 7, then pulled taut with a stretcher held as shown in Fig. 5.

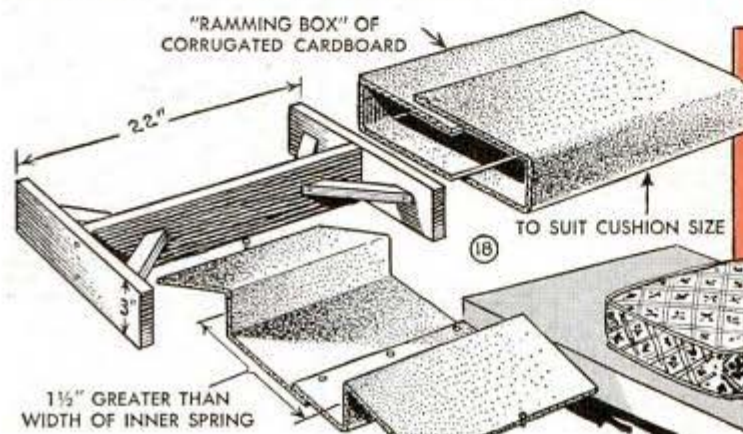
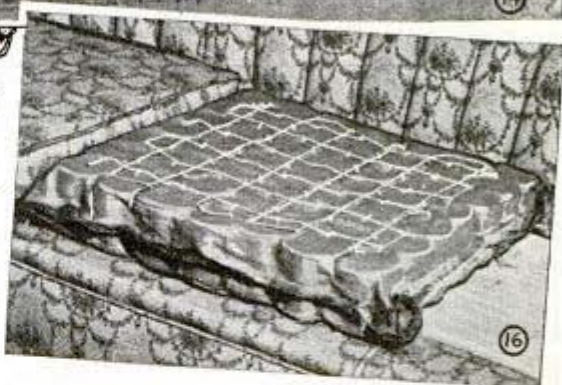
Retying springs: Many times a new upholstery job is necessary because the springs have shifted their position with use. For this reason, the springs should be fastened securely to the webbing in the manner shown in Fig. 6. Fasten each spring in four places, using regular upholsterer's stitching twine. At each point of fastening, tie a good knot on the bottom. If a spring is merely sewed round and round, it will shift in the event the twine breaks at a later date. Proper tying down of springs is a large factor in both the comfort and long-wearing qualities of an upholstery job. Detailed procedure for this important operation is shown in Figs. 9 to 12 inclusive. Note in Fig. 11 that the twine is tacked to the back rail first and tied to the rear side of the rear spring about two coils down from the top. Note also that the springs are tilted slightly toward the back as they are tied so that when the springs are pressed down to the proper height, Fig. 12, they will be pulled into an upright position. The twine is looped (not tied) around the front spring as shown in Fig. 10 and anchored to a large-headed tack driven into the rail. The looping permits shifting the spring into an upright position, after which the twine is carried up over the top coil to which it is tied and then carried back across the top for a distance of two or three springs where it is finally tied (study Fig. 9). Now, a second twine is run back up through the front spring parallel to the first piece which was only looped, but this time tying the spring. This step is shown completed to the left in Fig. 10. The proper method of knotting the twine is shown in Fig. 8.



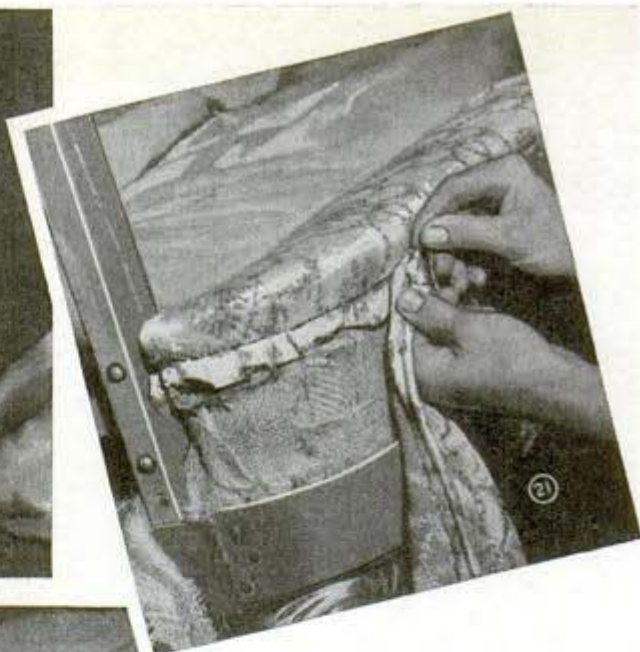
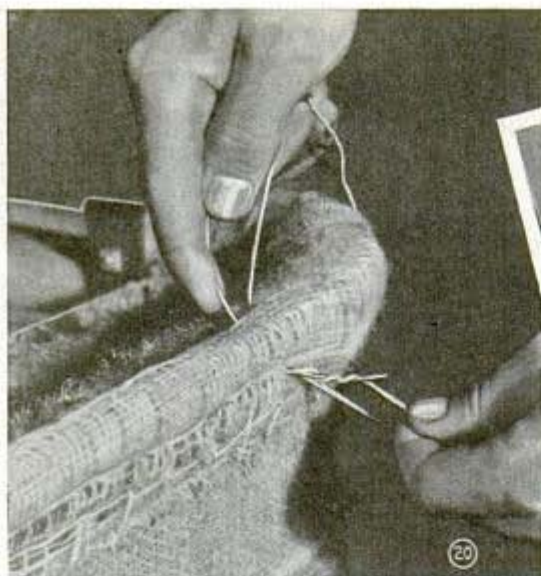
(15) CORRECT WAY TO SEW WELT CORD TO CUSHION TOP AND BORDER

Each row of springs is tied from back to front first, then from side to side and finally, diagonally as in Fig. 9. Note that the twine is tied to every piece of twine which it crosses between springs, in addition to being tied at every point where a spring is touched. Tying the edge wire to the front row of springs with stitching twine is done as shown in Fig. 13. Springs in the back are treated in the same manner as those in the seat, except for the edge wire, which is omitted.

You are now ready to cover the springs with burlap. If there are any holes in the old piece, they can be patched with material from a burlap bag. In the event the burlap is not in condition to use again, it can be replaced with Osnaburg or denim, which are entirely satisfactory as substitutes. Cover the bottom springs first. Next,



(19) HOW BOX AND RAM ARE USED



cover the back springs, tacking the cover to the bottom rail first, then to the top rail, beginning near the center as in Fig. 14.

Re-covering the cushions: At this point, the cushions should be re-covered, as they will be used later to determine the amount of stuffing needed for the arms and back, which are filled out to the cushions. By using the old cushion covers for patterns, cutting new ones is a simple procedure. You will, of course, have to use new welt cords. A welt cord is made by covering a heavy cord with top cover material and stitching on a machine close to the cord as shown at A in Fig. 15. A half foot, which is standard equipment on most home sewing machines, is used in the stitching. A piece of material $1\frac{3}{8}$ in. wide is sufficient to cover the cord and allow for sewing to the cushion on three sides. Detail B shows how the top and border pieces are held for stitching to the welt which conceals the raw edges when the cover is turned inside out as at C.

Some new cotton is necessary in covering the spring units, Fig. 16, as old cotton is usually packed and lumpy. Smooth out

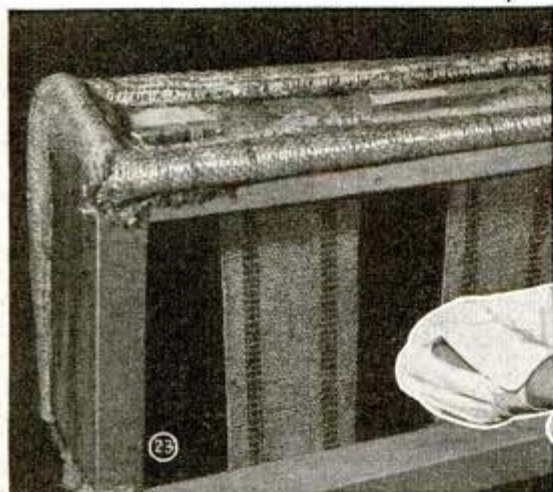
the lumps in the old cotton and tear off even with the edge of the spring unit. Then, wrap the unit in a layer of new cotton, letting this layer project over the edge as in Fig. 17. One layer of new cotton is sufficient where old cotton is also used. To slip this unit into the cushion cover without displacing the cotton layer requires a stuffing jig like the one shown in Fig. 18. This jig consists of a ram and a box in which the cotton-covered spring unit is

placed, after which the cushion cover is pulled over it. The ram is used as in Fig. 19 to hold the filling in place while the box is being withdrawn. The open end, which should be at the back of the cushion, is hand sewn.

Stitching the roll edge: If you like, the old roll edge can be used. Any soft spots should be regulated by inserting an ice pick through the burlap and shifting

APPROXIMATE YARDAGE OF COVER MATERIAL REQUIRED

Kind of Furniture	No. of Cushions	36-in. Fabric	50 to 54-in. Fabric
Wing chair	1	9 yards	5 yards
Wing chair	None	7 "	4 "
Club chair	1	7½ "	5 "
Club chair	None	5½ "	4 "
Wooden arm chair	None	2 "	1½ "
Arm chair (seat only)	None	¾ "	¾ "
Boudoir chair	1	5½ "	3 "
Boudoir chair	None	4 "	2½ "
Loveseat	2	12 "	7½ "
Loveseat	None	10 "	6¼ "
Divan (69 to 84-in. back)	3	16 "	9½ "
Divan (60 to 84-in. back)	None	10 "	7 "
3 piece suite	5	32 "	19 "



enough filling from other places to fill the soft spot. This regulating should be done as the roll is restitched. When restitching, start the needle in the front edge pointing up and permit it to go behind the edge wire. In returning the needle, go in front of the edge wire as in Fig. 20. Wind the twine around the needle as shown and pull tight. Repeat this operation until you have covered the entire front edge. If your job differs from this, replace the front edge as it was originally.

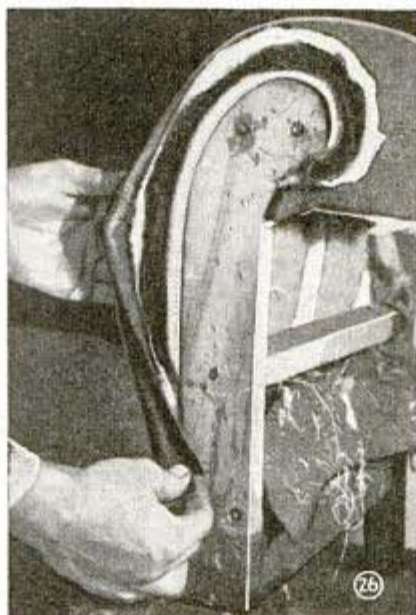
Putting on the top front band: The top front band consists of three pieces of the new material with a welt cord sewed between them. The center piece of the front band should be the same width as the center cushion and should match the pattern in the cushion material. Use your old cover for a pattern.

Before attaching this band to the divan or chair as the case may be, sew it to a piece of under-cover material large enough to cover the seat springs. Cut this piece amply large, as it can be trimmed after tacking. Under-cover material, which will be directly under the cushions, can be of denim. Or, you can use service velour or sa-teen, if desired. Pin the completed front band to the burlap to hold it in place. Then, stitch the back edge of the burlap at the point where the denim is joined, catching under the springs wherever possible. Use a curved needle and stitching twine. Put an even layer of cotton under this band, tear-



ing it off even with the front edge. Pull the band down over this filling and hand stitch beneath the roll. A completely sewed top band is shown in Fig. 21.

Making the bottom front band: Also made in three pieces, the bottom front band has a welt cord sewed between each piece and along the top edge. This front band should be cut from the cover material so that the design will appear to continue down from the top band. Hand stitch this to the top band as in Fig. 21, running it straight and using a blind stitch, which is made by first inserting the needle through the top band, then through the inside of the welt cord on the bottom band.





sign is in the center. Tack the cover to the bottom rail (over the top of the seat cover), using only a few tacks. These tacks may have to be removed to make the pattern run straight. Put plenty of filling on the inside and over the top to give a nicely rounded arm, stitching the filling to the burlap in the same manner as the filling was stitched to the bottom. Large

tacks will hold the filling in place on top of the arm. Pull the cover material up over the inside of the arm, tack it to the bottom of the front post and then pull the material tightly over the post at the front edge and tack. Fig. 26 shows an arm properly filled. Note the roll around the inside edge of the post. Now tack the cover to the front edge of the post and pull the material tightly

toward the back of the arm and tack. Mold the filling to the proper shape by patting with the palm of your hand, bearing in mind that the filling always should follow the contour of the arm. Begin this patting process at the front and tack the cover under the arm as you go. Tack to the back post on the side or edge. This operation will depend on the manner in which your divan or chair was upholstered originally. Pull the cover around the inside of the front post, splitting where necessary to make a smooth fit, and tack to the front of the post as in Fig. 27. Pleat the material as you go around the top curve. The back covering of the divan is usually put on before putting on the outside arm covers.

Covering the back: Ordinarily, the back is in three pieces to match the design of the cushions and front bands, a welt cord being sewed between each of the panels. Turn the divan on its back and put in a layer of stuffing, stitching it to the burlap as you did before. It is necessary to have more filling in the back than was used in the seat, and it is also necessary that you take closer stitches. The back should be stuffed out far enough to reach the cushions. Cover this stuffing with a layer of cotton, letting the cotton stick up far enough to pull over the top of the back rail. Tack the cover to the bottom rail first and proceed in the same manner as you did with the arms, tacking to the back side of the top rail and to the back posts. If the piece has a piped

When pulled tight, the stitch will not show on the surface. After this second band is attached at the top, turn the divan over on its back and place a layer of cotton all the way across under the band. Then pull the cover material down smoothly over this layer of cotton and tack underneath the bottom rail. If there is a finished bottom rail, tack the band to the top of the molding, cover the edge with gimp and fasten either with gimp tacks or antique nails.

When the front bands are finished, cover the seat of the divan with a thin layer of the old filling (hair, moss or fiber), stitching this to the burlap spring cover with three rows of long stitches to hold it in place. After this is done, cover the filling with a layer of cotton as in Fig. 22. Note that the under-cover material is turned back. Draw the under-cover material over the filling evenly and tack to the back and side rails. Do not use too much filling as the seat should always be lower than the front edge, otherwise you will be able to see under the front cushions.

Covering the arms: Put the cushions in place before covering the arms, as these are stretched out to meet the cushions. Furniture having wide, flat arms such as shown in Fig. 23, should have the edges built up with roll edges to improve the appearance and make the piece more comfortable. Cut the cover material for the arms, using the old pieces for patterns. If new cover material is of a floral design, be sure the de-

back, it will be stuffed in the manner shown in Fig. 25, stuffing one pipe at a time and hand stitching it to the burlap.

Putting on the outside arm covers: The outside arm covers come next. First, the material is tacked to the rail directly under the arm, Fig. 24, using a cardboard strip to give a straight edge here when the material is drawn down and tacked under the bottom rail. Finally, re-cover the front post panels and nail them on with 1¼-in. brads, cutting the heads off before driving them in as in Fig. 28. Pull the cover material over the headless nails by sticking an upholsterer's pin into the material and lifting.

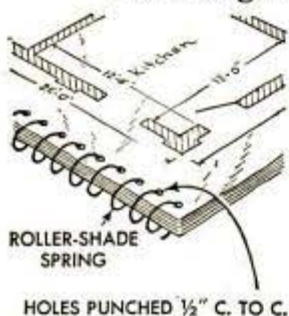
Putting on the outside back: Gimp tacks can be used to apply the outside back cover or it may be blind-sewed, using the same stitch as was used in attaching the second front band. Covering the bottom with cambric completes the job.

Small Magnet Holds Oil Can Caps Conveniently at Hand

You will not be apt to misplace the caps from an oil can when removing them if you solder a metal clip onto the can top to hold a small horseshoe magnet. This provides a convenient place to store the caps where they will always be at hand, even if the can is moved before replacing them. In cases where cans of this type have been used for transporting gasoline, they should be cleaned thoroughly before soldering the magnet holders in place.



Shade Spring Provides Binder For Large Blueprints



This is done by punching equally spaced holes along one edge of the sheets and then threading the spring through them by turning it from one end.

—A. E. Ogren, Chicago.

Nail Polish Brushes Are Handy For Children to Paint With



Instead of discarding the small brushes used in bottles of nail polish, save them for the children to use as paintbrushes. They can be washed in turpentine. They are much easier for small children to manipulate than larger brushes, and the little knobs on the ends are easy for small fingers to grip.—Benj. Nielsen, Aurora, Nebr.

Adhesive Left by Masking Tape Removed Easily From Work

Sometimes small patches of the adhesive will remain on the work when masking tape is pulled off. However, if a new strip of tape is pressed adhesive down over the patches they usually will adhere to it and come off when the strip is removed.



Speedy and Thorough Tool Oiling With This Handy Oiler



To speed up the job of oiling hand tools and, at the same time, make the job less disagreeable, one carpenter carries a handy oiler made from a length of 1-in. tubing or pipe and oiled cotton waste. The tube is packed with oiled waste, and in use, a portion of the waste is pressed out the end of the tube as shown.

Wedge Washer Locks Nut on Bolt



When using a bolt where vibration is likely to loosen the nut and there are no lock washers at hand, make a wedge washer by tapering an ordinary flat washer along one side. When a nut is driven down on the tapered washer, the bolt is twisted slightly to one side so that the threads will hold securely.

Old Clocks Fitted With New Faces By Photographic Process

The difficulty of obtaining new faces for old clocks and the high cost charged by commercial artists to paint special ones, led one jeweler to use his photographic equipment to solve the problem. This was done by removing the hands from a new clock so that a closeup photograph could be taken of the face, after which the nega-

tive thus obtained was used to make enlargements of any size desired. Only a few minutes are required to fit and glue these new faces onto old ones.

—Joseph Farkas, Jr., Chicago.

Tiny Wood Strips Bent Easily Without Steaming

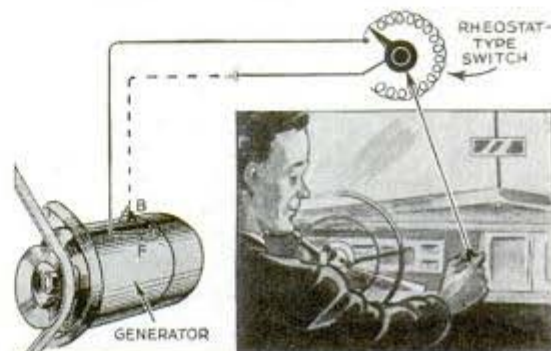
Thin wood strips used in the construction of tiny models often can be bent without steaming if they are scored as shown with a roller wheel made from a binding-post nut such as those used on small dry cells.



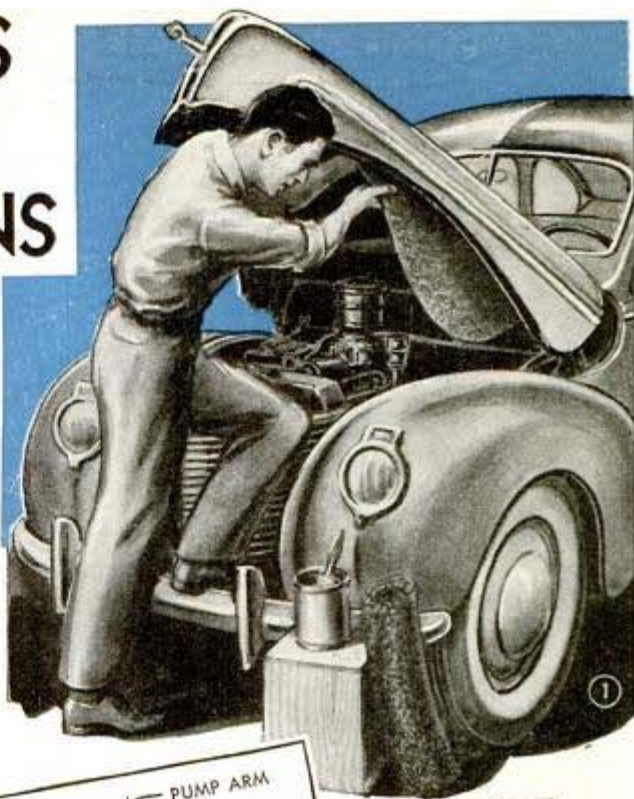
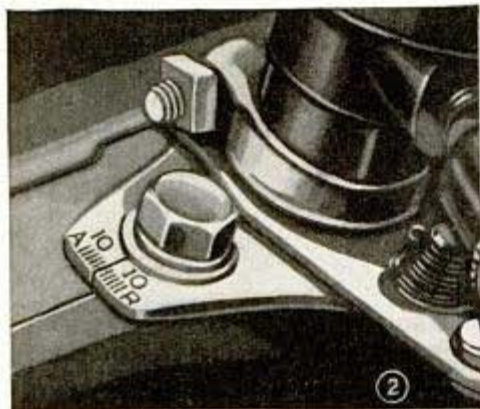
The nut should be slipped over a nail driven into a wooden handle for easy operation.

Output of Generator Controlled By a Heater Switch

If a car is used on short runs where frequent stops are made, voltage and current regulators sometimes reduce the charging rate of the generator too soon. To prevent this and keep the battery more fully charged, a rheostat-type heater switch to control the charging rate manually can be connected to the generator field terminal as shown in the wiring diagram. As most generator field circuits are completed by grounding the field terminal, the switch circuit should be from the field terminal, terminal F in the diagram, to the ground. However, as some generators complete the circuit by connecting the field terminal to the main terminal of the generator, terminal B, it may be necessary to complete the switch circuit by wiring the switch to both generator terminals as indicated by the dotted line. Turning the switch to the "on" position will give maximum output; a setting somewhere between "on" and "off" will give a reduced output.



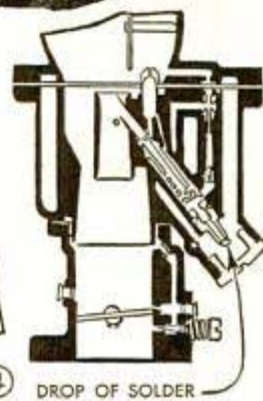
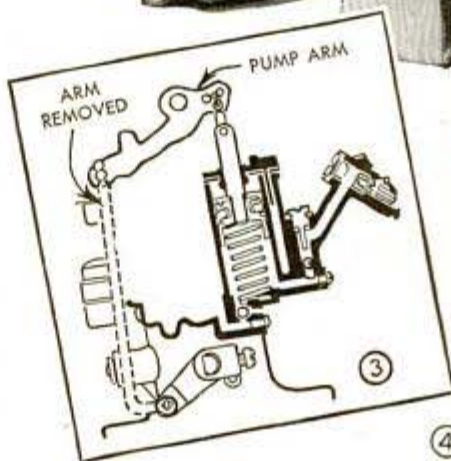
MORE MILES *from your* GAS COUPONS



By C. E. Packer

EVERY motorist realizes that peak performance of his motor plus sane, careful driving are necessary for minimum gas consumption. But, in these days of reduced speeds and mileage, keeping a motor at peak performance may be expensive and the labor shortage now evident in service work may make it impossible to keep your motor at its best. However, there are a number of things that any car owner can do to "stretch" his gasoline coupons. For example, one motorist found that it was an advantage to insulate the inside of the hood and the outside of the crankcase with thick felt building paper as shown in Fig. 1, besides, of course, using a radiator cover, to help keep the motor and oil warm while the car was parked during cold weather.

Adjusting ignition timing so that the motor will "ping" under rapid acceleration is another way that you can get maximum power out of each drop of gas. This is done by advancing the spark, Fig. 2, until you hear a ping when the throttle is opened quickly while traveling at the rate of 15 m.p.h. in high gear with the motor completely warmed to operating temperature. As all modern types of carburetors have three distinct jets that function at different car speeds, closing two of them often results in an appreciable saving of gasoline. There is a low-speed jet, which handles the



car up to speeds ranging from 25 or 30 m.p.h., a high-speed jet that operates at higher speeds, and a power jet located at the bottom of the accelerator well, which functions when accelerating, and also contributes to speed performance. By closing the latter two jets with a drop of solder on each one, Fig. 4, only the low-speed jet is left to function. If this is done, and there is no outlet from the accelerator well, the pump arm must be disconnected as in Fig. 3.

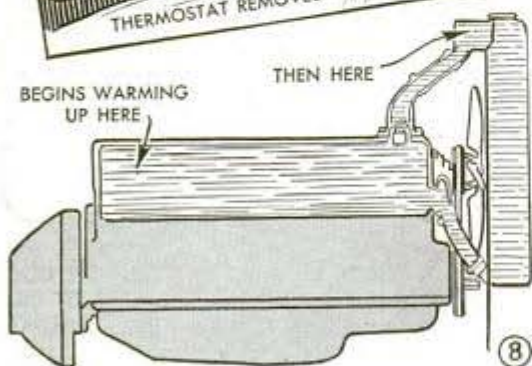
One of the most common causes of lost power and wasted gas is accumulated formations of sludge and carbon in a motor that is not being operated fast enough, far enough, or hot enough to burn them away. Changing the oil filter more frequently than is recommended for normal driving conditions will help to avoid sludge and carbon formations. A filter that is capable of picking up all sludge and foreign matter



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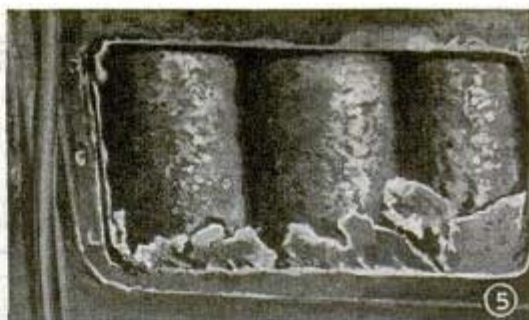


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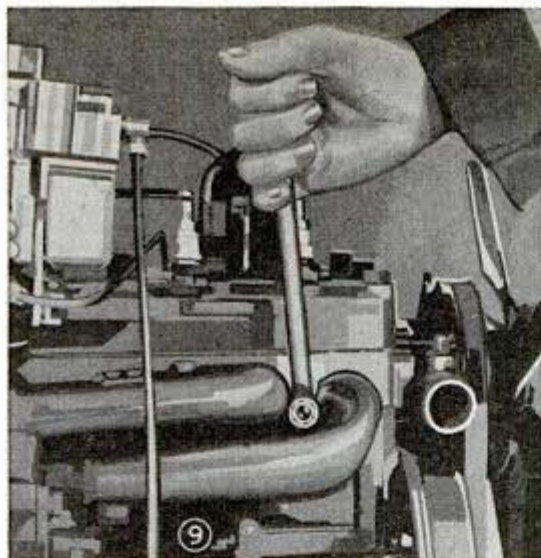
will, in addition to reducing engine wear, help to keep the piston rings free in their grooves. When rings stick, considerable gasoline is wasted through "blowby"—gases from the fuel charge passing between the rings and cylinder walls. However, "blowby" may be caused also by the cooling system. Unless this functions correctly, some cylinders may become hotter than others, or the temperature may vary at different locations on the same cylinder. This results in unequal expansion of the metal with consequent rapid wear on the cylinder walls and piston rings, which in turn causes "blowby." The cooling system should be flushed at least twice a year; the



radiator and motor block being done separately and in the direction opposite to the direction that water circulates in the system as indicated in Figs. 6 and 7. Fig. 5 shows what happens when rust, dirt and grease are allowed to accumulate and harden in the motor block.

The thermostat in the cooling system indirectly affects gas consumption. Its function is to make the motor reach operating temperature as quickly as possible and keep it there. The thermostat does this by preventing circulation of water through the radiator until motor-operating temperature is reached, and thereafter controlling the amount of water that passes into the radiator. A simple check for the thermostat is to feel the block as the motor warms up. Heat should be noticed first at the rear of the block and then at the front as in Fig. 8. However, there should be no indication of heat in the radiator until the block has become reasonably hot. If the radiator warms up at the same time as the rear portion of the motor, the thermostat is faulty. Also, if the radiator shows no sign of warming up even after the block has become hot, the thermostat is not operating, necessitating replacement.

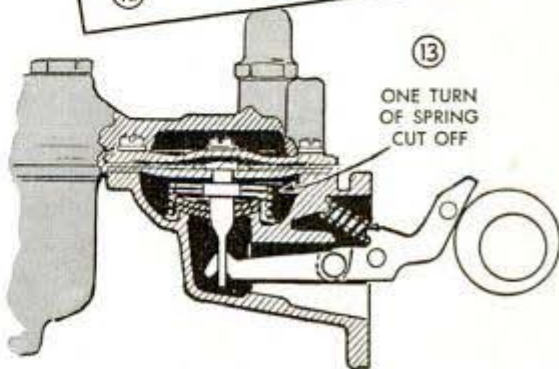
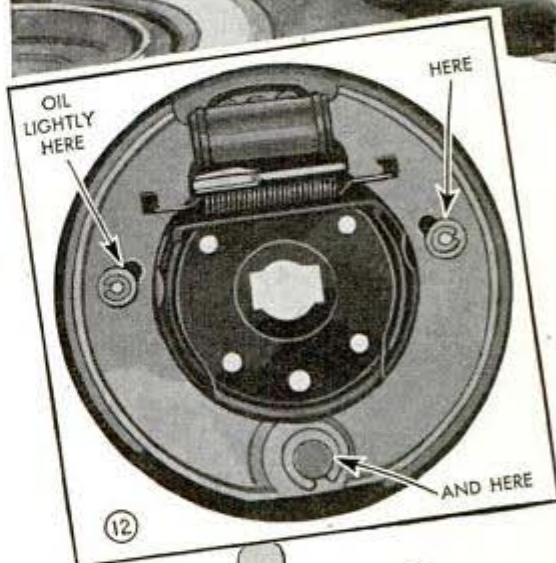
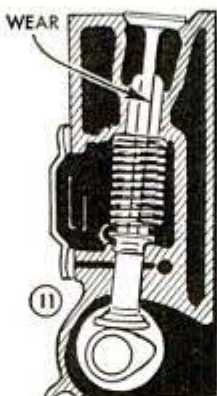
Be sure to keep the motor in good condition so that there will be no necessity for using an excessively rich fuel mixture, as for instance, when air leaks through a loose manifold, Fig. 9, between a carburetor and the base on which it is mounted or along the throttle shaft. These conditions necessitate a rich mixture to keep the motor from dying at slow speed. In such cases repairs should be made so that the carburetor can be adjusted to conserve gasoline. Similarly, worn intake-valve guides are gas wasters. Air enters around the guides, Fig. 11, making it necessary to enrich the fuel mixture. To make matters worse, oil is drawn up around the guides, resulting in excessive carbon formations inside the motor as well as a waste of oil. Carbon reduces the size of combustion chambers and restricts exhaust-gas passages, with the result that there is exces-



sive fuel consumption. This is especially true when the carbon accumulations are in the muffler, tail and exhaust pipes as it is impossible to burn fuel economically in a motor where there is back pressure due to a clogged exhaust pipe.

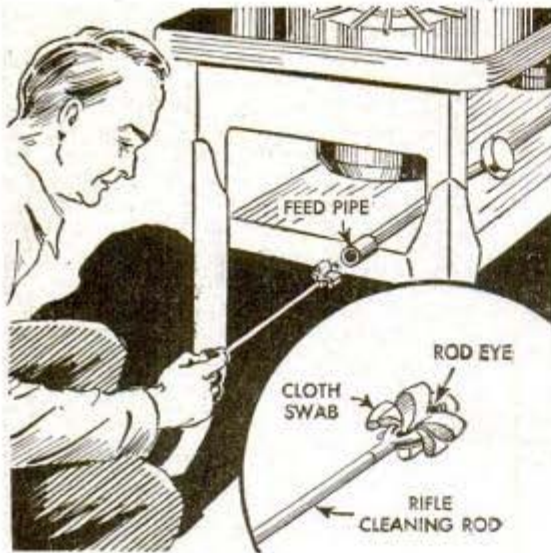
One of the most deceptive causes of lost power, with its resulting fuel waste, is a slipping clutch. A test for this is to drive at 20 m.p.h., then apply the brakes while the accelerator is pressed down. A clutch that holds will slow down the motor as the brakes are applied. Both the clutch pedal and brake pedal should have a free travel of an inch or so; otherwise the clutch may slip or the brakes may drag. It is good practice to remove the brake drums at least once a year and lubricate the moving parts of the brakes as shown in Figs. 10 and 12. And, in connection with the chassis, don't overlook heavy oil in the transmission and differential. Under present-day low speed and mileage, you can safely use light lubricants and thus reduce the lubricant drag on the motor to a minimum.

As a fuel pump is designed for general operation through the entire speed range of the car, it is possible to effect a gas saving by altering the pump when the car is driven at 35 m.p.h. or less. On examining the pump, you will notice that the fuel chamber is loaded by direct force of the cam shaft, but that delivery of gasoline to the carburetor is dependent on a spring pressure against the pump diaphragm. By removing one turn from the spring, as in-



indicated in Fig. 13, fuel pressure is reduced slightly to a point where the gasoline does not surge but will flow with less force into the carburetor. It is this surging of the fuel into the carburetor that causes a sudden rise in float-chamber level, which in turn results in a rich mixture.

Rifle Cleaning Rod Removes Dirt From Kerosene Cooking Stove



If the feed pipe of your kitchen oil stove becomes clogged, you can avoid tipping it or using other cumbersome methods of cleaning the pipe by simply using an ordinary rifle cleaning rod for the purpose. Just put a strip of cloth through the eye of the rod and insert the latter into the pipe to loosen and remove the sediment.

Hanger to Dry Rayon Stockings



As rayon stockings require from 24 to 48 hrs. to dry, a pair of wire holders like the one shown will spread the tops, which are heavier and take longer to dry, so that the stockings dry uniformly. The hang-

ers can be made from wire coat hangers, bent to the shape indicated.

—Mrs. Carl Forsgren, Seattle, Wash.

Better Success With Tree Grafts

In many cases of unsuccessful cleft grafting of trees I have found that the trouble was due to the bark being torn where the tree stock was split to receive the scion. To avoid this injury, proceed in the usual way, but before



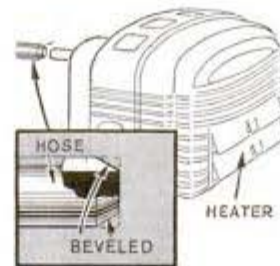
making the split in the center of the tree stock, cut cleanly through the bark on both sides with a sharp knife, making the cuts as far down the stock as the split is to extend. This will cause the bark to part cleanly without tearing when the split is made.—C. S. Marshall, Baptistown, N. J.

Cup Caster Prevents Creeping Of Washing Machine

Any tendency of a washing machine to creep toward the drain when operating it in the basement, can be prevented by putting a caster cup under one leg of the machine. The cup should be used under the leg on the high side of the floor. If the cup is put under any of the other legs, there will be a tendency of the high side of the machine to swing around.



Installing Heater Hose Easily

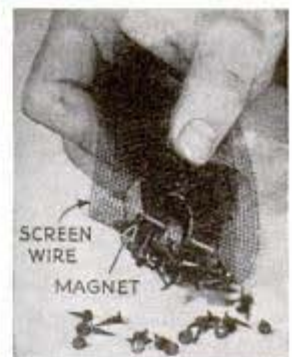


The job of installing an auto-heater hose can be simplified if the ends of the hose are beveled as shown. Beveling allows the end of the hose to stretch so that it can be pushed over the

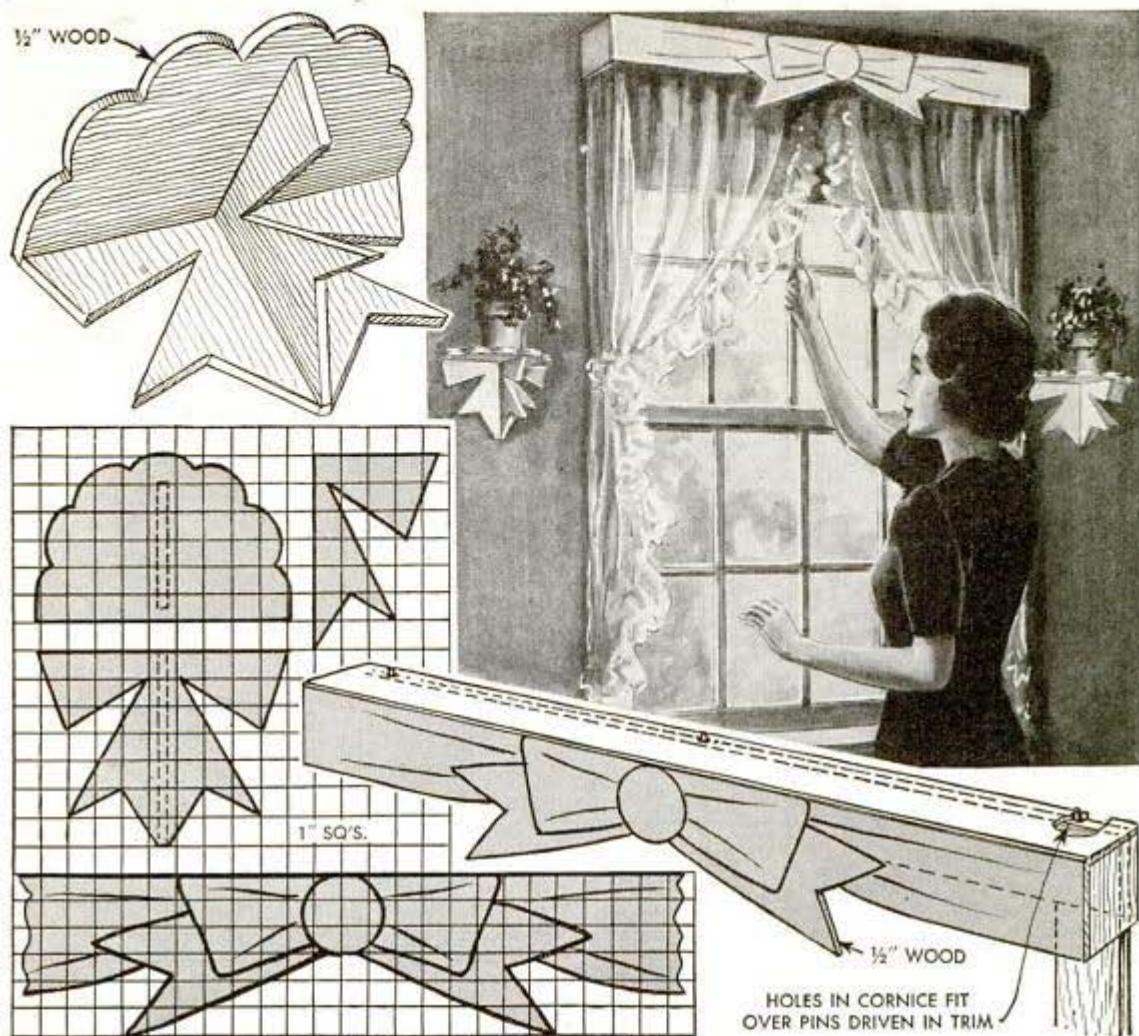
heater connections easily. Being sure that the connections are smooth and free of corrosion also will simplify the job.

Screen Wire Better Than Paper For Magnet Shield

When a sheet of paper is used as a shield to remove tacks, brads and other small articles picked up with a magnet, the paper insulates the magnet so that its strength is somewhat reduced. To overcome this and accomplish the same results, use a folded piece of screen wire instead of paper. The wire will increase the gathering area of the magnet without reducing its strength materially.



"Bowknot" Window Cornice and Wall Brackets



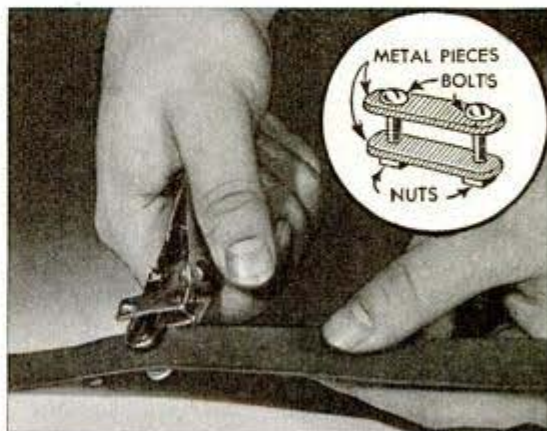
Flanked by matching flower brackets on the wall, this bowknot cornice board is effective in dressing up a window. After making patterns by drawing the designs on paper ruled in 1-in. squares, jigsaw the

cornice board to shape from $\frac{1}{2}$ -in. stock and fit it with endpieces and a top. Outline the bowknot with a paint that contrasts with the finish of the board. Use $\frac{1}{2}$ -in. stock for the wall brackets also.

Hand Punch Fitted With Guide to Space Holes Uniformly

Spacing holes at a uniform distance from the edge of paper, cardboard or leather strips will be a simple matter if your hand punch is fitted with a guide of the type shown. It consists of two metal pieces drilled near the ends to accommodate small bolts, which hold the guide in place after it has been slipped over one of the punch jaws and tightened in the desired position.

☛ If a scrap of paper sticks to your table top or other varnished surface, put a few drops of oil on the paper. Let it stand for several minutes, then rub gently with a soft cloth. This will remove the paper easily without damaging the finished surface.





By Fred G. Korth



TO BE successful in taking outstanding photographs of birds and animals, you must apply some of the same rules that are necessary in getting good photos of people. Many a photographer takes his shots straight from the shoulder, so to speak, which is a mistake since one of the first requirements in getting good animal photos is to hold the camera down far enough so that the lens will be at or below the eye level of the subject being photographed. To illustrate the importance of this, suppose that you are going out for an unusual photo of a dog, and you find a small, likely subject being taken out on a leash. If you were to hold the camera at a height of about 5 ft. the resulting picture could be entitled "man with dog," but by holding the camera about 5 in. or so above the ground, at or below the eye level of the dog, you would have the opposite effect, and it could be entitled "dog with man." In the first instance the dog would be subordinated but in the latter case the dog would be the center of interest and the man would be subordinated in importance. When taking a picture of a flock of turkeys, a low position of the camera is just as important. On the average turkey farm

where the birds are kept behind a fence, amateur photographers often step up and take a picture of the flock from the top of the fence. The result is similar to Fig. 6, which is not an interesting, effective photo. The way to get a good photo is to hold the camera as low as the grass will permit, being sure that there is no fence wire in front of the lens, and being as close to the flock as is possible, because a closeup photo showing a few birds of the flock is much more effective than a photo of a whole flock taken from a greater distance. The result of such a closeup picture is shown in Fig. 5.

Besides the position of the camera, the photographer must decide whether a closeup study of an animal itself is desired, or whether the photo is to stress the characteristic activity of the animal in its environment. Figs. 1 to 4 inclusive show the first purpose—treating the animals as individuals—while Figs. 5, 7 and 9 illustrate pictures of birds and animals in their natural surroundings. Usually a pet may be taken closeup with a greater degree of isolation than is possible in the case of barnyard animals or wild animals. A little thought concerning the natural instincts, habits and reactions of animals will help to get pictures of unusual interest. For instance, a lost fawn misses its mother, wants to be fed and will suck anybody's finger, which led the photographer to take the photo shown in Fig. 8. In this case the boy was made to



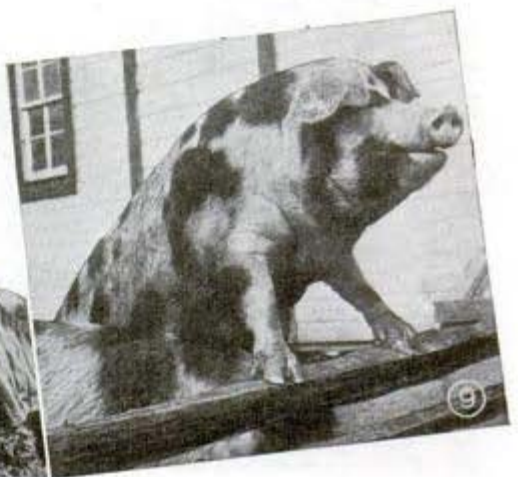
sit down to prevent dwarfing the fawn, which would result if he were standing.

Fig. 1 shows two Scottie pups placed in a basket, which was used for two reasons: to keep the pups from running away and looking in different directions, and also to minimize their size. In addition to this, the basket served to provide contrast against their dark fur. In Fig. 3 a kitten was held

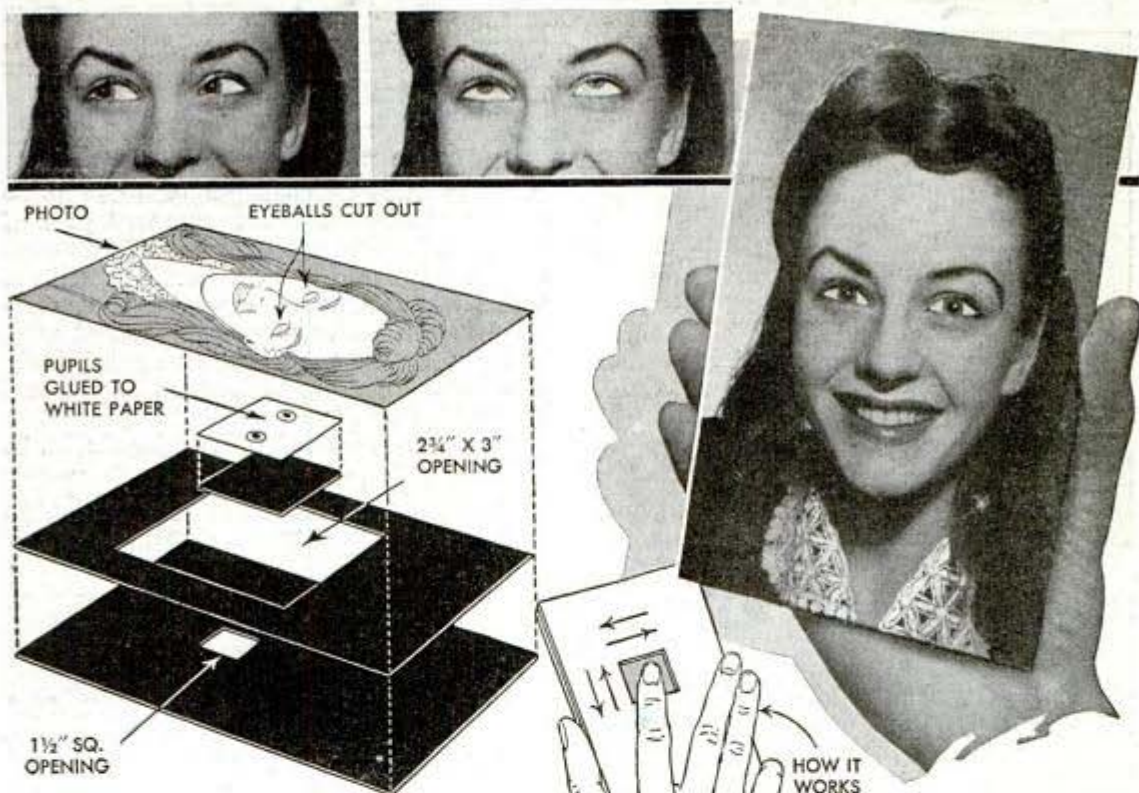




in two hands which gives a clue to its size, brings out the pet angle and also enables the photographer to keep the kitten in focus and in the desired position. Larger animals cannot be confined in this way without introducing the element of restraint. To give them the air of independence they should be photographed without being held or confined unless such angles as their friendliness and devotion to people are to be emphasized. Cats and kittens, left free to run and jump around, are extremely difficult to photograph in interesting poses. Only dogs, generally, can be made to remain in a desired position. In Fig. 9, the hog was lured to assume the position shown momentarily, which gave the photographer an opportunity to shoot the picture. As exposures must be short when taking animal pictures, flashbulbs, if obtainable, are best to produce highlights and reflections on animals having dark fur, and birds having dark feathers. Photo-flood lamps are next best for illumination if the pictures are taken indoors.



Movable Eyes Change Expression of Portrait



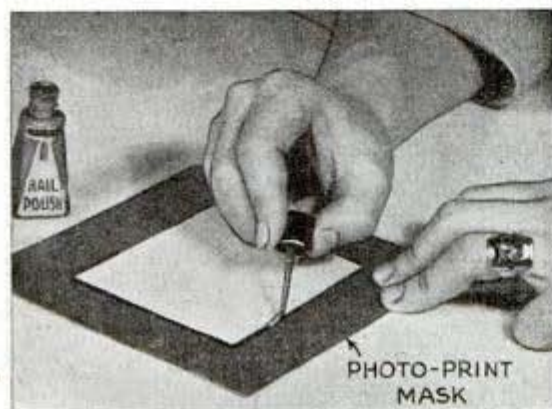
You can have a lot of fun with a portrait by removing the pupils and white portions of the eyes carefully with a razor blade and mounting the pupils on a piece of white or light gray paper glued to cardboard so they can be moved when holding the photo in one hand. The paper to which the pupils are glued should match the sheen of the photo as much as possible, preferably the same paper. The only other materials needed are two pieces of cardboard with openings cut in the center of them as indi-

cated. When glued together, these provide a stiff backing for the photo and they also hold the cardboard on which the pupils are glued in place. After the glue has dried thoroughly, edges of the backing can be trimmed neatly to conceal it. Or, you can improve the appearance of the portrait by fitting it in an attractive frame. The index finger only is required to move the eyes while holding the photo.

Nail Polish Cures Fuzzy Edges of Paper Printing Masks

A little nail polish used on the edges will make a paper printing mask smooth so it

will leave clean, sharp edges on the prints. Draw the polish brush firmly against the edges, in one direction, to press down and anchor any loose fibers.

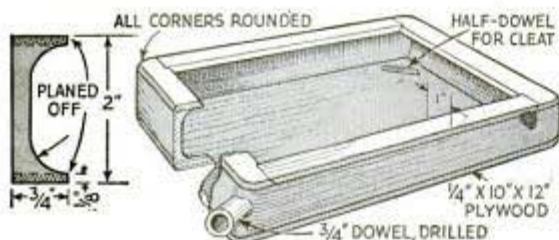


Scoop Improvised From Old Film

Sheets of old film are handy to use as improvised scoops for weighing out chemicals in the darkroom. Two corners of a film are fastened together with a paper clip to form a scoop, which can be used once and discarded or saved for future use.



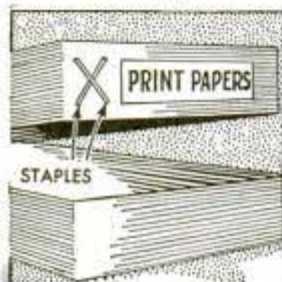
Nonspilling Photographic Tray Made Entirely of Wood



Concave sides that reverse the surge of the liquid and direct it back toward the center, prevent splashing and spilling of solutions while this wooden photographic tray is being rocked. Plywood or hard-pressed board is used for the bottom, while the sides are shaped from $\frac{3}{4}$ -in. solid stock. Plastic glue and nails are used to fasten the parts together. A hollow dowel in one corner, which is plugged with a cork while the tray is in use, makes it easy to pour the solution back into a bottle. Coat the entire tray with waterproof glue mixed to the consistency of thick cream, applying a second coat when the first becomes tacky. A half-dowel cleat tacked to the bottom, diagonally across one corner, keeps prints from sticking to the bottom.

—Edwin M. Love, Monterey Park, Calif.

Print Paper Identified in Dark



Different grades of sensitized paper will be easy to distinguish without turning on a bright light if each box is marked with paper staples. The different boxes can be rec-

ognized instantly by running a finger over the staples, using any simple code, such as one staple for No. 1 paper, two staples for No. 2, and more staples for other grades. Location of the staples on the box can be used to indicate different surfaces.

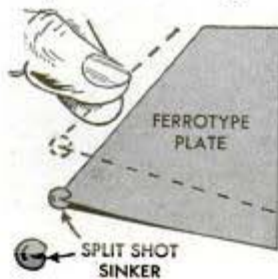
Permanent Titles on Photos

White titles on dark portions of photographs can be made a permanent part of the print by this simple trick. Fill a fountain pen, the "dime-store" variety will do, with hypo and, before exposing the sensitized paper, write any data desired with this pen on the part that will print dark. The hypo fixes the writing so it will not be affected by the subsequent exposure.

—Andrew M. Lavish, Washington, D. C.

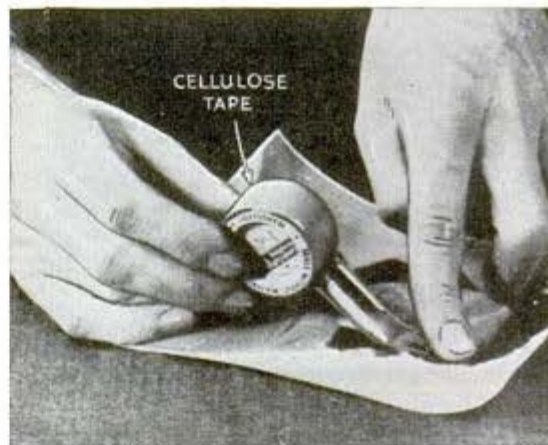
Shot Sinker on Ferrotypes Plates Make Them Easy to Pick Up

To simplify picking up a ferrotypes plate from a flat tabletop, one amateur photographer clinches a split-shot sinker on each corner. The sinkers elevate the corners of the plate so that a fingernail may be inserted under the edge easily. If your plates have sharp corners, the sinkers will cover them and make injury to the hands impossible.



Removing Lint From Photographs

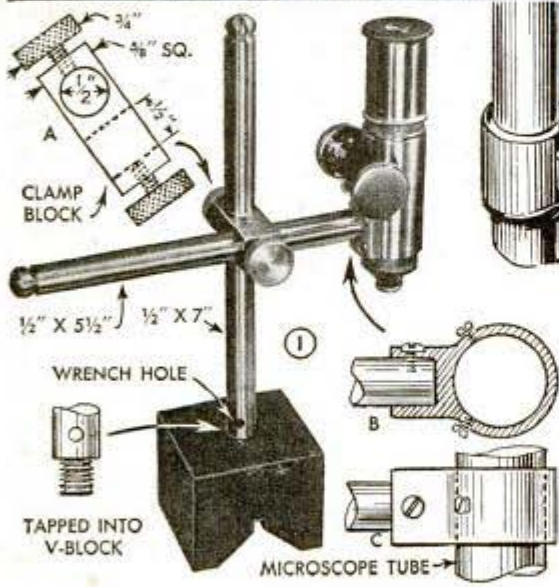
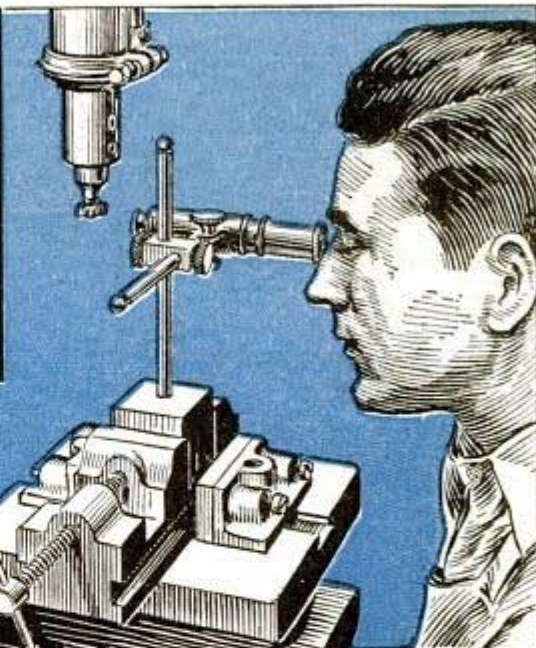
Lint picked up by photos dried between blotters can be removed with cellulose tape. Just place the tacky side of the tape in contact with the portion of the print to be cleaned and when it is drawn away the lint will come with it. The tape may be used repeatedly for the same purpose.





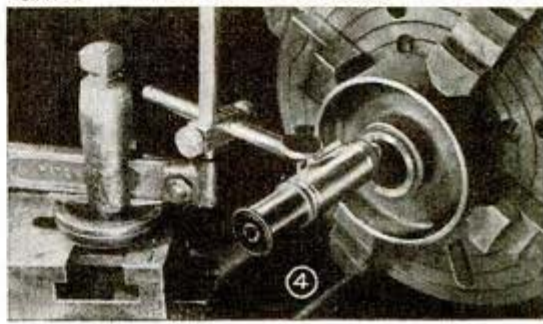
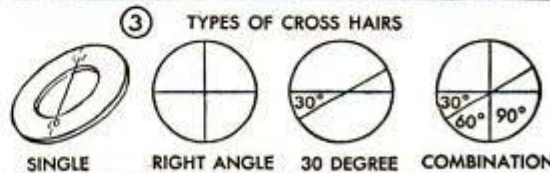
SHOP NOTES

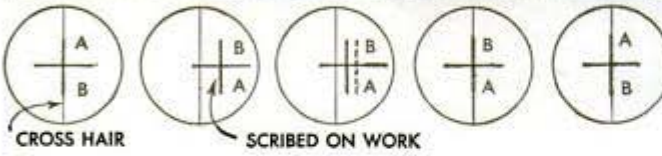
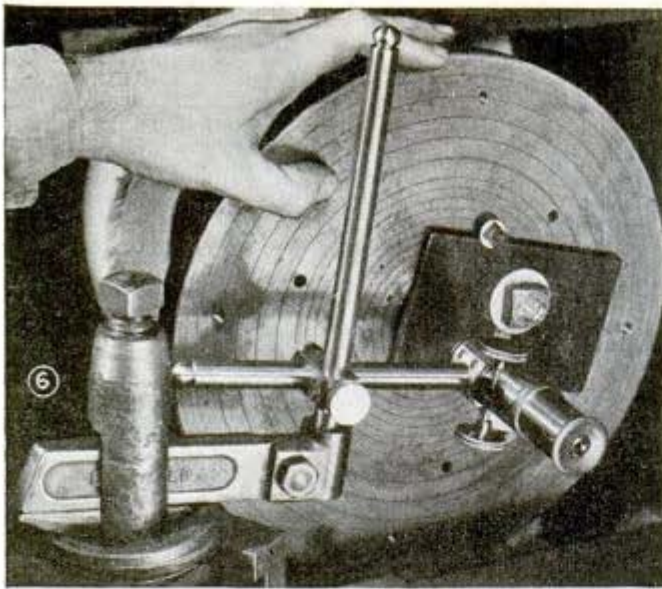
Precision MEASURING with a MICROSCOPE



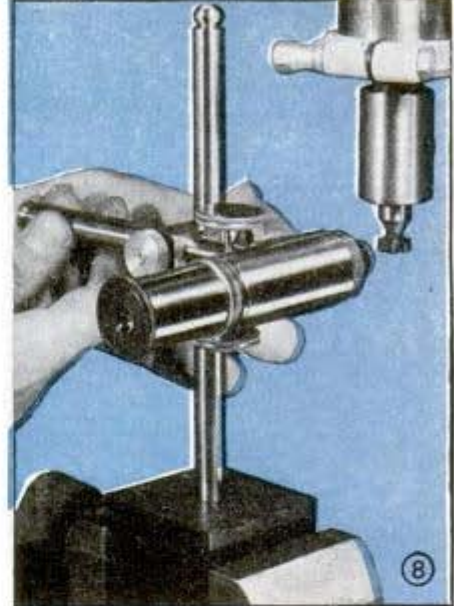
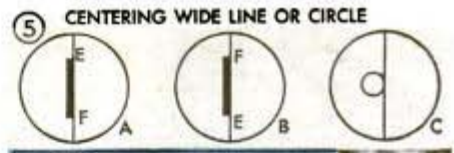
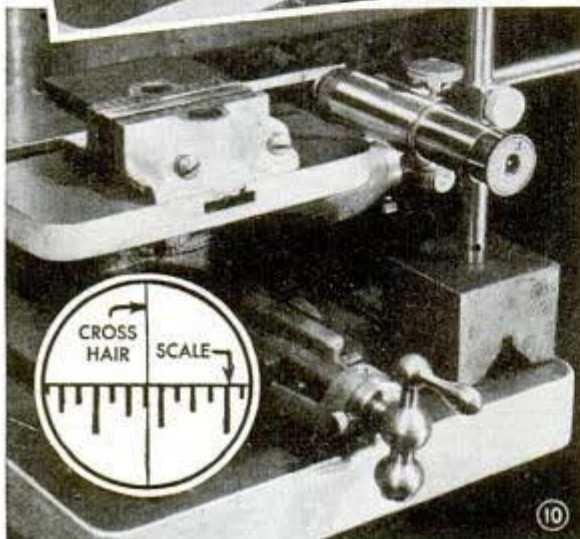
By Walter E. Burton

AS A measuring tool, a compound microscope having a magnification of 20 to 30 diameters can be of great help to the machinist who works to close tolerances. First of all, a stand like the one in Fig. 1 will have to be made to support the lens barrel, and then a cross hair installed in the eyepiece. This may be fine wire or a human hair, although the best material found for the purpose is the silk taken from a spider web. Transferring a strand, preferably from a web recently spun, is done with a cardboard strip notched as shown in Fig. 2, after which the tips are moistened with thin glue and then touched deftly to



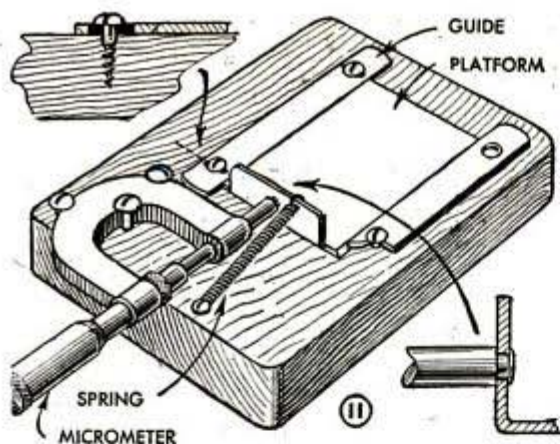


7 CENTERING WORK ON LATHE FACEPLATE



the spider web. Now, two dabs of glue are applied to the washer-like diaphragm of the eyepiece, diametrically opposite each other, after which the cardboard is touched to these spots to transfer the strand. A single cross hair will do in most cases, although two or more may be used as indicated in Fig. 3.

Now for the jobs to which this instrument can be applied: Centering work on a faceplate is one. Here the work is scribed with fine cross lines in the usual way, after which it is mounted on the faceplate. Now, with the lathe running, and the microscope supported by the tool post as in Fig. 6, you sight through the eyepiece and focus the lens on the approximate center of rotation. Next, the lathe is stopped and the eyepiece is adjusted so that the cross hair will be in a vertical position and parallel to one of the cross lines on the work as shown in the first detail in Fig. 7. If one is not over the other, the work is shifted accordingly. Now, the faceplate is rotated 180 degrees so that scribed line A-B will be upside down as shown in the second detail of Fig. 7. In most cases the scribed line will be on one side or the other of the cross hair. The space between the two represents the amount the work and microscope are off center. This is corrected by carefully moving the work sidewise until the space is reduced one half as shown in the third detail. With this done, the cross hair is



brought directly over line A-B as shown in the fourth detail. If the cross hair and the line coincide, when the faceplate is turned another 180 degrees, you will have the work centered in one direction. You go about centering the horizontal line in the same way, and when both the horizontal and the vertical lines remain in alignment with the cross hair as in the fifth detail, the work is centered. Where a hole, a button or a wide line is being centered, the cross hair is aligned with one edge as shown in the detail A, Fig. 5. Note in details B and C that the cross hair remains on the same side of the mark when the faceplate has been rotated 180 degrees.

Centering a pulley in a four-jaw chuck, Fig. 4, is another use where the microscope will be of help. Here the pulley is chucked and then a light cut is taken across its hub to brighten the metal. With the microscope supported as before, and focused on the hub, the lathe cross-feed and the eyepiece are adjusted simultaneously to bring the cross hair tangent to the edge of the hole in the hub. When it is noted through the microscope that the cross hair remains tangent to the edge of the hole during one complete revolution of the work, the pulley will be centered in the chuck.

Calculating beforehand the size hole a fly cutter will bore is another job made easy with a microscope. To do this, the microscope is set on the machine table or clamped in the work vise as in Fig. 9. Then it is focused on the tip of the cutter and the table is adjusted crosswise until the cross hair lines up exactly with the edge of the cutter. Now, a reading is taken of the table feed-screw scale, after which the spindle holding the cutter is rotated 180 degrees to move the cutter around to the opposite side. Next, the table is advanced, being careful not to disturb the microscope, until the point is reached where the cross hair is once more in line with the tip of the cutter. Finally, a second reading is made of the feed screw to determine the distance traveled by the table which equals the di-

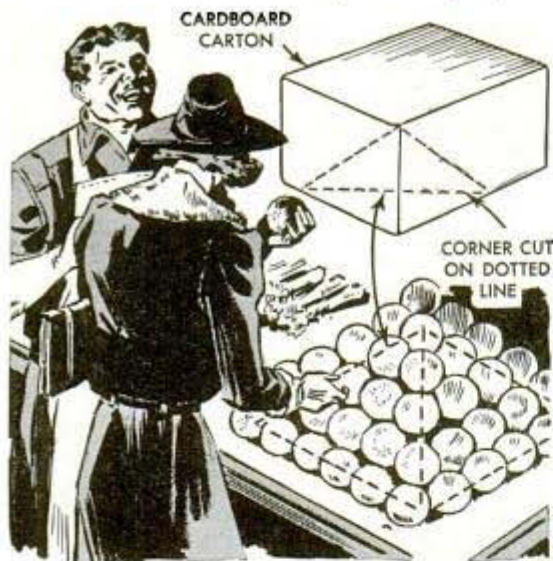


ameter of the hole that the cutter will make. A similar set-up, Fig. 8, can be used to determine whether a milling cutter is running true by simply sighting through the eyepiece and seeing if each tooth aligns with the cross hair. The magnification also will enable you to note whether the degree of bevel on each tooth is the same.

Cross-feed screws in tables of milling and boring machines can be checked quickly for wear with a set-up similar to the one shown in Fig. 10, which in this particular case shows a micrometer drill-press table being tested. A steel scale or ruler is clamped in the work vise and the microscope is placed on a stationary part of the machine. Then the cross hair is lined up with one edge of a graduation on the scale as indicated in the circular detail in Fig. 10. At this point, a reading is taken of the graduated scale on the cross-feed screw, after which the table is advanced until the cross hair has traveled one or more divisions on the steel scale, stopping it on the same side of the graduation as in the first setting. A second reading is taken of the feed screw and the amount it has moved is compared with the distance traveled on the scale. Thus, if you moved the cross hair across the steel scale $\frac{1}{32}$ in., the feed-screw scale should read 0.0313 in.

Figs. 11 and 12 show how a measuring device can be rigged up and used with the microscope to check the diameter of beveled holes in bushings. It consists of a sliding metal plate, the movement of which is controlled by a 1-in. micrometer, which has the anvil removed to permit insertion of a short rod to move the plate.

Corners From Cardboard Carton Make Pyramid Fruit Display



To make neat and uniform displays of fruit on the counter or in the display window, one clerk uses corner sections cut from cardboard cartons. These not only serve as shaping foundations, but also permit the pyramids to be built with smaller quantities of fruit and still make an attractive display.

Wrist Pin Dresses Grinding Wheel

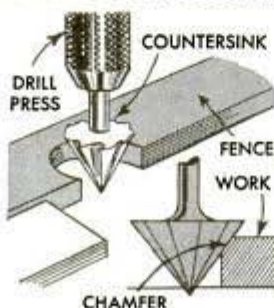


In the absence of a suitable grinding-wheel dresser, you can use an old auto wrist pin. A handle for the pin can be made from a length of small rod as shown. Be sure that the rod is of small enough

diameter to permit the pin to rotate freely on it.—Robert Hill, Sugarland, Tex.

Chamfering With a Countersink

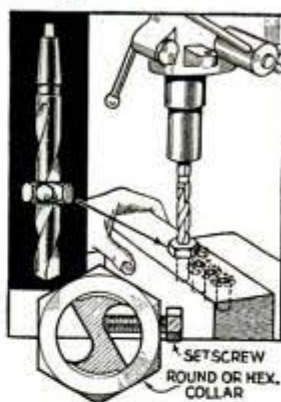
When there is no tool at hand for chamfering soft metals, plastics or wood, you can do a good job by using a countersink bit in a drill press. It will be necessary to make a fence and clamp it to the drill-press table to guide the work along the edge of the countersink bit. The fence can be made



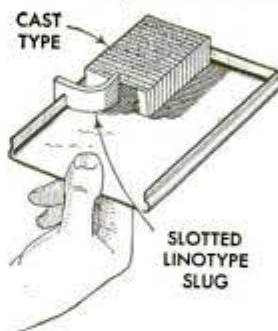
of wood as shown. For best results, the bit must be honed to razor sharpness, and should be rotated at the highest speed of the drill press.

Simple Depth Stop for Drills

This drill depth stop is easy to make and handy to use. Disks cut from round or hexagon stock and drilled to form collars can be used or you can ream out hexagon nuts to suit. A setscrew in one side of the collar locks it on the drill.



Cast Type Held in Galley Securely By Bent Linotype Slug

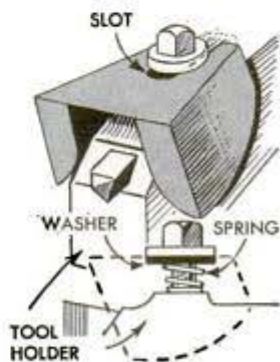


Instead of using weights to keep cast type in position in a galley, one printer uses linotype slugs. These are bent in an L-shape and notched near one end to slip over the side of the galley. When pushed tightly against the

type, the slotted slug wedges against the galley side and holds tightly, yet is easy to loosen when desired.

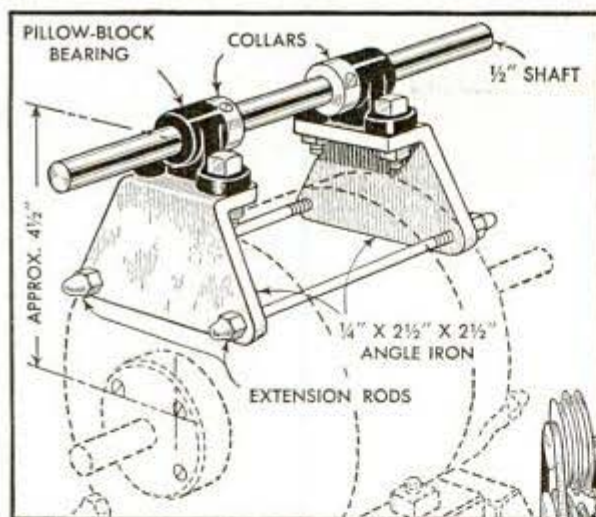
Shield Keeps Chips From Flying When Turning Brass or Bronze

To prevent chips from flying about when turning brass or bronze, I use a shield on the turning-tool holder like the one illustrated. The top portion of the shield, which is made from sheet metal, is slotted to straddle the bolt that locks the tool in the holder. The shield is held between two washers, which are forced tightly against the bolt head by means of a coil spring as indicated in the lower detail.



—D. E. McDonald, New York City.

Jackshaft on Motor Makes Variable-Speed Unit



You will find many uses for this compact motor-and-countershaft unit, which consists of a jackshaft mounted on an electric motor. The unit can be fastened in a fixed position for driving power tools, such as metal-turning lathes, drill presses, etc., where various speeds are required, or it can be carried about for operating a flexible shaft as shown. By using two 5-in. cone pulleys and a motor of 1,750 r.p.m. on the original unit a speed range of 700 to 4,375 r.p.m. was obtained.

Pillow blocks serve as bearings for the shaft, and they are bolted to angle-iron supports, which are attached to the motor by placing them under the nuts of the tie rods that hold the motor housing together. In some cases, it may be necessary to substitute longer tie rods for the original ones.
—Kent H. Alverson, Niagara Falls, N. Y.

Printer's Make-Ready Paste Dispensed From Grease Cup

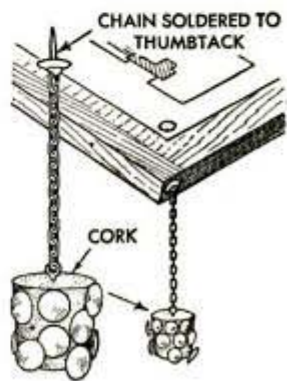
To save the time spent in opening and closing a jar or can of make-ready paste, when preparing a run on his job press, one printer attached a grease cup of the type that has a screw cover to the underside of the feedboard. The cover was fastened to the board with a couple of screws so that

it could not turn, after which the cup was filled with paste and screwed into it. A slight turn of the cup releases the desired quantity of paste, and refilling is necessary only at long intervals.



Cork Serves as Thumbtack Holder At Artist's Drawing Board

Artists and others who use thumbtacks for holding sheets of paper on drawing boards will find that a large cork makes an excellent holder for the tacks. The cork is fitted with a short chain to which a thumbtack is soldered to permit attaching the holder near one corner of the drawing board as shown. The cork cannot roll out of reach and it is always at hand.



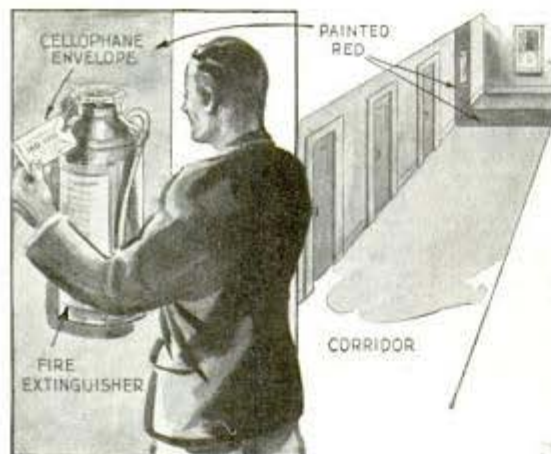
Button Pockets on Nail Apron Are Easy to Empty



Instead of digging into the pockets of his apron to empty them of nails and staples, one carpenter buttons the pockets on the apron so that they can be emptied easily as indicated. To do this, the pockets are made separately and then the lower edge is sewed to the apron and the upper edge is buttoned to it. Thus the pockets may be opened and dropped down to empty the contents without removing the apron. This also keeps them free of dust and shavings.

Fire Extinguisher Spotted Quickly By Painting Red Band on Wall

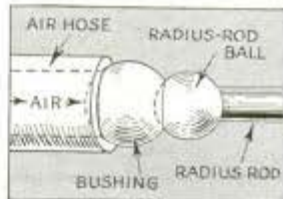
For quickly locating fire extinguishers in large buildings, it's a good idea to paint a wide red band on the wall and floor at the location of each extinguisher. In this way, such fire-fighting equipment can be rushed to the scene without loss of time, as only a glance down a long corridor is needed to spot the extinguisher intended



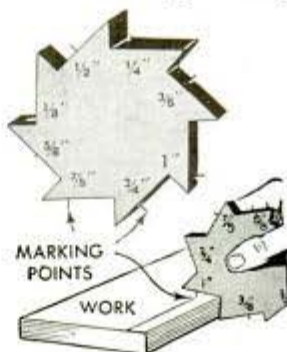
for use in that vicinity of the building. Also, where extinguishers are kept in factories, dust and grease often collect on the tags containing information about recharging, making the data difficult to read. This trouble is overcome easily by slipping the tags inside Cellophane envelopes, as shown.

Bushings Put on Ford Radius Rods With Aid of Air Hose

Difficulty in forcing rubber bushings over the ball ends of Ford radius rods can be overcome by using an air hose to do the job. First, wet the bushing with water, which serves as a lubricant, and then hold it against the ball. Place the air hose behind the ball and turn on the air. This will expand the bushing so that by pushing against it with the hose it will slide into place easily. Of course, the inside diameter of the hose must be smaller than the outside diameter of the bushing so the latter will not slip into the hose.



Marking Gauge Saves Time



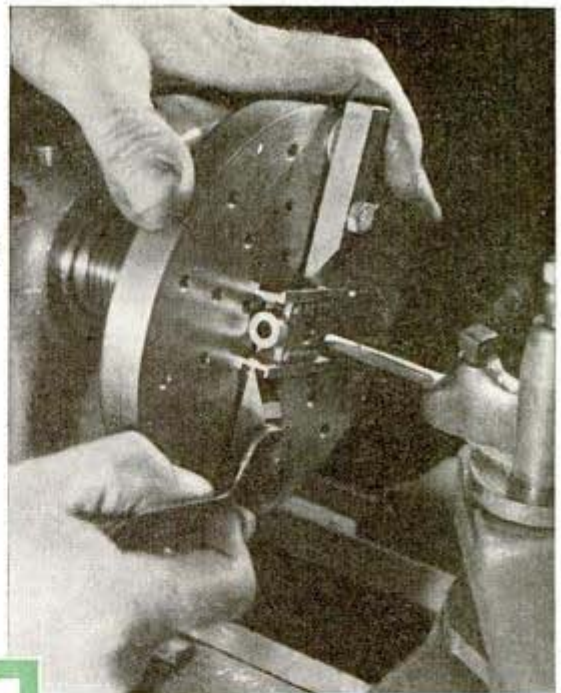
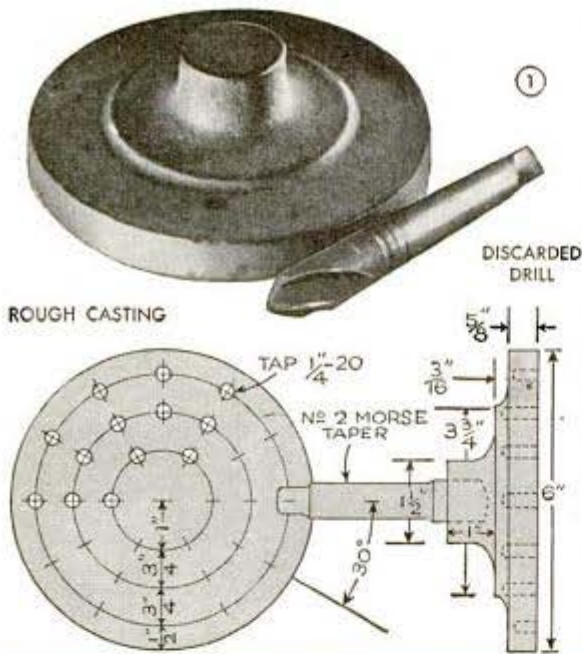
If you often have to use a marking gauge and the distance of the scored line from the edge of the work varies from $\frac{1}{8}$ in. to 1 in., this multiple gauge will save time as it has eight fixed score points calibrated in eighths of an inch.

The gauge is made from a disk of hardwood as indicated. Nails having their heads cut off and driven into the disk at the desired locations serve as the scoring points.

Sandblasting Distributor Contacts Increases Ignition Efficiency

Resistance in the secondary circuit that interferes with the spark and cuts down engine efficiency can be removed quickly with the aid of conventional spark-plug cleaning equipment. This is done by using one of the small spark-plug adapters to sandblast the distributor terminals until thoroughly clean, as resistance, in the form of corrosion, usually develops at contacts in the distributor cap.

—C. E. Packer, Chicago.



② METHOD OF MOUNTING SMALL WORK

Making a Taper-Shank FACEPLATE

WORKING from soft gray-iron castings, there are a number of machine-tool accessories that can be made in any small machine shop. A good example is this taper-shank faceplate, which has tapped holes in its face for attachment of dogs that hold small work securely for machining as in Fig. 2. Its shank is a discarded taper-shank twist drill that matches the hole in the headstock spindle, enabling the operator to slip it in or out of the spindle quickly.



③ CUT OFF DRILL FLUTES FROM SHANK

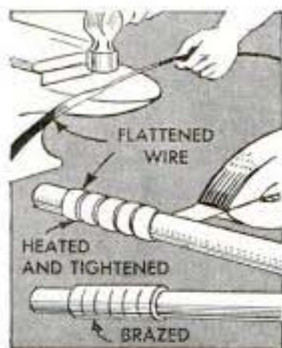


④ MACHINE THE BACK OF PLATE FIRST

⑤ TEST ARBOR HOLE FOR DRIVE FIT ON SHANK

Increasing Diameter of a Shaft

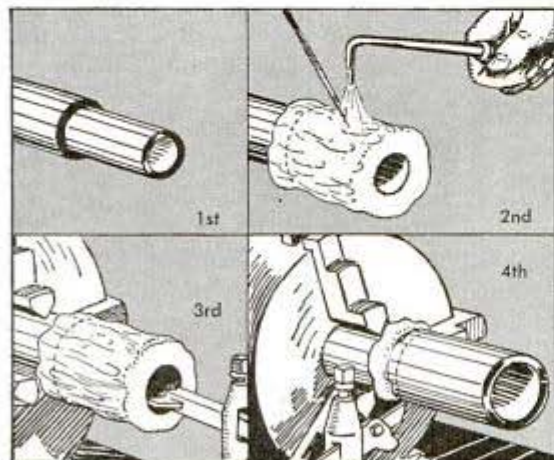
Here is an easy way to build up the diameter of a shaft where suitable equipment for the work is not at hand. In fact,



the work can be done in a blacksmith's forge. First, flatten a length of wire, the size of which is determined by the amount the diameter of the shaft is to be increased, and wrap it tightly around the shaft, spacing the wrappings as closely as possible.

Then heat the shaft and wire and pull the latter up tightly. Next, cover the wire by welding, being sure that the molten metal runs in between the turns of wire. If the work is to be done in a forge, heat the wire and rod to a bright red color and then apply brazing flux and melt the brazing rod by rubbing it over the red-hot wire. If a hard surface on the shaft is desired, use cast steel or spring wire. After building up the shaft, turn it down in a lathe to the desired diameter.

How to Make a Bronze Bushing



If a bronze bushing is needed and there is no stock at hand for turning one, you can do the job with a welding torch. First select a piece of steel tubing that has an outside diameter slightly smaller than the required inside diameter of the desired bushing. Then, with a torch and bronze welding rod, build up a collar on the turned end of the tubing, making it a little larger both in diameter and length than that required for the bushing. Now, bore out the collar to the desired size, making sure all the steel has been removed. Next, turn down the outside to the required size.

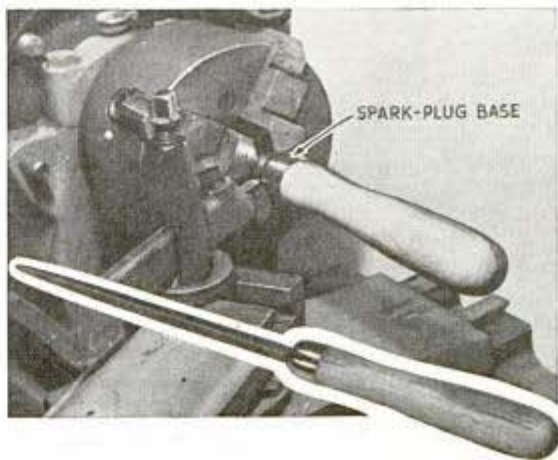
Carton Flaps Held for Packing By Stops in Bench



Annoyed by having the end and side flaps of cardboard cartons get in his way when filling them for shipment, one clerk drilled holes through the bench top for the insertion of wooden dowels. These are spaced to accommodate the various sizes of cartons employed, and may be driven up to hold the carton flaps.

Tool-Handle Ferrule Made Easily From Base of Spark Plug

Tool-handle ferrules that are strong and really "stay put" can be made from the bases of certain types of spark plugs. First, dismantle the plug and turn the base onto the end of the handle so that the threads cut into the wood. Then chuck the assembly into a lathe and turn down the base, removing the shoulder and the knurled surface. Then polish the turned surface with emery cloth and saw off the base flush with the end of the handle.



Using a



By H. J. Chamberland

SURFACE-GRINDING machines were once limited in size and only adapted to finishing small parts, particularly in tool-room work, but a modern surface grinder such as the one shown in Fig. 1, has a greatly increased range of application. Some of the larger models have a work capacity as much as 16 ft. in length. Surface grinders vary in design. Some are equipped with vertical spindles, are fitted with cylinder-like or cup grinding wheels, and have tables that either move transversely or rotate. Other surface grinders have horizontal spindles fitted with large straight wheels and have rotating tables only, while still others have horizontal spindles and tables which move transversely. The latter type of machine, which is used most gen-

erally, has the widest range of applications for machine-tool construction as well as precision tool work, and it is the only type of surface grinder capable of producing irregular and plain surfaces in a single work set-up.

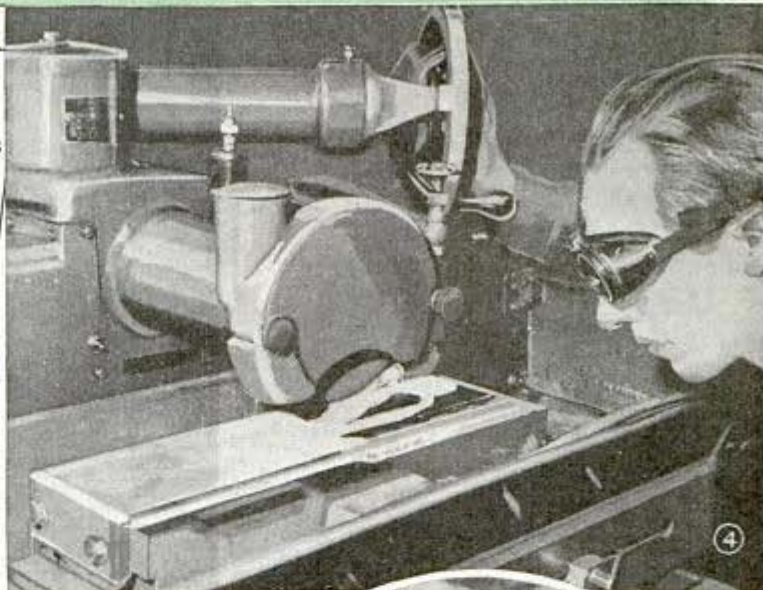
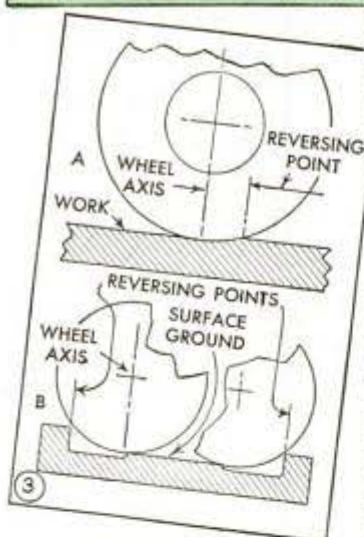
What the machine does:

A modern surface grinder of the horizontal-spindle type and traverse table movement must meet four requirements, often simultaneously if the nature of the work demands it. These requirements are accuracy of size, accuracy of flatness, accuracy of parallelism and accuracy of finish. While accuracy may vary .0005 in. on large machines, it is often as close as .00005 in. on tool-room surface grinders. Size, flatness and parallelism represent surface accuracy. Finish accuracy is controlled by the effectiveness of the grinding wheel, and also by the amount of feed—vertical, longitudinal and cross-feed. The small casting shown in Fig. 2, which is being surface-ground, is apparently of a nature to disregard size and parallelism; accuracy of flatness is the objective here as the surface must be mated to a similar one. In this case, the finish is also of secondary importance provided a perfect joint results. On the other

hand, the surfacing operation shown in Fig. 4 is that of grinding simultaneously thirty-six gage blocks—a set-up demanding four-point accuracy. Accuracy of size depends on accuracy of flatness and accuracy of parallelism. The finish must also have that degree of fineness which safeguards lapping results.

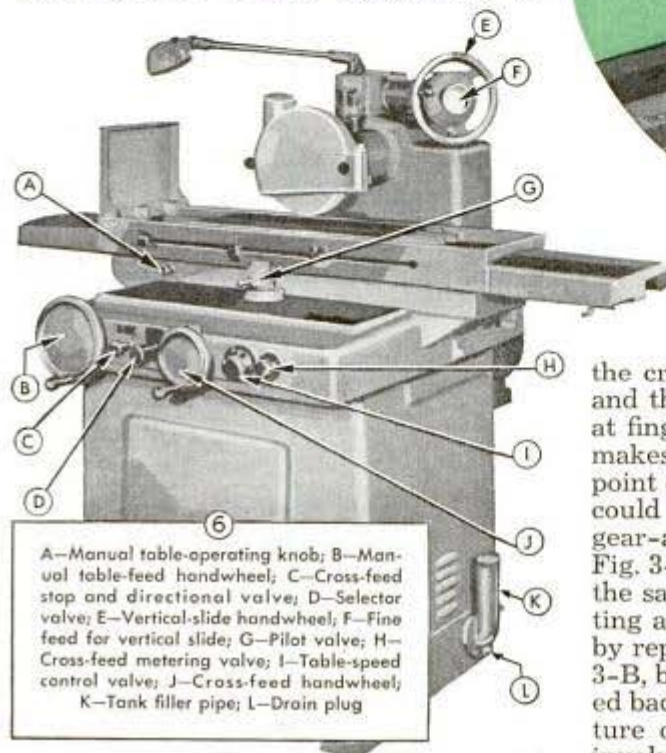
Surface-grinding machines produce surfaces of such precision that more than 75 percent of the former scraping operations have been made unnecessary, and the work of lapping is greatly simplified. However, even a precision surface-grinding operation is not accurate enough to mate the sliding members of a grinding machine. Therefore, after castings for surface grinders are aged to relieve them of internal strains, they are machined accurately and hand-scraped carefully, as shown in Fig. 5.

SURFACE GRINDER • • •

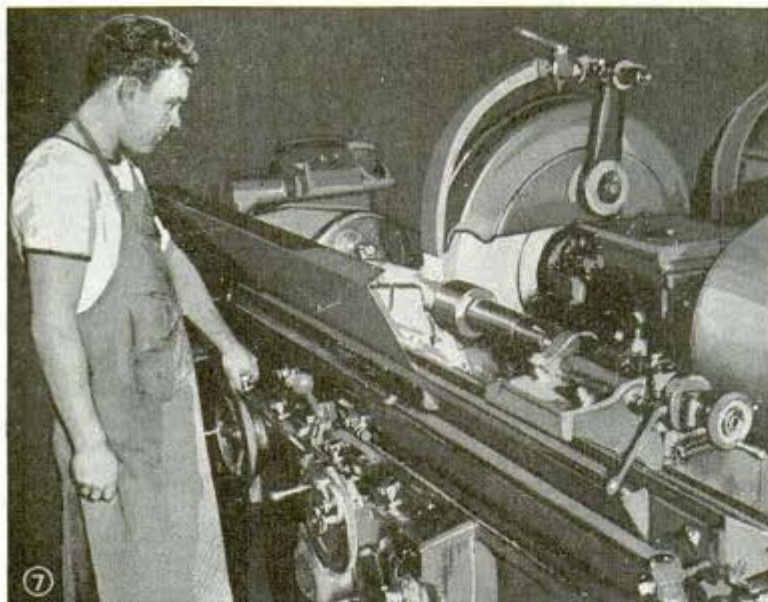


All cylindrical members are precision ground and lapped to produce a unit of absolute rigidity that will be free from vibration.

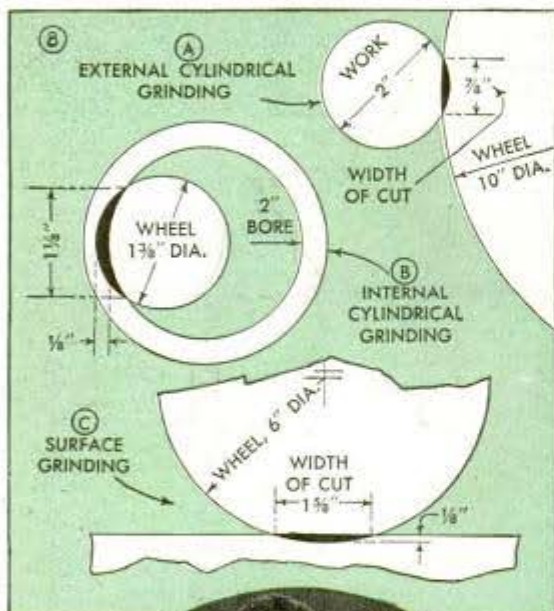
Easy to operate: Surface grinders of the horizontal-spindle type, regardless of size, embody the controls shown in Fig. 6. The hand-operated vertical slide feeds downward and is fitted with a directly driven, ball-bearing spindle. The hand-wheel permits making adjustments of



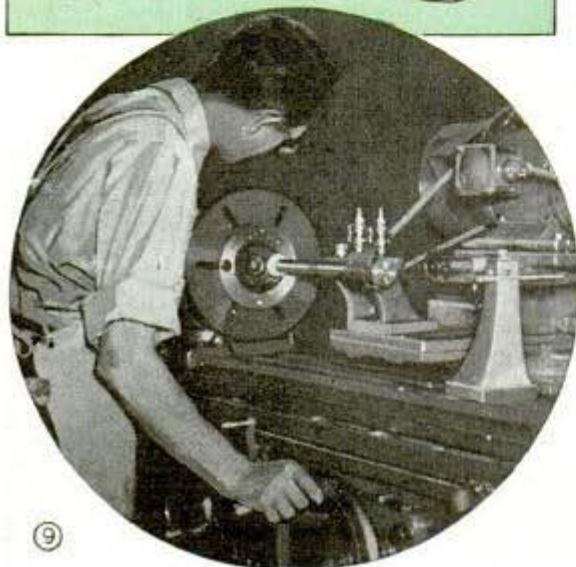
.0001 in. if necessary. The longitudinal movement of the table can be controlled by hand or hydraulically, which is also the case with the cross-feed. The amount of cross-feed and the rate of the longitudinal speed are at finger-tip control. Hydraulic operation makes it possible to limit the reversing point of the table within a hair line, which could never be done on a machine with gear-and-pinion operation. As shown in Fig. 3-A, the table must reverse exactly at the same point with each pass, or the cutting action of the wheel will be destroyed by repeatedly hitting the shoulder. In Fig. 3-B, both wheel and work would be affected badly by uneven reversal due to the nature of the particular grinding operation involved.



Area of contact: The grinding wheel is a cutting tool that differs from cutting tools made of metal in that thousands of small cutting edges do the work rather than one or a few. The correct grinding wheel and a dependable spindle represent the heart of a grinding machine. In all grinding operations, the area of contact where wheel meets work, is a decisive factor in wheel selection. The amount of contact area is as important a factor in choosing the proper grade of wheel for a job as the material to be ground. External cylindrical grinding, Fig. 7, differs



from internal cylindrical grinding, Fig. 9, and also from regular surface grinding in respect to area of contact. With external cylindrical work as shown in Fig. 8-A, the contact area is at a minimum regardless of the ratio between the diameter of the wheel and that of the work. With internal cylindrical grinding as in detail B, the area of contact is by far greater than is the case in detail A, even with the smallest practical diameter of wheel in relation to the diameter of the bore. For efficient cutting, the wheel must be softer for internal grinding than for external grinding, as the area of contact is greater. Wheels used for internal work are usually two grades softer than those used for external grinding. In surface grinding, the area of contact might appear to be less than it is in internal cylindrical grinding but this is not the case generally. See detail C of Fig. 8. The work surface is straight and the wheel diameter is seldom less than 6 in., although it may be as much as 12 or 14 in. on large surface grinders. Therefore, the area of contact in

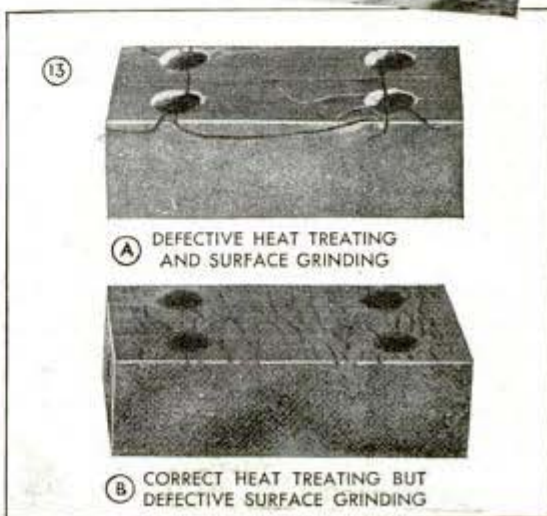
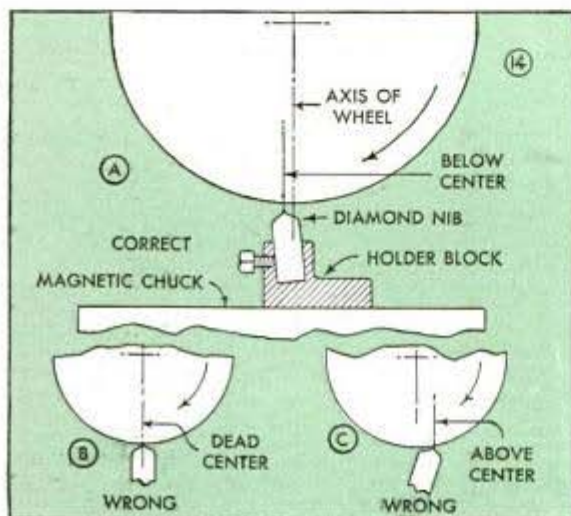


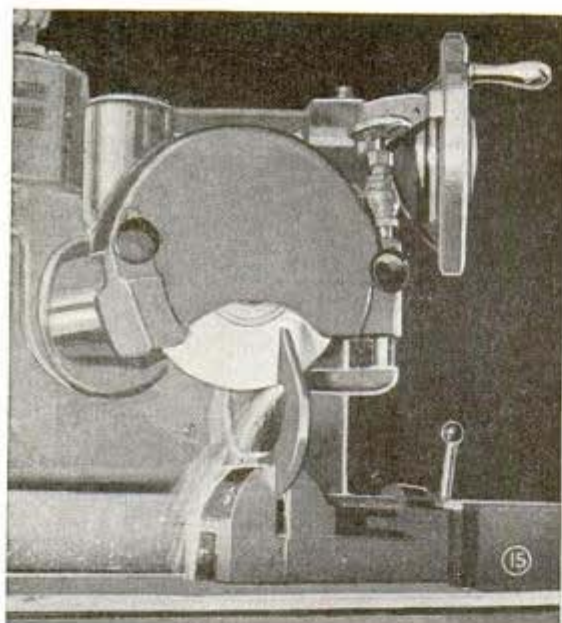
⑩ **Grinding Wheels to Use for Surface Grinding**
(With equipment of the horizontal spindle type)

Material	Wheels
Machinery steel - - - -	3836-L-8B
Carbon steel (soft) - - -	3836-K-8B
Carbon steel (hard) - - -	3836-I-10B
High-speed steel (soft) -	3846-J-8B
High-speed steel (hard) -	3846-H-10B or 3860
Stainless steel - - - - -	3836-H-8B
Cast iron - - - - -	3736-J-8T2
Brass - - - - -	3724-H-8T2
Bronze (soft) - - - - -	3724-H-8T2
Bronze (hard) - - - - -	3724-I-8T2
Aluminum - - - - -	3846-H-8B
Copper - - - - -	3724-I-7R
Chilled iron - - - - -	3736-I-8B
Magnetic chucks (important)	3760-H-8L

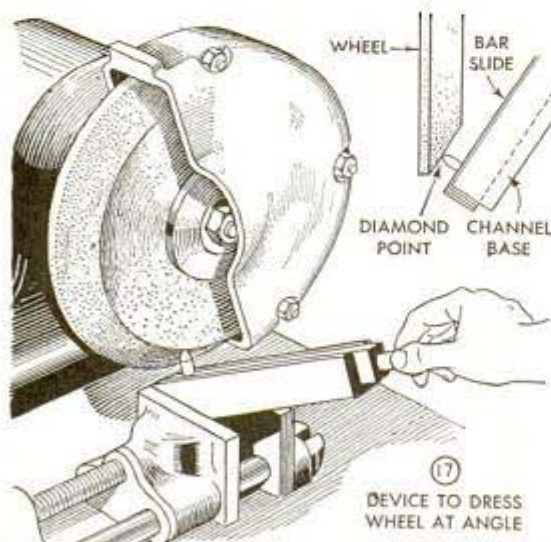
surface grinding depends on the wheel diameter. In all the details of Fig. 8, the sizes of grinding wheels and work as given are based on practical ratios, and in each case the wheel is fed into the work the same distance.

Grinding technique: As modern surface grinders are practically foolproof from the standpoint of functioning accurately, the degree of grinding accuracy is based on the proper selection and use of grinding wheels. The table in Fig. 10 gives general recommendations. Notice that the first two figures are 38 and 37 respectively. Tough materials require wheels of aluminum-carbide grains, expressed by 38, whereas softer materials require silicon-carbide grains, expressed by 37. The harder the material to be ground, the softer the grade of wheel, and vice versa. However, both aluminum-carbide and silicon-carbide wheels have their individual degrees of hardness to fit all metals. The hardness and size of the grains, and their spacing determine the cutting rate and the quality of the finish. For production grinding and some tool work, a coolant is used to speed the job and also improve the finish. On a surface grinder having a large range of movement and equipped with a large magnetic chuck, a considerable number of pieces can be ground in a given time as shown in Fig. 11. Fig. 12 shows how the sides of a part are being accurately squared by using a precision angle plate. In this case the finish had to be extra fine and therefore a 60-grain wheel was selected in preference to a 46-grain wheel. Fig. 13 gives an idea of what may happen when using too hard or too fine a grade of wheel to surface-grind hardened tool steels, although heat treatment may also be the primary cause of the defects. In detail A, a die was hardened incorrectly, which caused internal fractures that are not detected until the grinding stage. If the grinding feed is excessive, and the

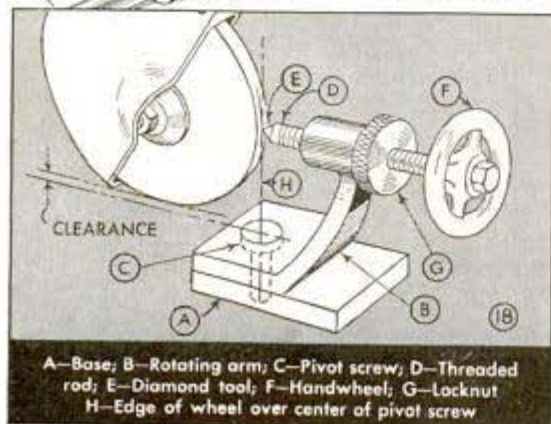




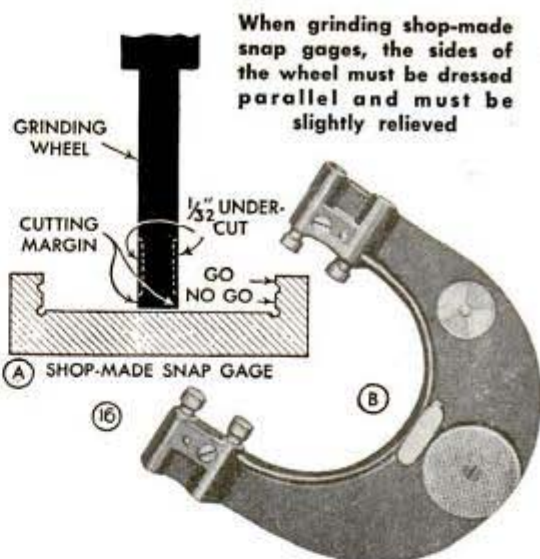
Wheel-dressing fixture in Fig. 17 can be adjusted for straight cuts at various angles. The fixture in Fig. 18 produces a concave or convex face on wheel depending on location of point with relation to pivot



DEVICE TO DRESS WHEEL AT ANGLE



A—Base; B—Rotating arm; C—Pivot screw; D—Threaded rod; E—Diamond tool; F—Handwheel; G—Locknut
H—Edge of wheel over center of pivot screw



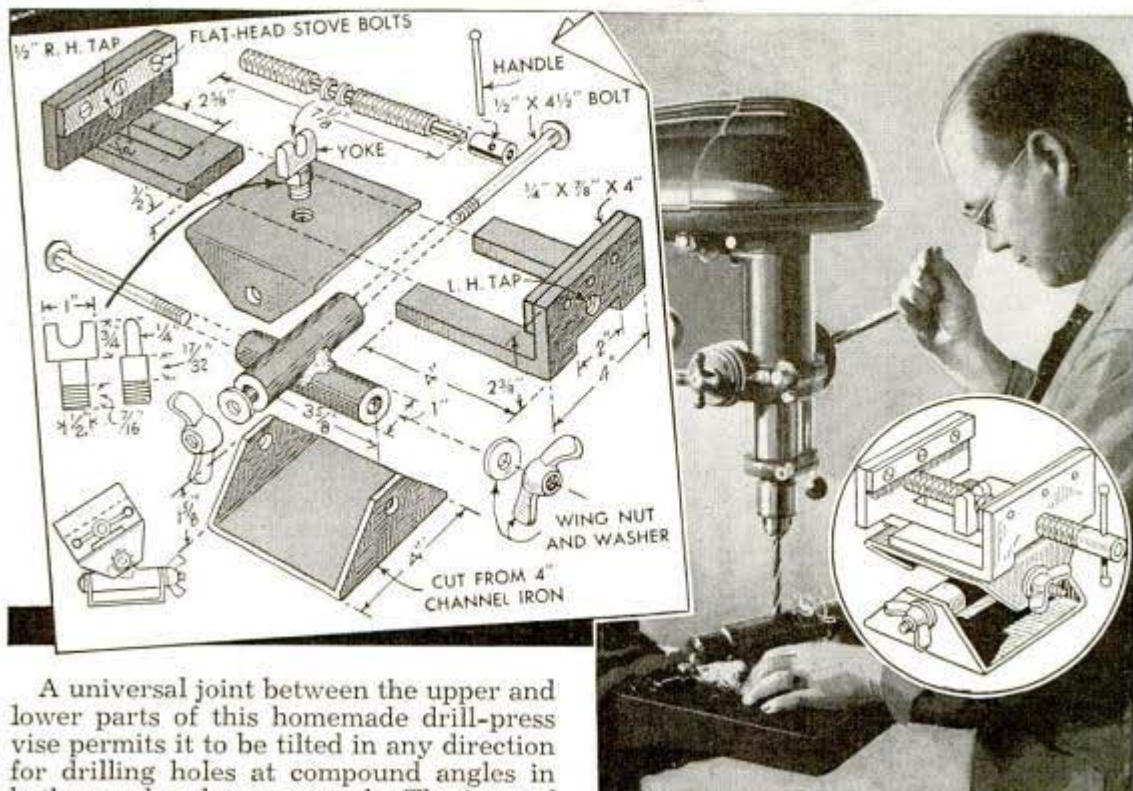
When grinding shop-made snap gages, the sides of the wheel must be dressed parallel and must be slightly relieved

wheel is too hard and not sufficiently open-grained, the internal cracks will gradually work themselves through and become visible. If the heat-treatment is correct, a wrong infeed and a poorly selected wheel will surface-crack the die as shown in detail B of Fig. 13.

Dressing the wheels: When dressing grinding wheels with a diamond nib set into a small steel block, the diamond will stay sharp longer if the holder is set at a slight angle as shown in Fig. 14-A. The diamond is set at the location indicated or below the wheel axis in relation to its direction of rotation which is shown by the curved arrow. The diamond point should not be on dead center as shown in detail B, and results will be disastrous if one attempts a set-up as shown in detail C. For grinding snap gages, Fig. 15, the sides of the wheel should be dressed parallel and should be slightly relieved to produce a cutting margin about $\frac{1}{8}$ in. wide on each side. As shown in Fig. 16-A, the undercut can be as much as $\frac{1}{32}$ in. deep. In this way a minimum of contact area is provided to maintain the maximum of parallelism. Grinding wheels of the H-grade and 80-grain grade will assure four-point accuracy with the grinding of snap gages. Detail B shows a snap gage on which the contacts are adjustable.

Angles can be formed on either or both sides of a wheel with a simple fixture shown in Fig. 17. A device to help in grinding a wheel convex or concave (depending on whether the point is in front or behind pivot), is shown in Fig. 18; a rotating arm holds the diamond tool, the rod being screwed in or out with a handwheel, and locked in any desired position by means of a locknut.

Handy Drill-Press Vise Has Universal Action



A universal joint between the upper and lower parts of this homemade drill-press vise permits it to be tilted in any direction for drilling holes at compound angles in both round and square stock. The jaws of the original were made of angle iron and faced with pieces of old file to provide non-slip surfaces. Before the pieces of file can be drilled for attaching, they will have to be annealed by heating and then quenching quickly in water. The two-part base is of 4-in. channel iron, although it can be formed of flat stock by heating and bending it U-shape. The universal joint consists of two pieces of 1-in. rod which are drilled centrally lengthwise and welded together at right angles as shown. From

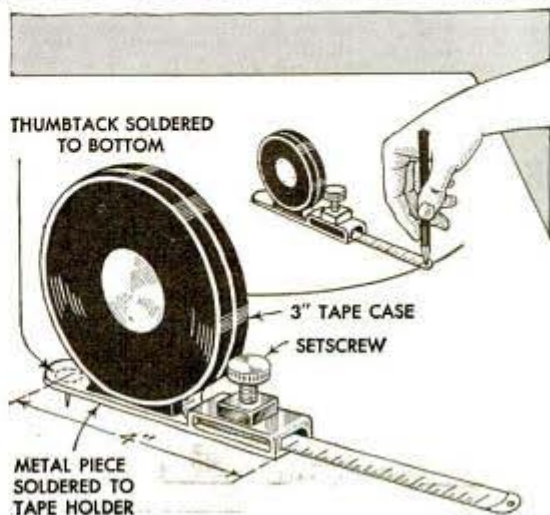
the pull-apart drawing you can see how the various parts go together and the circular detail shows what the assembled vise looks like. Note that the front half of the threaded shaft on which the jaws travel has a left-hand thread, so that the vise will open when the handle is turned counter-clockwise. The yoke should fit closely between the shoulders turned in the shaft to avoid any appreciable back lash in closing and opening the jaws.

—Harry F. Steede, Ladysmith, Wis.

Special Base Adapts Steel Tape for Use as Beam Compass

Interfering in no way with its regular use, here's how you can make your steel tape do double duty as a beam compass, the capacity of which is limited only by the length of the tape. From a strip of $\frac{1}{16}$ -in. metal, form a base like the one shown in the drawing and then solder a thumbtack to the underside at one end and a nut for a locking screw at the other. With the clip on the end of the tape flattened, so that it can be slipped under the locking screw, solder the case to the base after first roughening it with a file to assure a good bond. In use, the distance between the thumbtack point and the end of the base is deducted in determining the radius of a circle by the graduations on the tape.

—Opie Read, Jr., Chicago.



Points on Beak of Hand-Truck To Raise Heavy Crates



The difficulty of lifting heavy crates of machinery above the floor for inserting rollers under them led one shop foreman to weld spike points on the beak of a hand-truck. These are forced into the wood of the crate so that the truck may be operated as a lever to lift one end of the crate.

Safe String Cutter on Counter From Window-Shade Bracket

Screwed to a counter or table where packages are wrapped, a window-shade bracket provides a handy cutter for string used in tying the packages. The edges of the slot in the bracket are filed to a knife edge for cutting the string, thus making it almost impossible to injure the fingers accidentally on the sharp edges. You will



find that the shape of the bracket is such that the string can be looped over it at any point and when given a slight tug will slide into the notch and be severed.

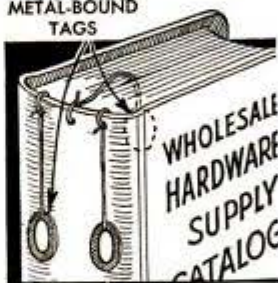
Clamp Holds Loose Paper Sheets Uniformly in Trimmer

When you have a number of loose sheets of paper to cut on a trimming board, they can be prevented from creeping under the trimmer knife by holding them with a paper clamp. This assures that all the sheets will be of a uniform size. In use, just stack the sheets in position for trimming and then slip the clamp over them.



Metal-Bound Tags Mark Pages Of Thick Catalogues

METAL-BOUND TAGS

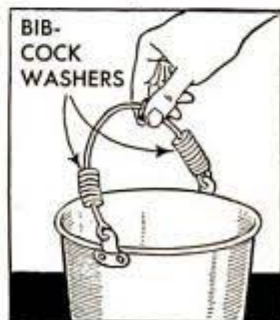


As certain pages in his wholesale supply catalogue were referred to frequently, one owner of a hardware store fitted the catalogue with handy markers improvised from metal-bound tags. These were fastened to the catalogue permanently by attaching them to short strings tied at the top edge of the binding as indicated. In use, the markers are merely dropped between the pages to be located.

tended to the catalogue permanently by attaching them to short strings tied at the top edge of the binding as indicated. In use, the markers are merely dropped between the pages to be located.

Washers Slipped on Bucket Bail Aid in Mixing Poultry Feed

If you have trouble mixing poultry feed accurately when using an ordinary bucket as a measure, loosen one side of the bail and slip several bib-cock washers on it. These can then be used to keep a record of the number



of buckets of feed dumped into the mixture by sliding them all to one side and then shifting one to the opposite side of the bail each time the bucket is emptied.

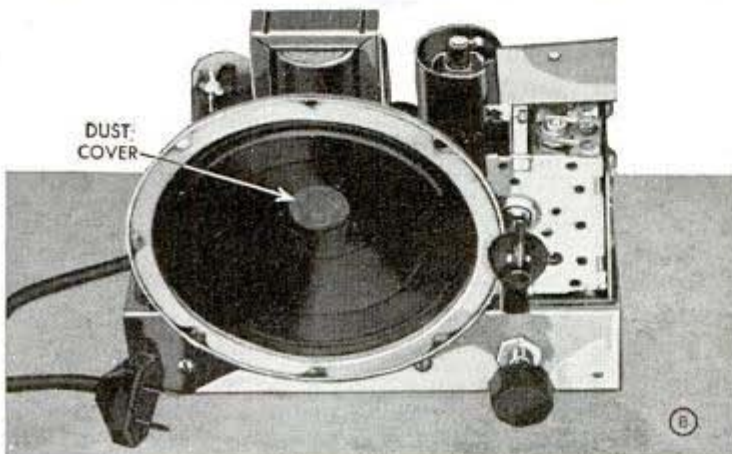
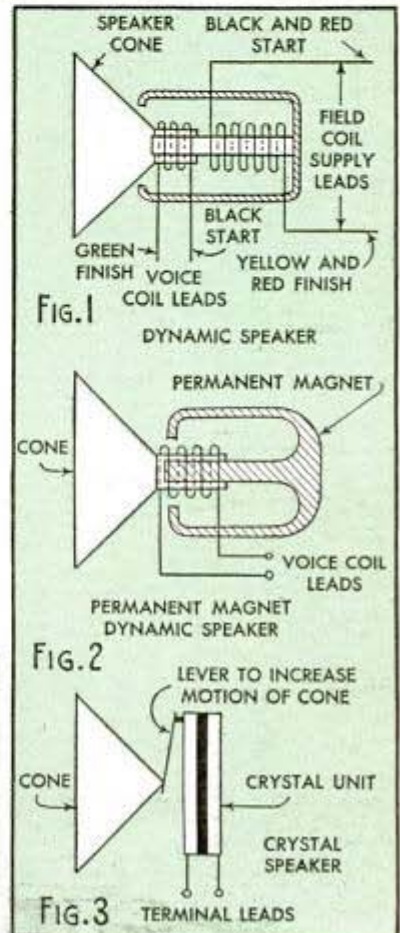
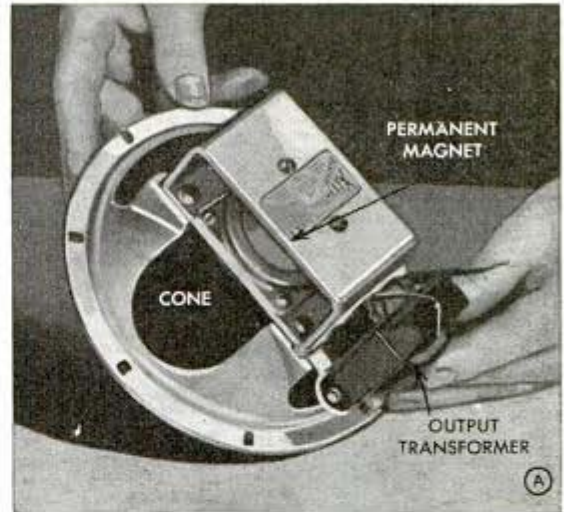
RADIO



LOUD SPEAKERS

CONVERTING the amplified audio frequency currents that issue from the output tubes of your radio receiver into sound waves, the loud speaker is merely a vibrating diaphragm that sets the surrounding air molecules into motion. It operates like the diaphragm in a headphone receiver only on a much larger scale, and the diaphragm is usually shaped like a cone.

The efficiency of any loud speaker is based on the ratio of the usable sound power radiated, to the electrified power supplied to the speaker load. Even the best types now produced are only claimed to be about 35 or 40 percent efficient. However, as the average ear is not critical, this comparatively low quality performance is usually satisfactory. Figs. 1, 2 and 3 show the basic details of three varieties. The dynamic type consists of a large paper diaphragm, to which is secured a very light coil of wire, called a "voice coil." This voice coil is maintained in an intense magnetic field by a coil of wire wound around the pole piece and separately energized. In the type shown in Fig. 2 this field coil and separate power supply are eliminated by the use of a permanent magnet. The crystal type employs the "Piezo-electric" effect of rochelle salt crystals, and no magnet or field supply is required. The adjustment of the voice coil, or other cone-driving device, is critical, and such adjustments should not be attempted by the average set owner, as special tools are required. The permanent-magnet type shown in photos A and B always should be protected by a thin felt dust cover to keep out metallic particles.



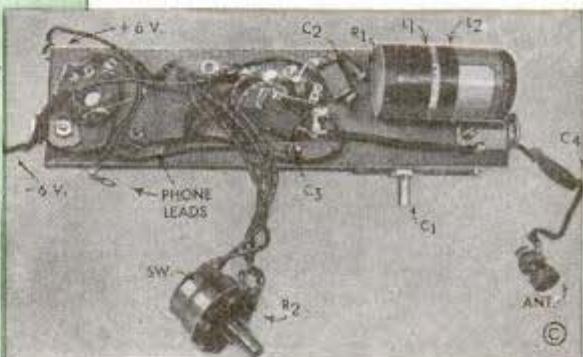
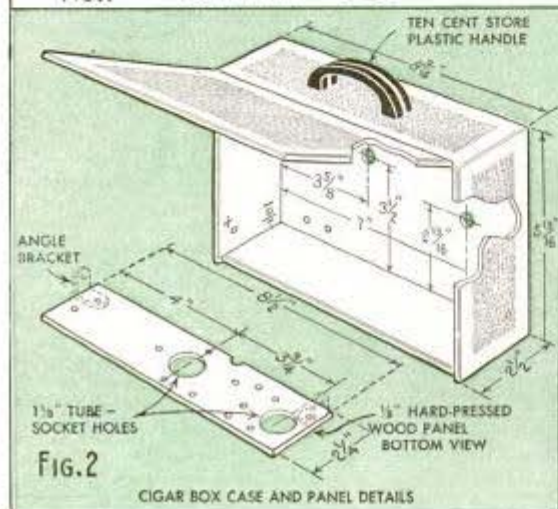
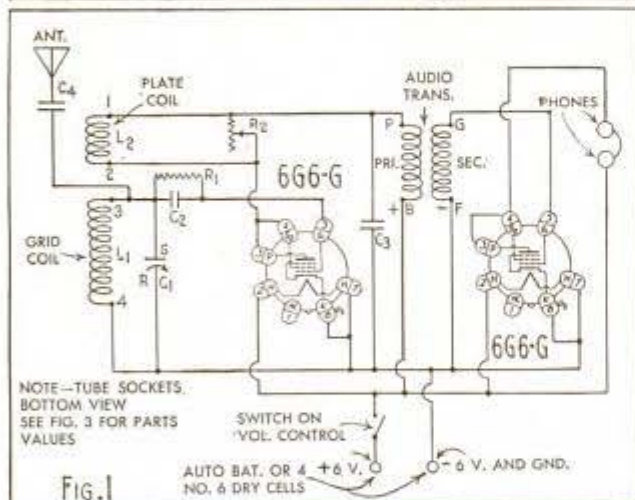
SIX VOLTS WORK THIS

By S. A. Johnson

THIS is an improved wartime version of the 2-tube "Hurricane" emergency receiver originally described in a previous issue of Popular Mechanics Magazine. Like the original model, it requires no B-battery, operating entirely from any 6-volt auto storage battery or four No. 6 dry cells connected in series. Under blackout conditions in localities where a power line supply would not be available for operating standard receivers, and if no dry-cell batteries of any type were obtainable, the nearest automobile would provide a 6-volt storage battery that could be used to listen in on local broadcasting stations for emergency safety and blackout instructions.

Capable of considerably more volume and greater range than the original model, this unit employs two 6G6-G low-drain tubes that require only .15 amp. of heater current, and the B-supply obtained from the same source is so low that it can be disregarded in figuring battery life. These 6-volt tubes are commonly found in the junk boxes of radio students, experimenters, and servicemen.

The schematic circuit diagram is given in Fig. 1, and it will be noted that only a handful of junk-box parts are required. These include an old audio transformer of any type with a 3-1 or higher ratio. These parts are assembled on a small hard pressed wood panel as shown in the simplified wiring diagram Fig. 3 and photos B and C. The assembly is housed in a cigar box and finished off with a ten-cent-store plastic handle, as illus-

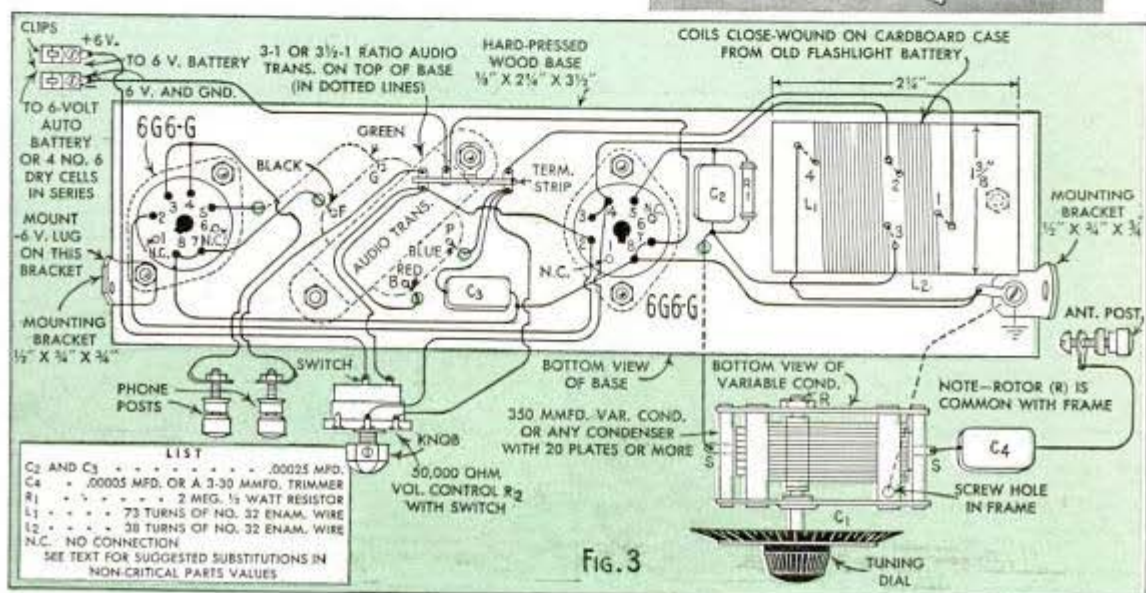
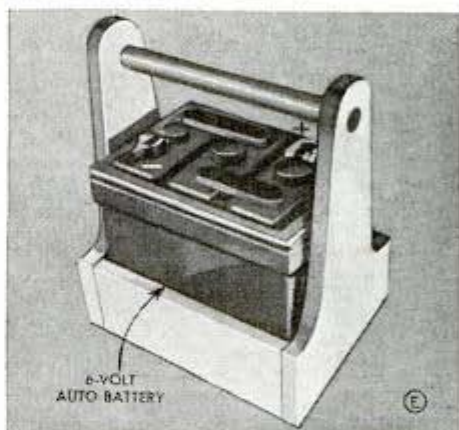


BLACKOUT EMERGENCY SET

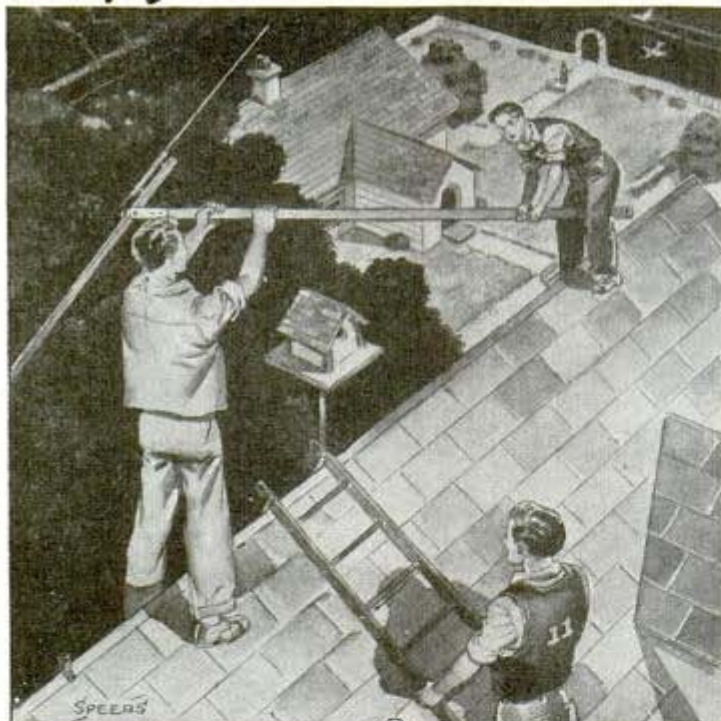
trated in photos A and D. Dimensions and drilling details for this case and panel are given in Fig. 2.

A cardboard tube removed from an old flashlight cell provides the form for winding the coil, the turn data for which is given in diagram Fig. 3. The wire can be salvaged from a burned-out filter choke or an old audio transformer, and can be any size from No. 28 to No. 34, either enameled or cotton covered. Wind coils L_1 and L_2 in the same clockwise direction, space them $\frac{1}{8}$ in. apart and anchor the start and finish ends through small holes punched in the form with a needle. Detailed material list R-319 is available from Popular Mechanics radio department, for student use if desired.

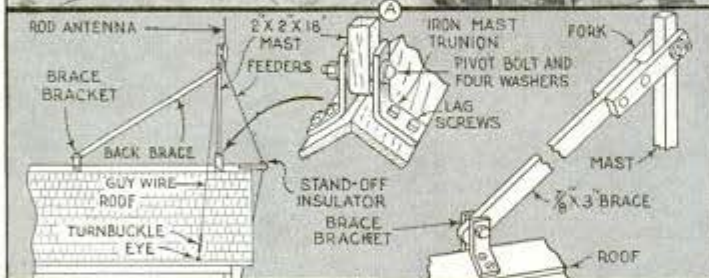
The volume control R_2 is mounted directly on the bottom of the cigar box which becomes the front panel of the set. Two small angle brackets support the base panel, and it will be noted that the mounting screw for one of these brackets is also used to mount the variable condenser C_1 . The antenna binding post is mounted directly on one side of the cigar box; two Fahnestock clips are mounted on the other end of the box for the positive and negative leads from the 6-volt battery. A ground lead should also be connected to the negative 6-volt battery clip. A good ground connection is necessary for maximum results, and a 20-foot indoor antenna is all that is required for local stations. However much stronger signals will be received if a long outdoor antenna is used. For portable use in certain emergency shelter applications, the 6-volt auto battery can be placed in a home-made wood carrying case of simple design as shown in photo E.



Helpful RADIO SUGGESTIONS



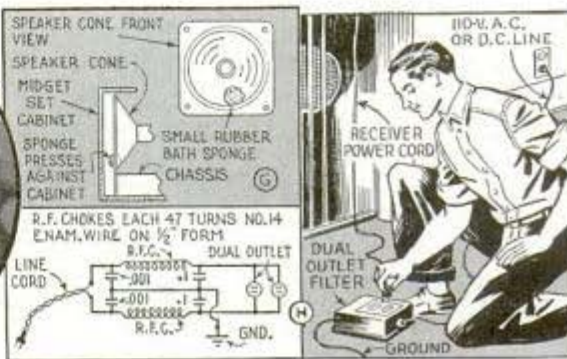
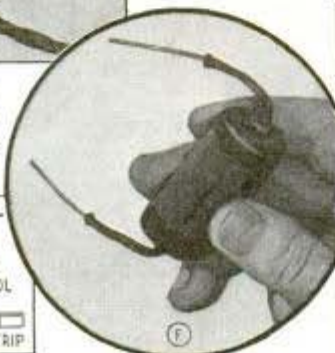
(A) Ridge-pole ultra-high frequency antenna mast for student and WERS applications. Non-critical construction details are given for a mast that is easily raised and lowered to try out various types of rod or di-pole antenna systems. To lower the mast, merely remove the feeders and the brace bolt, and walk back along the ridge with the back brace, as shown in the illustration, until the mast lies flat on the ridge. The guy wires should be located where they will permit raising and lowering of the mast without re-adjustment of tension and prevent side sway during the operation. (B) Insulated screwdriver for radio workers has long plastic handle and is provided with a pocket clip. (C) Extra soldering tip of 1/8-in. copper rod is threaded in a hole drilled and tapped in flat end of regular copper tip for hard-to-reach radio chassis jobs



(E) Handy plastic-handle tool for servicemen combines an aligning tool with a screwdriver. (F) An ordinary paper-type .25 to 2 mfd. 400 volt condenser may be used to determine the presence of voltage in a radio circuit if a voltmeter is not available. Insulate the leads with "spaghetti" tubing, as shown, and place the bared ends across any terminals suspected of voltage. Then remove and bring the leads together; a spark will indicate that voltage was present. (G) Small piece of old rubber sponge stops speaker rattle in midset sets when voice coil is slightly off center. (H) Homemade dual-outlet line filter. Condenser values are not critical, however, these condensers should be tubular paper types rated for either 400 or 600 volts



(D) Temporary repair for carbon volume control in older types of receivers





You may
worry about
feeding
your pets

but you won't worry about your car
with **Marfak Chassis Lubrication**

With Marfak Lubrication you have a sweeter, smoother-running car. For Marfak, you see, is one of the finest, most thorough and efficient chassis lubrication services ever devised.

Your dealer works with a scientific Marfak chart. He checks every vital point on your car, from battery and tires to differential and rear-end gears. No guess-work here—the job is *accurate*, to protect irreplaceable engine and chassis parts.

Insist on genuine Marfak Lubrication today—to keep your car in "top" condition. At Texaco and other good dealers everywhere.

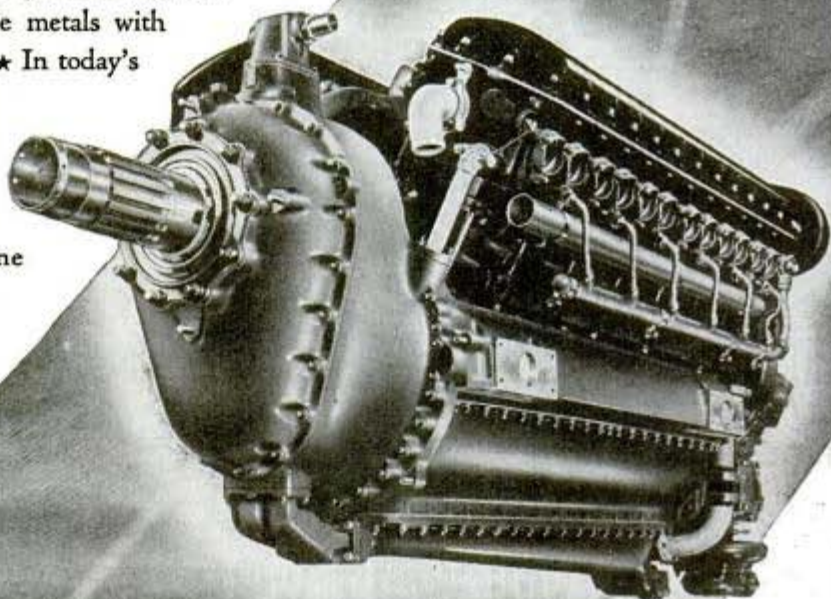


Tune in the TEXACO STAR THEATRE every Sunday night. See your local newspaper for time and station.

You're Welcome at **TEXACO DEALERS**

BRILLIANCE WITH A PURPOSE

Like mirrors and jewels is the sparkle of polished metal parts in an Allison—but the eye cannot begin to see the perfection this brilliance reflects. ★ For one of the challenges in making aircraft engines is this . . . ★ To preserve — by exquisite accuracy of manufacture and finish—all of the inherent strength and endurance in every ounce of material used. ★ This need for perfection is nothing new to Allison. For years it has been our special province to handle metals with precision and lapidarian skill. ★ In today's tasks we are advantaged by all that General Motors has to offer in production techniques. ★ The result is a liquid-cooled aircraft engine which in performance can speak for itself—and an engine which we are resolved to make the finest in the world.



KEEP AMERICA STRONG
BUY MORE BONDS

POWERED BY
ALLISON

P-38—Lightning
P-39—Airacobra
P-40—Warhawk
P-51—Mustang

LIQUID-COOLED AIRCRAFT ENGINES

Allison

DIVISION OF



POPULAR MECHANICS

*"Good Pictures"
bring you
together*



Send your soldier "Good Pictures"... of the old familiar scenes... the home place, the best girl, the old fishin' hole, sister Mary's new baby, the puppy now a dog, the cabin up the river... all the happy scenes of home sweet home. That's what counts a thousand miles from nowhere.

Make the most of your present camera! Take good care of it, and conserve vital film by making each picture a good picture. After Victory Argus will make new cameras... employing the new techniques and extensive experience acquired in War Production.



AWARDED TO PLANT 2
OPTICAL DIVISION

"Good Pictures"

Make the best use of your present equipment—learn more about lenses—films, filters and composition. Send 25c today for this 56-page booklet.

FINE AMERICAN CAMERAS
PRECISION OPTICAL INSTRUMENTS
AVIATION RADIO EQUIPMENT
BUY WAR BONDS

argus

INTERNATIONAL INDUSTRIES, INC.



ANN ARBOR

MICHIGAN



"Maybe next year, Queenie!"

"Mallards! Gosh, don't they remind me of some swell times!

"Gets you kind of excited too, Queenie, doesn't it? I understand. My dog was a lot like you, and I know how he loved hunting.

"There'd be cold, gray autumn mornings when the wind almost blew our ears off. I'd paddle out to our favorite hunting place. Pretty soon our decoys would be bobbin' away. Some mallards would start down to get chummy—then—*whammo!*

"No matter how far away the ducks dropped, that dog of mine used to retrieve 'em every time. I'll bet you did too. And boy, what wouldn't we both give to do some duck hunting this season!

"But there's a war on now, Queenie. We're in the Coast Guard, and we've got a job to do. Maybe next year . . ."

Remington's job right now is to supply a lot of military arms and ammunition fast—to help speed, among other things, the return of hunters and hunting dogs to their favorite marshes. Here is what we are doing . . .

1. *Every working day, Remington produces thirty million rounds of military small arms ammunition.*
2. *And, every working day, Remington produces more than enough military rifles to equip an entire infantry regiment at full fighting strength.*

After the war is won, we will again be serving our sportsmen friends with Remington shotguns and rifles, Nitro Express shells, Kleanbore Hi-Speed .22's, and Core-Lokt big game bullets. *Remington Arms Company, Inc., Bridgeport, Conn.*

"Nitro Express," "Kleanbore," and "Hi-Speed" are Reg. U. S. Pat. Off.
"Core-Lokt" is a trade mark of Remington Arms Co., Inc.

**HELP YOURSELF LATER BY HELPING YOUR
COUNTRY NOW, BUY WAR BONDS!**

Remington

DU PONT

White Magic

(Continued from page 75)

emits a golden light twice as powerful in lumens per watt as the incandescent lamp. Preservation of food in brine may help solve today's canning problems; at North Carolina State College, experimenters have successfully salted down lima beans in brine. Salt is now being employed in the subsurface of paved roads, acting as a stabilizer and antifreeze.

It's an old Russian custom for the newly-weds to fling grains of salt into the corners of their first home to assure happiness and health. That's one of many salty superstitions, among them our own notion of luring luck by tossing a pinch of salt over the left shoulder. The Morton Salt Company suggests a few more productive uses for "white magic" around the house:

Salt is an excellent gargle, dentifrice and cleaner for open wounds. A salt water bath is good for aching feet, a mild solution is a natural eye bath, and it has even been recommended as a hair tonic. Iodized salt is a goiter preventive.

A little salt sprinkled in the pan before the fat will prevent splashing when frying meat. Parsley sprinkled with salt chops easier and finer. When a boiling egg cracks, a pinch of NaCl helps to keep the egg from boiling out. A pinch of salt keeps milk fresh longer, and you can keep butter hard without ice by setting the dish in cold salt water. Soak nuts overnight in salt water and the meats will come out whole. Hot brine poured down the drain once a week helps clean out the grease. A salt-and-turpentine bath will restore whiteness to yellowed enamel bathtubs. You can concoct a good dry cleaner by mixing equal parts of salt and cornmeal, moistened well with turpentine. Ants will retreat if salt is sprinkled where they gather. On the other hand, the goldfish will thrive on a teaspoonful of salt every week. To get rid of egg stains on silver, rub with salt and then wash in warm water and soap.

Or try this. Place a few irregular lumps of coal in a shallow dish and pour in two inches of salt brine containing an excess of salt. Gradually the snowwhite crystals will creep over the entire surface of the coal in a cauliflower-like growth, which can be colored with red ink or watercolors. The salt garden is not utilitarian, but it's amusing.

No wonder the Indians called it White Magic.

☞ To learn where to buy commercial products described in these pages, see the index.

RADIONICS*

**“the impossible we do immediately
the miraculous takes a little longer”**

ARMY SERVICE FORCES—

The Army is . . . men . . . trained men . . . equipped and maintained. On the home front . . . in factories and on farms . . . civilians produce the armament and food and supplies. The bridge between civilians who furnish and soldiers who use . . . is . . . the Army Service Forces. Wherever the soldier is . . . whatever he does . . . the Army Service Forces are charged with seeing that he lacks no essential thing. To fulfill the task outlined in the twenty-one words above . . . literally . . . the “impossible” and the “miraculous” become daily routine with the Army Service Forces.



“AYE, AYE, SIR”

In old English, “Aye” meant “yes.”

It means far more in the Navy.

“Aye, Aye, Sir,” means that the order is understood and will be obeyed.

The Navy has given Zenith many “orders” since this war began.

Our prompt “Aye, Aye, Sir,” has, we believe, been justified by the “intelligence and initiative” (as the Navy says) with which these orders have been executed.

—in days of civilian radio, Zenith was proud of its long series of “firsts”—improvements which made radio history and established leadership in the industry.

—today our viewpoint has changed—materially.

—engaged exclusively in war production, the things we have been called upon to do—the tasks we have succeeded in accomplishing, make past improvements in civilian radio literally look like “child’s play.”

—the work of our engineers in radionics has made the “impossible” possible and accomplished the “miraculous.”

*—mark that word “RADIONICS” (with its subdivisions of Electronics, Radio, etc.)—it has brought into reality and being, devices which only a year or so ago came in the “impossible” and “miraculous” categories.

—today Zenith works in the science of radionics for our armed forces alone.

—in that bright “tomorrow” when peace returns—

—we can only say—the post-war radios that Zenith will produce will contain many interesting new developments.

—that statement is based upon experience which we can not now reveal—but you may take our word that it is a fact.

ZENITH RADIO CORPORATION, CHICAGO

BETTER THAN CASH

U. S. War Savings Stamps
and Bonds

ZENITH
RADIO
LONG DISTANCE
RADIONIC PRODUCTS EXCLUSIVELY—
WORLD'S LEADING MANUFACTURER

141 W. Jackson Blvd.
Chicago, Ill.

Industry's Dr. Jekyll and Mr. Hyde

(Continued from page 45)

Dicalcium phosphate and tricalcium phosphate are among the finest polishing agents for tooth pastes. The former, as made by Victor Chemical Works, is milled to a powder so fine that the largest particle is less than 1/1,200 of an inch in diameter. The tricalcium phosphate, Victor experts point out, is not only used in dentifrices but also as a base for face and beauty creams, for mineral fortification of foods, and as a container to prevent salt, soda and sugar from caking.

Monsanto Chemical Co. also points out that derivatives of phosphorus are used in oil well drilling muds, in sugar clarification processes, and in rustproofing metals.

In the past few years, according to Henry W. Easterwood of the Victor Chemical Works, hundreds of patents have been taken out for uses of organic phosphorus compounds, among the uses being: Preventing fatty oils from becoming rancid; improving hair dressings; flameproofing cellulose acetate, rendering wood termite-proof, and mothproofing wool.

Phosphorated oils are finding uses as plasticizers and softening agents in some types of resin products. Other compounds of phosphorus are used in flotation agents for ore separation, as sprays for plant pests, as stock foods, to acidulate soft drinks, and to make biscuits one-third lighter than Mother—even Grandmother—could make.

Thus, firebrand or friend, in war and for long after the war ends, phosphorus will continue its anonymous job of affecting everyone's daily lives. When you brush your teeth tonight, consider that the same "Dr. Jekyll" that's keeping your molars white might, as Mr. Hyde, be burning down your house.

Engineering for War and Peace

(Continued from page 37)

rushed by taxicabs from another plant. Designers, engineers and workmen stuck to the job all night and by dawn the first bomb adapters were trucked to an airport, taken by a waiting transport plane and reached the bomb crews several thousand miles away 90 hours later.

Another tough one was to design an airport ground light that would withstand the load of a heavy bomber rolling over it. The engineers built a new runway marker lamp using the principle of bridge design, capable of enduring a 100,000-pound load. While they were doing it they designed a

(Continued to page 152)

Avoid those "Icicle evenings"



PROTECT HOME COMFORT WITH BALSAM-WOOL ATTIC INSULATION



Tooth-chattering "evenings at home" aren't fun! But there's no need to endure chilly, uncomfortable rooms. At low cost, you can make your home far more comfortable—and save up to 20% in fuel at the same time—by applying Balsam-Wool Insulation in your attic.

Applying Balsam-Wool is as easy as laying a carpet! That's because Balsam-Wool is a finished insulation—tailored for quick application. Wind-proof, moisture-proofed and fire-resistant, it is scientifically designed for lasting efficiency—and sold under a money-back guarantee of satisfaction.

● Make this lasting investment in comfort and fuel saving. See your lumber dealer about applying Balsam-Wool in your attic—or mail the coupon for full information.

Balsam-Wool

SEALED INSULATION

WOOD CONVERSION COMPANY
Dept. 210-11, First National Bank Bldg.
St. Paul, Minnesota

Gentlemen: I want to know more about Balsam-Wool Double Value Attic Insulation.

To assist us in giving you special information, please check: I am a home owner , renter , architect , student , contractor .

Name.....

Address.....

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





Millions of "Small Arms" Essential to Victory

The sporting arms industry of America ... long skilled in the ways of gun-making ... undertook a tremendous task in production of arms for our Government and its Allies.

The record of its achievement, in quality and stupendous quantity, is a vital factor in America's guarantee of victory.

"Savage" with its thousands of workers is proud to be a part of this industry's important war effort. Reports from all parts of the globe record the effective performance of the Browning Aircraft Machine Guns, and other guns and military rifles produced in our plants.

Savage Arms Corporation, Utica, N. Y.

Buy Wisely - Buy War Bonds

SAVAGE



Since award to Savage of the Army-Navy "E," new and higher production schedules have been exceeded.



SAVAGE AUTOMATIC SHOTGUNS will resume their steady rise in popularity which, before the war, culminated in the introduction of the lightweight model for upland hunting.

A PROTRACTOR-RULE

and a REPAIR HANDBOOK



both sent
FREE

if you mail the coupon

Here are TWO handy helps every householder and handy man should have, and which are available without charge to the readers of this magazine.

1—A durable metal protractor, with black letters on a white background for greatest legibility, with angles reading in both directions, and with an inch scale on the straight side.

2—The 40-page Smooth-On Handbook, with simple instructions for time-saving, labor-saving and money-saving repairs to household and auto equipment, etc. Illustrated by 170 diagrams.

The instructions in this handbook are based on the experience of thousands of mechanics and repair men, and include much information not to be found in any other publication. Some of the subjects covered:

How to seal cracks in boilers, stoves, water heaters, radiators, pipes, auto engine water jackets, gear cases, etc.

How to stop leaks at seams, bolts, rivets, threaded or flanged joints, etc.

How to tighten loose parts of furniture, apparatus, fixtures, utensils, tools, etc.

How to waterproof concrete, brick or stone floors, walls, cisterns, pools, etc.

Get Smooth-On No. 1 in 1 3/4-oz., 7-oz., 1-lb. or 5-lb. container from your dealer, or if necessary from us. For your protection, insist on SMOOTH-ON, used by mechanics and repairmen since 1895.

Send the coupon TODAY to be sure to receive the free protractor and repair handbook before the supply is exhausted.

SMOOTH-ON MFG. CO., Dept. 37
574 Communipaw Ave., Jersey City 4, N. J.

Please send the Protractor and the Smooth-On Repair Book.

Name

Address

11-43



Do it with **SMOOTH-ON**

simpler lens with eight percent higher lighting efficiency.

The searchlight on a submarine called for stamina, too, so they built one that can take the blow of heavy waves, the shock of gunfire a few feet away, with a stainless steel reflector impervious to salt water corrosion and a 1,000-watt filament lamp in heat-resistant glass unaffected by dousing in an arctic sea a minute after it has been burning.

Supercharging engines and planes for flight seven miles high posed plenty of problems. Now the engineers are perfecting an ingenious automatic control for the supercharger drive. Since the supercharger must run faster as the altitude increases, they contrived a way to use the density of the air as an automatic control. In rarer air the fan tends to run faster and the amount of current needed to operate it decreases. The new control interprets this current drop as a demand for faster motor speed and steps up the voltage of the supply generator proportionally. Thus cabin interiors will automatically be kept at a safe pressure. Another item on the high-altitude flight program is an adaptation of the common photoelectric cell; a tiny light is passed through the lobe of the pilot's ear to a photocell from which an instrument reading is taken indicating the oxygen content of the pilot's blood.

Your sealed-beam automobile headlight is the landing light of Yankee bombing planes. Your air-conditioning outfit is giving a hot and cold shock treatment that kills moths in army uniforms.

Peacetime engineering has given us wartime production supremacy. The secrets that are being unwrapped in wartime engineering laboratories will come home to you in the next peace. There is an average lapse of seven years from an invention to its practical commercial application. But it is likely the momentum gained under wartime conditions will enable American industry to rebuild your world quickly when the gunning ceases.

Cheating Death at Sea

(Continued from page 25)

ing but a sheet of rubber between them and water miles deep. The epics of shipwrecked wanderers have made the rafts a familiar and dramatic feature of the war. Collapsible boats now come with paddles, a sail, and a covering which serves as an awning, screening off wind, sun and rain. No longer need the larger types of rubber craft drift aimlessly, since they can be

(Continued to page 154)



There's been
a
big change



● Sentiment about the old things is an admirable American trait. But even the most sentimental of us must admit that change frequently is for the best.

An outstanding example of progressive, beneficial change is that which Tyson has made in tapered roller bearings. Tyson improved the old-time conventional bearing by adding an average of

30% more load-carrying rollers. Result: Tyson users enjoy greatly increased load capacity—almost doubled bearing life!

* * *

These users often tell us that the Tyson "All-Rolls" Bearing is the greatest improvement in tapered roller bearings in forty years. *The big name in bearings today is —TYSON!*

 TYSON BEARING CORPORATION, MASSILLON, OHIO

COUNT THE ROLLS • THE ROLLS COUNT



Tyson

TODAY'S HEAVY-DUTY BEARING

★ BACK THE ATTACK — WITH WAR BONDS ★



Dear Jim:

You ought to see

the interest in motorcycles around here. When our outfit comes in from maneuvers the fellows all crowd around asking questions and begging rides. Believe me, our Club is going to have plenty of new riders after the war.

These military Indians are honeys! They take punishment like regular champs -- and they're easy to handle and safe, just as Indians have always been. Wish I could tell you about the new Indian improvements, but military secrecy won't let me. Regards to all the Club members.

INDIAN MOTORCYCLE COMPANY, SPRINGFIELD, MASS.



BUY WAR BONDS NOW

★ ★ TO BUY AN INDIAN LATER ★ ★

navigated just like a lifeboat of wood or steel. The fabric package which protects them until inflated can be converted into a steadying sea anchor.

Literally hundreds of other devices have been developed to save lives at sea. More efficient breeches buoys transfer men from ship to ship and some serve as life preservers in case of a slip up. Metal baskets with complicated rigging lessen the chance of additional injury to wounded men as they are transferred from one vessel to another. Rubber flotation bags either keep land-type planes afloat for hours, or long enough to give the crews time to escape. Waterproof signal lights have been perfected, some of them equipped with keys so that Morse code messages may be tapped out. Watertight containers have been made for flashlights, medical kits and for provisions.

While it can't be said that a man shipwrecked during this war has all of the comforts of home, it is true that this nation is supplying its seafarers with every practical device Yankee ingenuity can think up.

Wild Horses of the Sky

(Continued from page 65)

whole—a tribute to his flying ability as well as to the sturdiness of the craft.

The Mustang was first used by the British Army Cooperation Command. It has a wide track for its front wheels for stability on the newly-prepared airfields on which an advancing army might have to rely. But until needed for actual invasion support—as camera planes, strafers, spotters, and air arms of the ground troops—the Mustangs were sent on frequent independent missions over the continent.

In that capacity they made ferocious raids on German-held railways, canal and sea transport, troop concentrations, gun emplacements, powerhouses, hangars, radio stations and the like. Though its armament officially is restricted, it has been credited with carrying eight machine guns—four .50 caliber and four .30 caliber—besides a high-speed automatic camera.

Making its bow with the United States Army Air Force, the Mustang, or P-51, has also acquired a new designation, the "A-36." Under that name it is converted into a dive bomber.

British correspondents have tended to rave over this knife-prowed fighter with the name romantically suggestive of the wild and woolly days of the American southwest. They have credited it with a speed of "well over 400 miles an hour." More than one officer has flatly called it the

(Continued to page 156)



Little BUT Mighty

IN WAR AS IN PEACE

A piston ring looks insignificant alongside a mighty gun. Yet both are necessary—to winning the war.

Consider that the simple, inexpensive installation of a set of piston rings can be counted on to restore performance and economy in a worn motor—for many more thousands of miles.

Consider that neglecting to repair an oil-pumping motor may result in a breakdown that will leave you without a car—indefinitely.

Obviously, the sensible thing to do is see your motor service man *before* trouble begins.

Should he find the installation of new piston rings advisable—and recommends Hastings Steel-Vents—you will know he does so out of experience.

HASTINGS MANUFACTURING COMPANY, HASTINGS, MICHIGAN
Hastings Mig. of Canada, Ltd., Toronto

It's a privilege to buy War Bonds

HASTINGS

STEEL-VENT PISTON RINGS

*Tough on Oil-Pumping
Gentle on Cylinder walls*



H&R WARTIME LINE Available Now for Essential Use



**THE H&R REISING
SEMI-AUTOMATIC RIFLE**

Caliber .45; bottom-fed from 12 or 20 cartridge clip; fires as fast as trigger is pulled; effective range 400 yards; weight with magazine 7 lbs. Excellent weapon for police, guard or military use.



H&R STANDARD

Single barrel shotgun, 12 gauge. Unique action design takes up its own wear.



**H&R FLARE PISTOLS
MARK IV; MARK VI**

For ball or parachute flares; 37 mm. and 1" bores.



H&R DEFENDER .38

Five shot, .38 caliber, rugged, precise, general purpose revolver.



H&R SPORTSMAN

Nine shot, .22 caliber. World-famous for crisp action and balance.

WRITE for your free copy of the Manual of the H&R Reising Sub-machine Gun. Also now in preparation—a more detailed catalog of the H&R wartime line covered briefly here; we'll reserve a copy for you at your request—will mail it as soon as it's off the press. Harrington & Richardson Arms Company, Worcester 2, Mass., U.S.A.



H&R

FINE FIREARMS

For Sportsmen, Police, and the Military

fastest reconnaissance craft in the world. A correspondent wasn't censored when he said observers estimated the speed of a Mustang in level flight barely above the tips of the trees, at 425 miles an hour.

The plane's range, too, is astonishing. Mustangs were the first single-engined fighters in the history of British aviation to make raids into Germany from bases in England. On their first such flight, in October, 1942, they flew 250 miles east, attacking objectives on the Dortmund-Ems canal, a round trip of well over 500 miles.

In one month Mustang squadrons rang up more than 100,000 flying miles, destroying, incidentally, 42 railway engines.

Any collapse of Hitler's continental supply lines can be credited in great part to the Mustangs, which have long carried on a personal grudge fight against German trains. Hedge-hopping across the tracks, pilots blow up the locomotive boilers.

In one raid, a pilot destroyed a freight engine and 30 cars. In one week, Mustang pilots knocked over 19 locomotives, seven tugs, and numerous barges and trucks. Within two minutes one Mustang pilot shot down an Me. 109 and a Junkers-52 troop carrier, then set fire to two ships. A Mustang-flying wing commander in 25 minutes damaged or set afire two armed launches, a tug, a steamer, and a locomotive.

Sensation of watching the Mustang in flight is its amazingly fast and silent approach. It bounds in just above trees and buildings, hugging the earth so enemy gunners cannot get a long-range shot.

There is no distant engine drone, growing louder as the plane approaches, but a sudden screaming roar overhead, and the wild horse is upon you.

"Tough, maneuverable, no vices," is the laconic verdict of one British pilot.

"A good plane to have on our side."

Airline to Anywhere

(Continued from page 11)

five months before the last of the marooned crew was taken off, and through those five winter months Capt. Kenneth H. Turner and his crew kept ferrying supplies to them.

"With the days only a little over two hours long part of the time," General George relates, "through the worst kind of winter weather, Turner and his men kept them alive. They carried arctic clothing to them, sleeping bags, stoves, walkie-talkie radios, medical supplies and instructions, and food of course. Mainly they dropped army rations, but they also managed some delicacies like canned chicken, even some

(Continued to page 158)



HOW TO WHITTLE DOWN A WOLF PACK

FIRST STEP in sinking a sub is to *see* her. And if you don't see her *soon* enough, it may be the last sub you'll *ever* see.

First to last, sub hunting from the heaving deck of a freighter calls for precision teamwork by the gun crew, and for precision instruments. Particularly, precision *optical* instruments to help you see and sight your target.

Such instruments are required in unprecedented numbers for every operation in this war. To help meet this need, Universal is making them for the Army, Navy, Marines and the United Nations, in *quantity production* hitherto

thought impossible where nothing but the finest will do.

Today, thanks largely to Universal engineering research, outstanding accuracy in lens-making is achieved more economically than ever before, *anywhere in the world*.

Result: a new impetus in the development of photographic and optical instruments . . . promise of finer-than-ever cameras available to everyone.

Straight lines through optical flat indicate perfect flatness.



PRECISION IN THE MAKING

Measured in fractions of lightwaves

One half wavelength of light is the tolerance allowed for prism flatness in Universal Binoculars. Variations of more than 1/100,000 of an inch — show up as curved lines instead of straight ones when the prism is inspected through the optically perfect master.



There's only one flag we're prouder of!

UNIVERSAL CAMERA CORPORATION

NEW YORK • CHICAGO • HOLLYWOOD

Makers of Precision Photographic and Optical Instruments • Peacetime Manufacturers of Cinémaster, Mercury, Corsair Cameras

"Off we go, into the wild blue yonder..."*

Valiant, indeed, are those who have made this song their battle hymn. Who of us can honestly say that he would not turn back time, given the chance, to be able to join their select company—to consort with avenging eagles?

Let's not forget that we can and do go with them directly in proportion to the War Bonds we buy. Then, too, many like us, producing equipment for their use, have a hand in their welfare—the ability and determination to build something better so that they will be better equipped to triumphantly fulfill their missions.

Champion Spark Plugs are but one small, vital piece of equipment produced for the air forces. But vital they are, and so into them we pour all the skill of our thirty odd years in the spark plug business exclusively, plus that extra zeal for Victory which motivates all of us.



*By special permission of Carl Fischer, Inc., copyright owner of "The Army Air Corps," Robert Crawford, Author and Composer.

CHAMPION SPARK PLUGS



BACK THE ATTACK—WITH WAR BONDS

Say you saw it in Popular Mechanics!

butter and candy bars. They dropped some mail to them; that helped a lot."

The winds were too violent to parachute supplies, so the crew flew over the wrecked plane at 50 feet and "bombed" the men with packages. When the rescue was finally made, Turner and his crew flew on to England and delivered their Fortress.

Pilots of the Air Transport Command range from 21 to 46 years old, many of them commercial air line pilots now under army orders, and more and more of them women. The girls are being recruited as Air Transport pilots at a rate of 75 every six weeks, and, General George reports, "I can tell you they're good, too. They fly everything the men fly except the four-motored bombers, and I wouldn't be surprised if they delivered some of them one of these days, too. We anticipate that eventually 40 percent of the transport flying in the United States will be done by women."

The ATC flies a variety of cargo planes, some of them two-story freighters with an elevator to load through the upper door and another loading door in the belly. There is the Douglas DC-3, the conventional "workhorse of the air lines," and its conversion models, the Army C-47 "Skytrain," and the C-53 "Skytrooper," with wood floor, benches for troops, and a tow cleat on its tail for towing gliders. There are the Boeing and Martin and Vought-Sikorsky flying boats, the Boeing Stratoliner and Lockheed Lodestar, Consolidated's famed "Catalina" flying boat, the big Douglas DC-4 "Skymaster," and the new Lockheed "Constellation," that flies faster than a Jap Zero and is easily recognized by its sharklike fuselage and triple tail assembly. The Curtiss "Commando" was added since the war began. And one of the busiest of the ATC fleet is the Liberator bomber, translated into a troop carrier or into the C-87 cargo plane. Yet none of these aircraft was primarily designed to

(Continued to page 160)

Model Builders Attention!

	V	V-2	V-3
Hex	1/2"	3/8"	5/16"
Thread	3/16"-24	1/4"-32	1/4"-32
Thread Length	7/32	7/32	5/32
Weight, Grams	8	3 1/2	2 1/2

Actual Size V-Plug

Champion spark plugs for model gas engines give the same dependable performance as regular Champions. Sillment sealed. Sillimanite insulator. Alloy needlepoint electrodes for easy starting. One piece construction.

CHAMPION

SPARK PLUG COMPANY • TOLEDO, OHIO



Here's how the Navy is using your
GENERAL ELECTRIC auto dome light

Equipped with special new shock-resistant filaments, this old friend is withstanding the pounding waves and the vibration of powerful motors on harbor patrol boats. And remember mother's sewing machine light? It's been adapted for Navy signal devices and instrument illumination. All in all the Navy is using 102 different G-E lamps.



Here's how you can make your present General
Electric Lamps **"STAY BRIGHTER LONGER"**

Take the G-E sealed beam headlamp on your car, for example. Traffic dust, dirt and grease on the lens may cut your light as much as 50%. By keeping your car headlights clean and adjusted, you may help save a war worker's life, not to mention your own. Don't waste light at home either. Keep your lamps and fixtures clean and turn off lamps that are not needed.



Here's how you can be sure of getting
the benefits of General Electric lighting research
when **"THE LIGHTS COME ON AGAIN"**

Will lighting—everywhere—take on new dimensions after the war? Will homes really enjoy sunlight? Will we enjoy the wonders of fluorescent lighting in our homes? Will we kill germs with light? The answer to these questions about the lighting of tomorrow are being explored in General Electric laboratories. But of this you may be sure: The G-E monogram on a lamp bulb will continue to be your assurance of lighting progress, through research.

Hear the General Electric radio programs: "The Hour of Charm", Sunday 10 p.m. EWT, NBC; "The World Today" news every weekday 6:45 p.m. EWT, CBS.

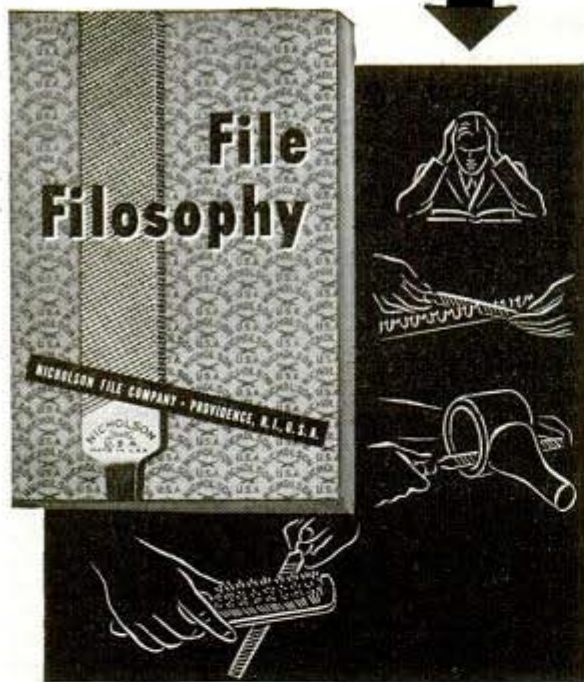
G-E MAZDA LAMPS

GENERAL  ELECTRIC



INVEST IN YOUR COUNTRY'S FUTURE... BUY AN EXTRA WAR BOND THIS MONTH

"A HOME-STUDY COURSE" for a postage stamp



ARE you a shop foreman, mechanic or mechanical "trainee" who appreciates the importance of sound fundamental knowledge of the proper use, proper care and proper selection of tools?

Start with files and filing—one of the most basic and widely applicable subjects in the mechanical curriculum. If you are in or definitely aiming toward a mechanical career, a postage stamp will bring us your request for

"FILE PHILOSOPHY"

—the most authoritative book of its kind. Widely used in school-shops and shop-schools, "File Philosophy" takes you through the history of files; the way files are designed and manufactured; the kinds, sizes and cuts of files; the purposes and characteristics of many special files. Tells how to use files expertly—on various metals, in sharpening saws and other tools; how to take care of files.

IT'S FREE—this valuable "text-book" of 48 interesting, informative, profusely illustrated pages—a Nicholson contribution to the advancement of American industry and the vast army of trained men who are its back-bone.

NICHOLSON FILE CO., 22 Acorn St., Providence 1, R. I., U. S. A.
(Also Canadian Plant, Port Hope, Ont.)

Manufacturers of Nicholson and Black Diamond quality files—sold through hardware and mill-supply houses.



carry freight. A true cargo plane, however, is on the way.

More than once the swift couriers of the Air Transport Command have met an emergency that changed the course of the war. Once they played their essential part in saving Egypt. Rommel was at the very gates of Cairo when the British sent a call for help. They were virtually out of anti-tank ammunition fuses. The SOS came to the ATC, and within 72 hours the fuses were gathered up in America and flown across and unloaded on the African desert.

British soldiers, British guns, British leadership beat Rommel. But without the ammunition flown in the nick of time by the U. S. Air Transport Command, Rommel might not have been stopped.

In such vast operations, an accident rate of 44/100 of one percent is amazingly low. That's one accident per 200 planes, and few of these keep a plane out of service long.

The Air Transport Command is one reason why your gasoline is being rationed. Its fuel consumption must be a military secret, but it is unimaginably enormous.

Today the tremendous fleet of thousands of Air Transport Command aircraft is carrying ten times as much material, and ten times as many passengers, as all the air lines of the world before the war.

Hitler's 500-Acre Headache

(Continued from page 5)

70,000. There are 50 miles of water and gas mains, 500 miles of telephone wire.

Compared with this impressive plant, the engine it produces seems unbelievably simple and insignificant at first glance. It is only when one follows the intricate steps in the creation of this modern miracle that one appreciates its production problems.

At one end of the plant is the forge shop for the heavy parts that go into the engine. Here red hot blocks of steel are beaten and squeezed into shape by giant hammers. The concrete bases that support the blocks under the hammers have piles that go down to bed rock. The dies that shape the thousands of parts are made in the die shop, and the hard steel tools for cutting the dies are made in a nearby tool shop.

In twin units, each of which would be considered a major industry in its own right in normal times, castings of aluminum and magnesium are made. The world's largest magnesium castings are poured in the magnesium foundry. If one of these big castings were made of steel, it would be more than a man could budge; as it is, it can be lifted with one hand. It doesn't take

(Continued to page 162)



RAINBOW IN THE SKY

There is good news in the work of American laboratories. It is a reason for confidence in the war — a promise for the future.

Little is said about our scientists because they labor behind locked doors and their work is secret. But the topside of the German and Japanese armies and navies know about them. Things they do turn up at the front and make life harder for our enemies.

After the war, from these same scientists and their laboratories, will come the things that make jobs, comforts, conveniences and luxuries for the American people. They hold out prospects for good use of the opportunities victory will bring.

The Bell Telephone Laboratories, with some seven thousand workers, are among the many research groups that are devoted to winning the war.

When that is done, Bell System scientists will be back on their old job of making your telephone service, and your human contacts over the distances, easier and better than ever.

BELL TELEPHONE SYSTEM



HELP THE WAR BY MAKING ONLY VITAL CALLS TO WAR-BUSY CENTERS. THAT'S MORE AND MORE ESSENTIAL EVERY DAY.

FOR MEN WHO REALLY KNOW PIPES

Royalton



Makes a home-body
feel like Somebody . . .

To enrich your close-to-hearth hours select a Royalton for complete smoking satisfaction . . . The pleasure that a Royalton brings will endure long after ordinary pipes have been laid aside.

Royalton Silver Crown

Choice Grains

\$5



Royalton
SPORTSMAN

Wherever Better Pipes are Sold

© 1943, Henry, Leonard & Thomas, Inc., Ozone Pk., N. Y.

an aeronautical expert to appreciate the importance of this comparatively light-weight part in a bomber engine.

The process of pouring magnesium is one of industry's most colorful operations. The white-hot metal that has a tendency to burst into a pyrotechnical display unless carefully treated is poured into molds made of sand baked as hard as stone. The molds, of course, are also made in the foundry. Before pouring the magnesium, carbon dioxide gas is pumped into the recesses of the mold to remove all air, for the hot magnesium burns on contact with oxygen.

When the large and small castings are broken out of their molds, rough spots are machined away and they are sent along on the network of assembly lines that feed into the main machining and assembly building.

Here the parts that pour from the foundries and forge shops in a never ending stream are cut down, ground and polished on the greatest array of lathes, drills and other finishing machines ever assembled. Metal is ground to specifications measured in hundred-thousandths of an inch.

In this building many of the parts receive a final heat treatment to harden their mirrorlike surfaces. Others are painted and treated with chemicals, and some are even plated with tin, nickel or chrome.

Visitors are taken through the building on a platform trailer pulled by a tiny tractor. Beside each seat is a loud speaker that carries the voice of a company man who sits beside the driver with microphone in hand.

Two-thirds of the main building is used for machining, and a "small" area of about 22 acres is occupied by the sub-assembly, first run, and final assembly lines. This section is air-conditioned to guard against minute expansion or contraction of the metal parts. On the sub-assembly line, the finished parts are gathered and put into a specific piece such as the supercharger, pistons or ignition system.

At the end of the first run line, the engine is lifted from the assembly dolly and placed on a test mount designed to speed the transfer to a test cell, and the job that once took hours is accomplished in a few minutes. In the cell, a generator instead of a propeller is attached to the shaft and the energy is used to make electricity.

After the first test, the engine is completely taken apart and each part is minutely examined. If any defects show up, new parts are substituted before the second assembly begins on the final line.

Workmen have nicknamed the plant "Hitler's Headache." One of these days the engines they are building will be roaring over Berchtesgaden.



"FIRE BOMBS FALLING ... Rush the Pumpers!"

It's a forward base for the big push . . . and the Japs know it. They're trying to burn us out. For a while it seems we have more fires than we can handle . . . that is, till the fire pumpers arrive. They're hauled by anything that will pull! They unlimber and go into action like artillery. Fire just hasn't a chance with them around!

Nearly anybody can operate a Chrysler War Emergency Fire Pumper . . . Originally developed to meet an acute shortage of fire equipment in areas vulnerable to air raids, they had to be simple and easy to use. Thousands of them now augment our regular fire departments in all parts of the country. They've proved so compact and

mobile that many more have been sent into service at our advanced bases overseas.

The Fire Pumper is built around the same sturdy, dependable engine used to power thousands of cars manufactured by Chrysler. The engine with its moving parts Super-finished mirror-smooth—some to one-millionth of an inch, for quietness, economy and longer life.

Such Chrysler wartime developments demonstrate the pioneering leadership of Chrysler Division.

BACK THE ATTACK—
WITH WAR BONDS

CHRYSLER



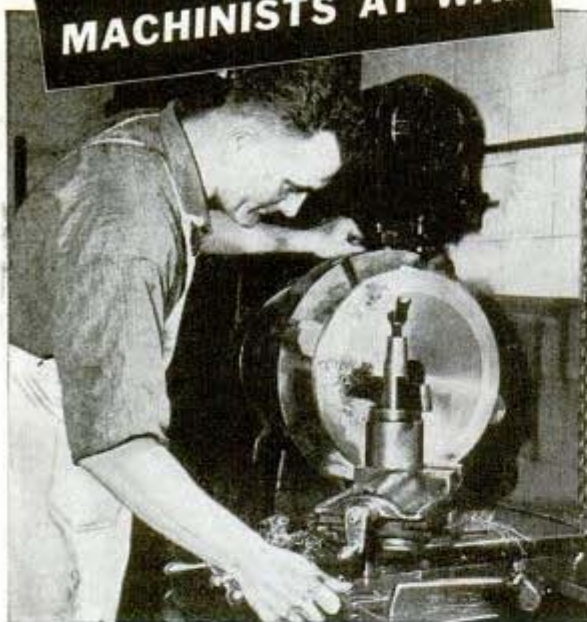
DIVISION OF CHRYSLER CORPORATION

WAR PRODUCTS OF CHRYSLER DIVISION

Industrial Engines • Marine Engines • Marine Tractors • Navy Pontoons • Harbor Tugs • Anti-Aircraft Cannon Parts • Tank Engine Assemblies • Airplane Wing Panels • Tank Parts • Fire Fighting Equipment • Air Raid Sirens • Gun Boxes • Navy Searchlight Reflectors.

THE NATION-WIDE CHRYSLER DEALER ORGANIZATION
OFFERS OWNERS SERVICE FACILITIES TO MEET
THEIR WARTIME TRANSPORTATION NEEDS

TOOLS FOR MACHINISTS AT WAR



The manufacturing might of all America is concentrated on producing for victory. In the front rank of this vast industrial army are the machinists—and their weapons are tools!

In plants everywhere throughout the nation machinists are busy at every phase of their craft—helping to turn out more, faster, with tools by Disston. Some of the machinist's tools supplied to industry by Disston are the files used every day in general machine shop work, Superfine Swiss pattern files for precision work, file cards, hack saws, hack saw blades, metal cutting hand saws, metal cutting band saws, solid and inserted tooth metal cutting circular saws, metal cutting sabre blades, tool bits, machinist's chisels and others.

● If you need a hand saw for essential war work, see your Hardware Dealer about

DISSTON D-7



Lightweight Straight-back pattern. Universally popular, moderately priced, Disston quality. Made in 26-inch 7, 8, 10 and 11 points cross-cut, 5½ points rip.

KEEP TOOLS WORKING with the help of the Disston Saw, Tool and File Manual—FREE from your Hardware Dealer . . . or write for a copy.

HENRY DISSTON & SONS, INC.
1111 Tacony, Philadelphia 35, Pa., U. S. A.

PALMGREN ANGLE VISES

for Drilling
Milling
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Solve Difficult Angle Jobs

Quick, accurate setups at any angle. End makeshift methods—time loss—rejections. Ideal for tool rooms or home workshop. Accurately machined and graduated. Once set, it stays locked. Jaws hardened steel—plain or grooved. Sizes 1½" to 8" Jaws. Orders filled on plant priority ratings only. You may qualify. Write,

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8365 South Chicago Ave.
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"101 ANGLE OPERATIONS" describes complete line, gives many uses and details of CASH PRIZE AWARDS

PRECISION WORK AT ANY ANGLE

PROTECTION FROM RUST

TOOLS — GUNS — LOCKS, Etc.

For years hunters have used Fiendoil to keep their guns clean and free from rust . . . equally effective on all metal articles.

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In 35c, 2 oz. Bottle

FIENDOIL

MCCAMBRIDGE & MCCAMBRIDGE CO.
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New OTTAWA WOOD SAW

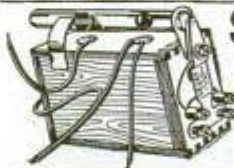


For Tractors

Makes wood sawing fast and easy. Can cut enough wood to pay for itself quickly. Easily moved while attached. Big heavy blade. FREE details.

LOW PRICE

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SELL ELECTRIC FENCER

The New HIBALL FENCE KIT is the best yet. Sell dealers or direct. Salesmen make up to \$188.64 per gross. Good territory open. 2 Samples, \$3.00.

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TRAILER AXLES, HITCHES, AND PARTS

● If you are interested in purchasing trailer axles, hitches, and other trailer parts, contact us promptly. Complete house trailer blue prints, \$1.00. Write for free literature.

HAMMER BLOW TOOL COMPANY, Dept. 111, WAUSAU, WIS.

MOTORISTS Wanted!

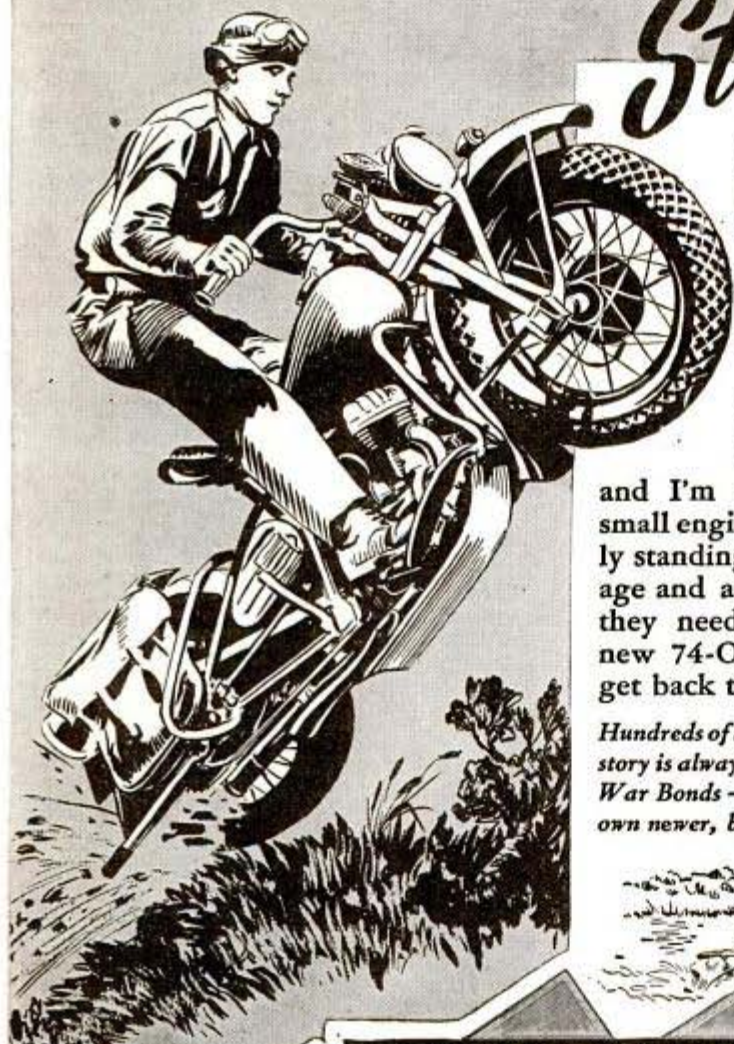
TO MAKE THIS UNIQUE GAS SAVING TEST

Will you permit us to send you at our risk the Vacu-matic, a device which auto owners everywhere are praising? Install it on your car. Test it at our risk. Unless it trims dollars off your gas bills by saving up to 30% on gasoline consumption, gives more power, quicker pickup and faster acceleration, the test will cost you nothing.

Automatic Supercharge Principle
Vacu-matic is entirely different! It operates on the supercharge principle by automatically adding a charge of extra oxygen, drawn free from the outer air into the heart of the gas mixture. It is entirely automatic and allows the motor to "breathe" at the correct time, opening and closing as required. Saves up to 30% on gas costs, with better motor performance.

AGENTS Get Yours FREE
FOR INTRODUCING. Here's a splendid opportunity for unusual sales and profits. Every car, truck, tractor owner a prospect. Send name and address now for big money making offer and how you can get yours Free.
The Vacu-matic Co., 7617-845 W. State Street, Wauwatosa, Wis.

Harley-Davidsons are Really *Standing Up!*



On all war fronts, the men who ride and service Harley-Davidsons are learning what "dependable performance" really means. You can't beat tough war action for proving that Harley-Davidsons can "take it and dish it out."

One fighter wrote from (CENSORED): "We're in an ordnance maintenance outfit and I'm overhauling trucks, cars and small engines. Harley-Davidsons are really standing up. They get twice the mileage and abuse other vehicles get before they need attention. I intend to get a new 74-OHV Harley-Davidson when I get back to the good old U. S. A."

Hundreds of these letters continue to pour in—and the story is always the same. Put your fighting dollars in War Bonds — and join the riders who are going to own newer, better Harley-Davidsons after the war!



HARLEY-DAVIDSON
MOTORCYCLES

HARLEY-DAVIDSON MOTOR CO.
Dept. P, Milwaukee 1, Wisconsin

Please send at once free copy of 24-page "Enthusiast" Magazine, filled with motorcycle action pictures and thrilling stories.

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SEND COUPON NOW

FREE!

THIS IS THE WHEEL, MR. JONES



Maybe you were stumped by grinding jobs before, but they won't worry you any more.

300 shapes and sizes—every grade and grain—there is a Chicago Mounted Wheel custom-built to take on any grinding problem. Each

wheel is a whirling point of power that turns your jobs out smooth—and in a hurry.

PROMPT DELIVERY—Our wartime set-up concentrates on mounted points and grinding wheels 3" in diameter and under. Production is stepped up and keeps pace with demand.

Handee Tool of 1001 Uses and Hi-Power Grinders are still available to all who have priorities.

Send for Free Catalog

CHICAGO WHEEL & MFG. CO.
108 S. ABERDEEN STREET, CHICAGO 7, ILLINOIS

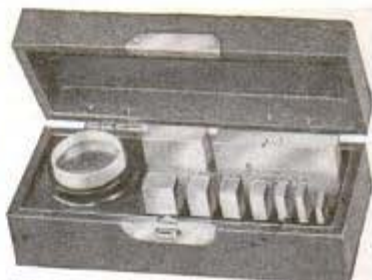


PRECISION GAGE BLOCKS

Indispensable in interchangeable manufacture, in testing and setting tools, in checking micrometers, U L T R A - C H E X are now available in nine block sets as illustrated.

Every toolmaker and mechanic can now afford his own set of gage blocks. Order now to turn out highly precise work, reduce rejections, save material.

The ULTRA-CHEX set consists of the following blocks: .0625", .100", .125", .200", .250", .300", .500", 1", 2", enabling you to make up 331 combinations.



BECOME A BETTER CRAFTSMAN BY ORDERING ULTRA-CHEX NOW!
Price with optical flat... \$27.50 Price without flat... \$19.50

ASK FOR NEW FOLDER "THE USE OF GAGE BLOCKS"
GEORGE SCHERR CO. 128A Lafayette St. New York, N. Y.

Speed Welding Production

with Steel-Grip one-piece-backwelders' gloves

Specially designed Steel-Grip Welders' Gloves give extra protection against heat and wear. Keep production "rolling." Entire back cut in one piece from special tanned heat-resistant leathers. No seams in back. No burned-through or ripped seams. Wool heat breaker lining inside back for added protection. Finger seams welded at points of greatest wear. Widespread thumb reinforcement. Try a pair. Order No. 13475. Outlast other gloves. Order No. 13475 now from jobber or direct, 10% discount on 12 pair lots. Write for welders' clothing catalog.



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FIX THAT WOBBLY CHAIR

IN 1 MINUTE FOR 1¢

Get TITE JOINT, amazing new fabric cross impregnated with powerful adhesive. Tightens chair rungs, table legs, drawer pulls, umbrella handles, other loose joints. Just wet, place over end of loose dowel, and push into socket. Cements itself to wood; is there to stay! Department, hardware, chain stores. . . . Wholesalers' inquiries invited.



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110-VOLTS AC from DIRECT CURRENT

with KATO KONVERTERS. Furnish standard 110-v AC from 32, 110, or 220-v. DC. Good deliveries on sizes 350 through 1500 watts on priority orders.

Good deliveries on 5, 7½, 15 & 25 KW AC generators. Mfr's of motor generators, frequency changers and high frequency generators.

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LUBRICATES • CLEANS • POLISHES • PREVENTS RUST

3-IN-ONE Heavy Body OIL

PROTECTS LIGHT MOTORS



At Hdwe., Drug, Grocery and 10¢ Stores

Mortite UTILITY TAPE

BETWEEN YOU and THE COLD

New pliable plastic stops leaks, saves fuel. Weatherstrips windows, doors, baseboards—caulks casements; makes packing, gaskets.

Easy to apply. Unrolls like ribbon. Just press into place and it stays put. Does not crack, chip, dry out or shrink.

About 80 ft. to a box. At Hardware, Plumbing, Mill Supply Dealers or \$1.25 prepaid (\$1.40 west of Rockies).

Send for Circular

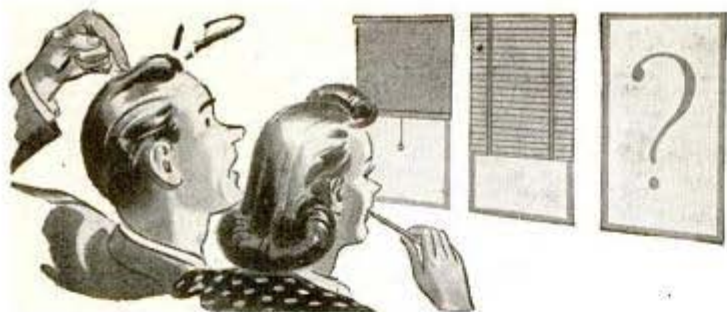


STOPS THAT DRIP

A sure cure for condensation drip from tanks, pipes, walls, ceilings, etc. Apply with brush, trowel or spray. At stores or \$1.90 for 1 gal. prepaid (\$2.10 west of Rockies). Free Circular.

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Say you saw it in Popular Mechanics!



What kind of "window blinds" do you want for your home after the war?

TELL US...YOU MAY WIN \$200.00* IN WAR BONDS OR ONE OF THE 41 OTHER PRIZES, TOTALING \$500.00

WHAT HAS BEEN DONE



Many years ago, window drapes and shutters were used to regulate light and give privacy.

About 1864, the spring roller for cloth shades was perfected. Since then there have been few changes in this roller, or in cloth shades.



Fifteen years ago, CLOPAY perfected and introduced cellulose fiber window shades which looked like expensive cloth shades, but cost about 1/5 as much.



Then women asked: "Why can't you make a shade to attach to our old rollers so we can afford to put up fresh, clean window shades every year?" So CLOPAY invented the gummed strip which makes it easy to attach a new CLOPAY shade to an old roller—without tacks or tools. These "refill" shades still sell for 10c, 15c—with lovely washable ones for only 29c.



Next, Venetian Blinds for all. CLOPAY developed Venetians with sturdy, curved fiber slats that look like the smartest steel and wood Venetians. They cost about half as much — \$1.69 to \$2.19.

What's your pet window shade peeve? How would you remedy it? What gets your goat about Venetian Blinds? How would you improve them? Have you a brand-new, bright idea about window blinds?

WHAT MIGHT BE DONE

For instance, you may have an idea for a window shade that pulls from side to side. Such a shade could be made.



Or, perhaps you'd like a Venetian Blind with slats of glass or some other material. Maybe you have an idea for an entirely new kind of slatted shade.

How about an accordion-type blind—one that lets down from the top, or pulls up from the bottom?



Let's have your ideas and suggestions for the window blinds CLOPAY is planning for the brighter homes of tomorrow. And even the simplest thought may win one of the 42 prizes. It may be a suggestion for a new pattern, color or material...an idea for improving wearability...a new way of hanging, pulling or adjusting. Read the easy rules and get busy this very minute.

CLOPAY CONTEST RULES

1st Prize\$200 in War Bonds*
2nd Prize.....\$100 in War Bonds*
Next 40 Prizes..Each, \$5 in War Stamps

1. Write a letter telling us what you think is wrong with window shades or Venetian Blinds; what changes you would like after the war. Suggest, if you can, how these improvements might be made. Or briefly explain any brand-new idea you have for window blinds. Write plainly, on one side of paper only.
2. Mail your entry to CLOPAY Corporation, 1278 CLOPAY Square, Cincinnati 14, Ohio. All entries must be mailed no later than midnight, December 31, 1943.
3. Entries will be judged on the basis of originality of idea, state, and local laws Penmanship or fancy
4. No entries will be returned. All entries, ideas and contents thereof become the property of the CLOPAY Corporation.
5. This contest is open to any resident of the United States or Canada, except employees of the CLOPAY Corporation or its advertising agency and their families, and is subject to all Federal, state, and local laws and regulations.

*Maturity value.

CLOPAY WINDOW SHADES

On sale at 5-&-10c and neighborhood stores everywhere.



No. GA121—This watch can go places—sturdy, anti-magnetic, precision tested, 15-jewels. Has radium dial and hands, non-breakable crystal, waterproof strap, sweep second hand and stainless steel back. SHOCK-RESISTANT. **\$39.75**

No. GA328—Same, 17 jewel, SELF-WINDING, SHOCKPROOF. **\$59.75**

Attractively Boxed. Prices include Federal Tax. Postage Prepaid.

Write for Free Illustrated Booklet "GA" MAIL ORDERS PROMPTLY FILLED

BELL WATCH COMPANY

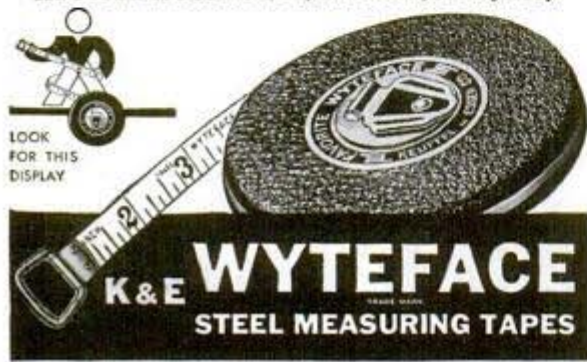
Time and Life Bldg., Rockefeller Center, New York, 20, N. Y.

"I'LL TAKE THE WHITE ONE EVERY TIME"



... EASY TO READ

—easy to clean—unconditionally guaranteed for one year. The crack-proof white surface is bonded to the steel—protects it from rust. 25, 50, 75, 100 ft. lengths. Sold by hardware, building material, mill supply dealers everywhere. Write for folder. **KEUFFEL & ESSER CO., Hoboken, New Jersey**



Say you saw it in Popular Mechanics!



Want a cheery fire, fast? Light a HEATAB! Wet or dry it gives instant flame, long-burning, intense heat—outdoors, indoors, for cooking, camping, picnics, hunting, fishing, starting furnace, stove or grate fires. Countless other uses by housewives, doctors, nurses, dentists, chemists, industrial workers, Boy Scouts, Girl Scouts, Red Cross and Civilian Defense workers. Needed in First Aid and Emergency Kits. Carried by armed forces to heat combat rations. Solid, compact, non-poisonous. NO SMOKE, SOOT, FUMES or ASH!

SPECIAL OFFER: COLLAPSIBLE STOVE (fits vest pocket) included with TWO LARGE BOXES OF HEATABS... only \$1.00 postpaid... ORDER BY MAIL, TODAY!

J. W. SPEAKER CORPORATION
1673 N. Water Street Milwaukee, Wis.



Land or Water "DUCKS" know their Way

At beach-heads in strange lands our soldiers must know directions. HULL STRAMLINE COMPASSES are used on most military vehicles, taking the entire production of the Hull plant. The engineering necessary will provide a more accurate and serviceable compass for civilian autos after the war.



HULL MFG. CO., P. O. Box 246-D11, WARREN, OHIO

PAINT STRIPING TOOL ONLY \$1.00 POST PAID

Try it! See the Added Beauty

With this NEW TOOL (not a brush) everyone can now draw lines with paint. Used on autos, trucks, toys, tiled walls, cabinets, furniture, linoleum floors and all home workshop projects.

As easy to use as a pencil

Send only \$1.00 for complete tool for painting a 1/16" wide stripe, including adjustable guide, operating instructions, etc. C. O. D. price \$1.25. Tool uses paint, enamel, lacquer, etc. Patented interchangeable tips are available for wider or narrower stripes.



Every Painter and Craftsman Should Own One. Send for your tool today. Use it. If you are not satisfied that you have added character as well as beauty to your work, return the tool and we'll refund your money promptly.

Dealer: Write for literature, etc. **WENDELL MFG. CO.** 2531 N. Ashland Ave. Chicago, Ill.

MAKE BIG MONEY SAWING WOOD NOW!

350 Cuts a Minute



OTTAWA ONE-MAN TRACTOR SAW

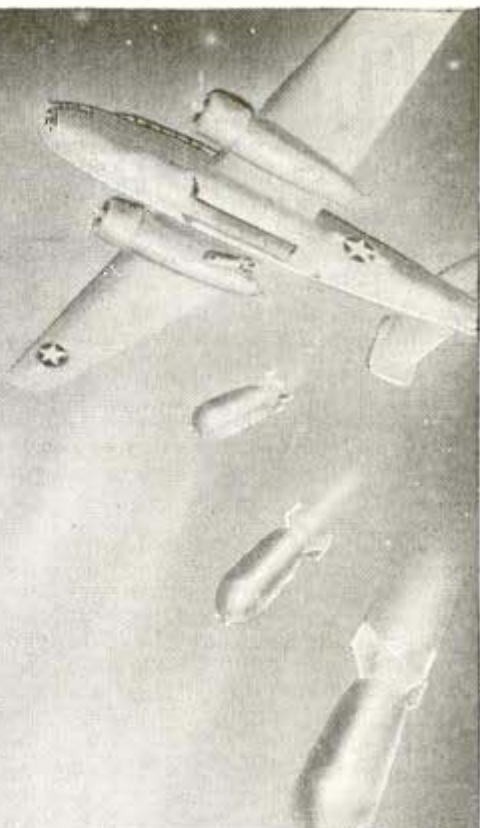
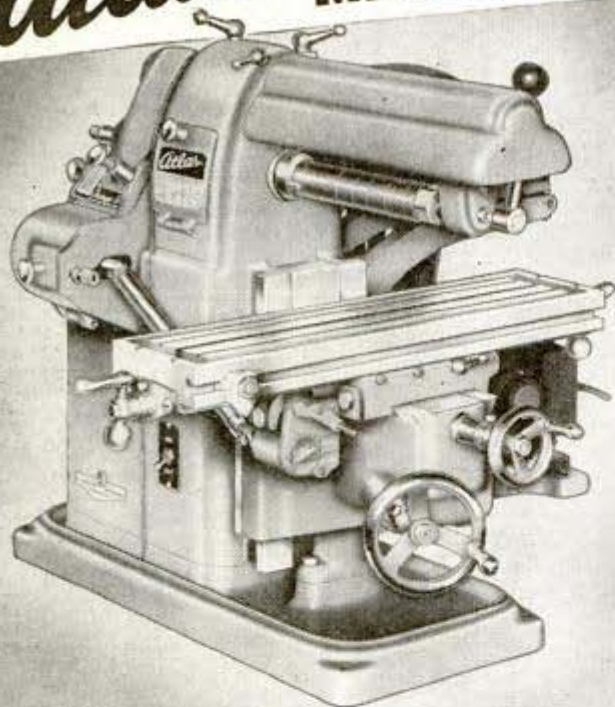
Turn wood lots into cash; help save other fuels to win the war. Use Ottawa—fastest cutting; easiest way. Cuts large and small logs, fells trees. Thousands in use. Built to last with special heavy stiff saw blade. Positive safety clutch control, driven from any power take-off.

OTTAWA MFG. CO., D-1127 Forest Ave., Ottawa, Kansas

FREE BOOK and Price List

POPULAR MECHANICS

Atlas MILLING MACHINE



ON EVERY FRONT WHERE PRECISION COUNTS

Millions of dazed Germans fleeing devastation from the air . . . captured Nazi supermen cowed and begging to see our "automatic cannon" . . . Jap warships sunk in pitch black night, out of sight but not out of reach — such military miracles are tributes to the American ingenuity and the production ability of American industry.

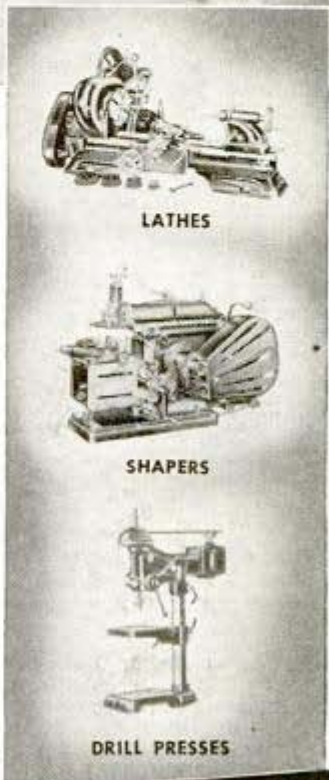
We're proud that in thousands of war plants, and in the mobile machine shops of our armed forces, compact modern Atlas machine tools are picked for the precision work that helps make such victories possible.

Typical of Atlas development for war production is the Milling Machine — shown above — first low cost bench milling machine. It handles the full range of milling on small parts, relieves larger machines of such work, and maintains precision production day after day. It's a good tool to remember for your post-victory shop.



ATLAS PRESS COMPANY

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LATHES

SHAPERS

DRILL PRESSES

★ BUY WAR BONDS NOW ★

FOR A NEW *Atlas* SHOP
AFTER THE WAR

HOW TO CHOOSE A GLUE

Don't think that there is any *one* glue that does all gluing jobs. Here are two simple rules to follow.

RULE 1

USE CASEIN GLUE: For all interior or protected construction—furniture, cabinets, toys, laminated trusses and beams, interior wall panels and all types of "odd jobs".

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 waterproof, 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.)



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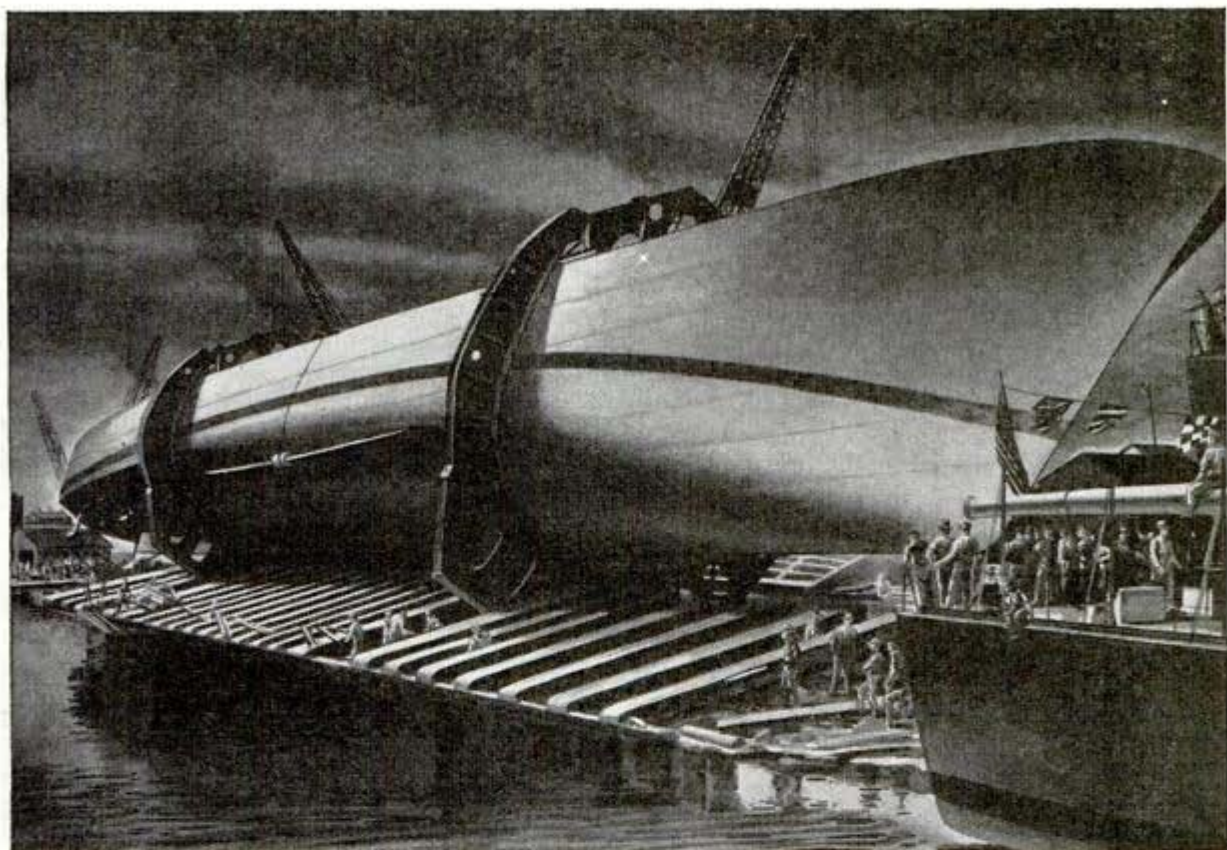
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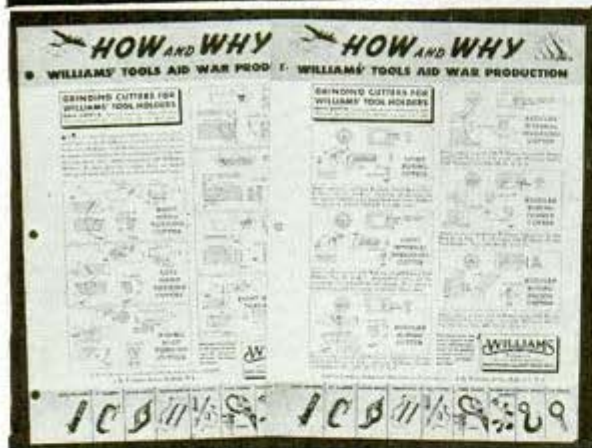
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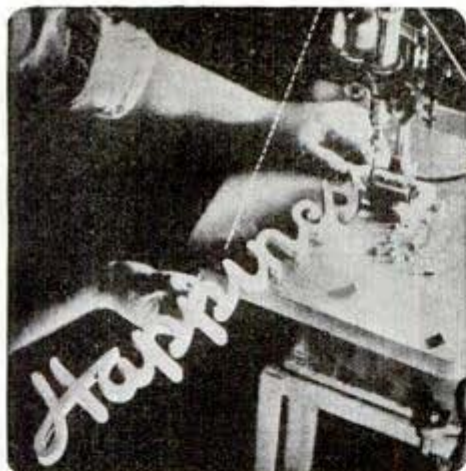
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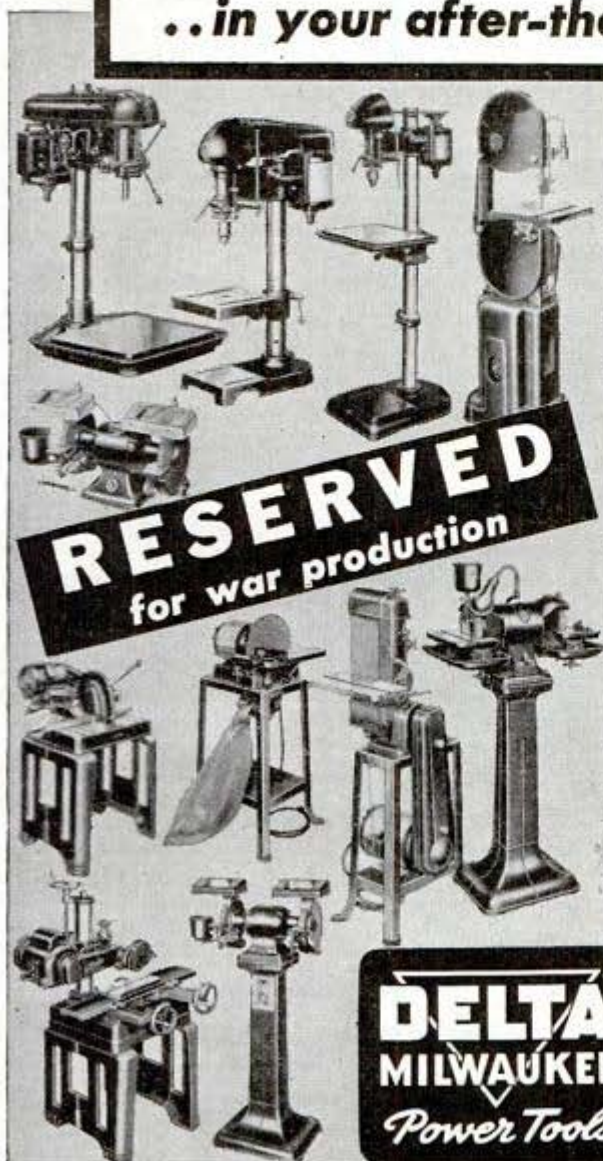


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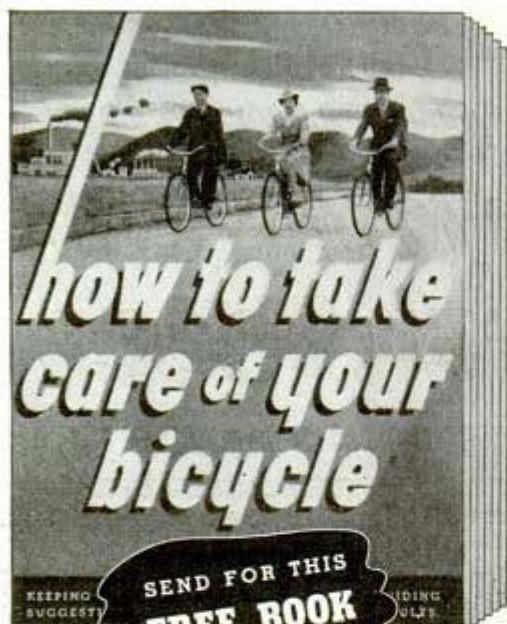
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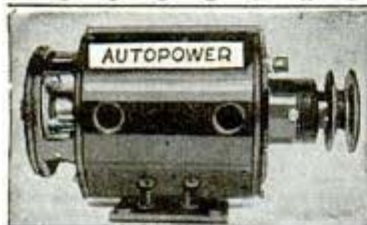
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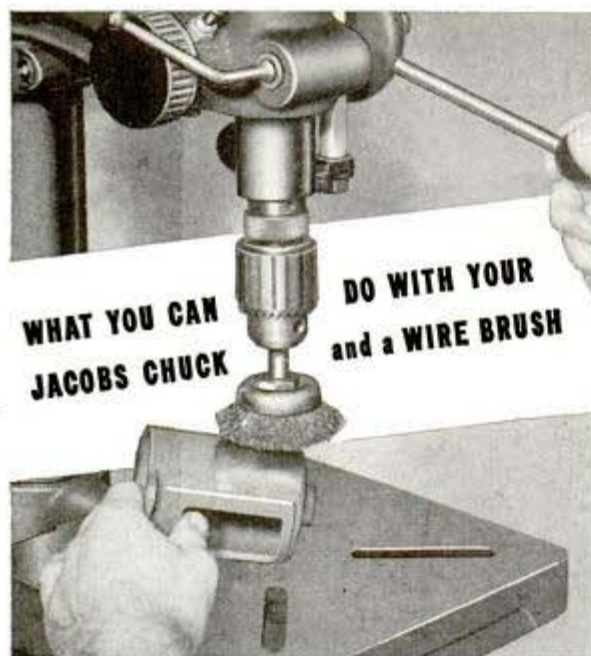
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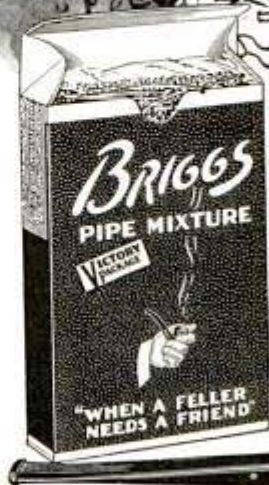
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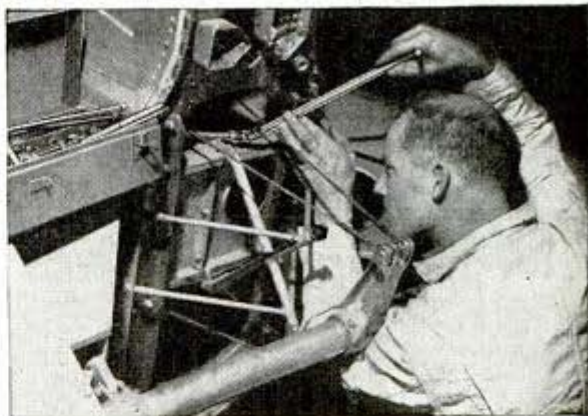
NOVEMBER, 1943



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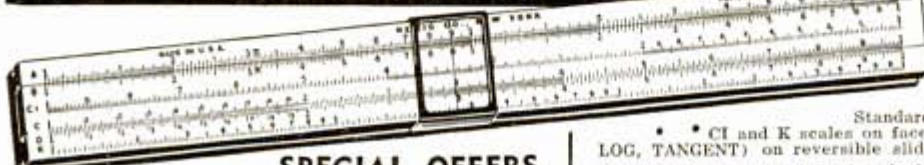
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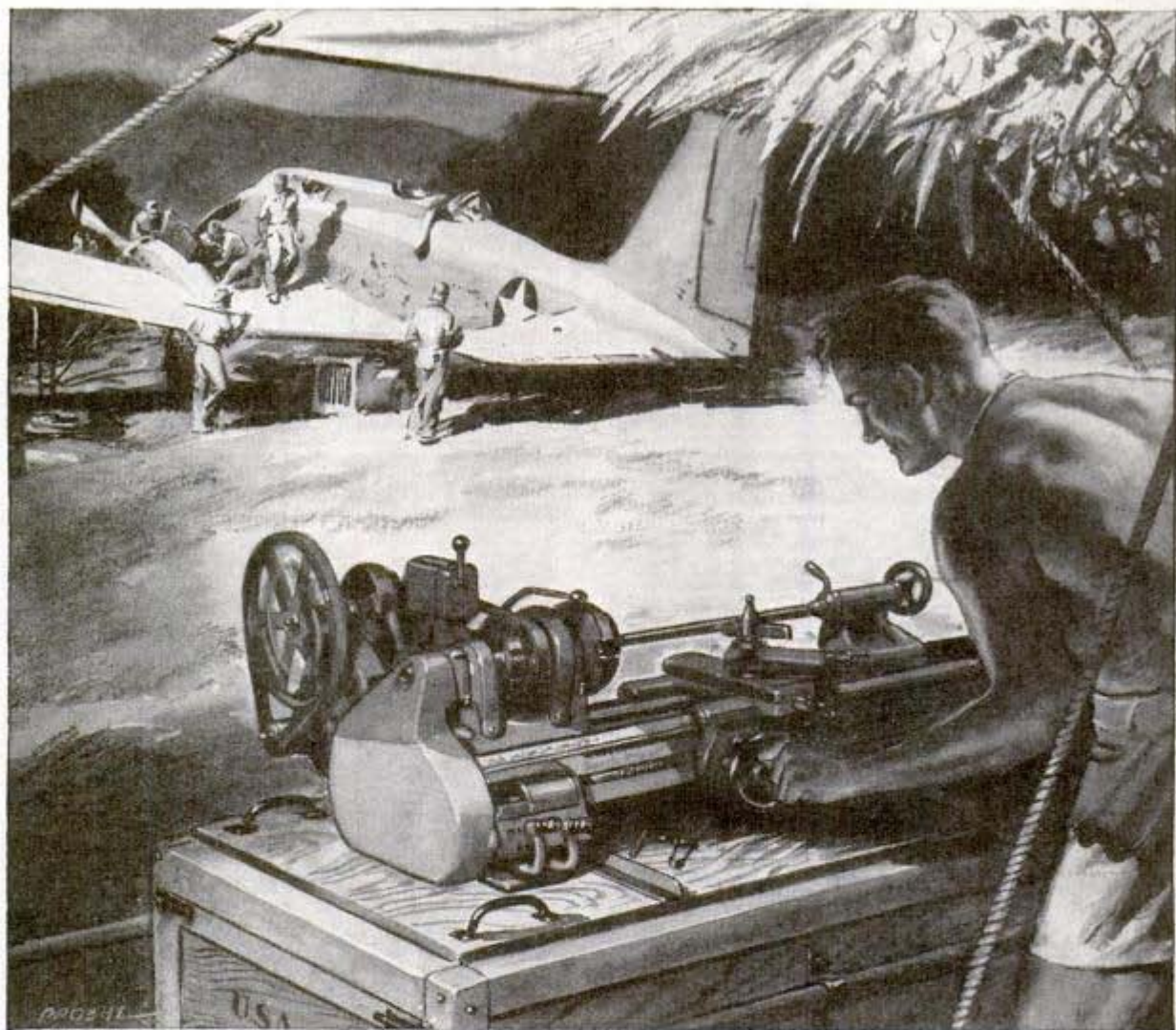
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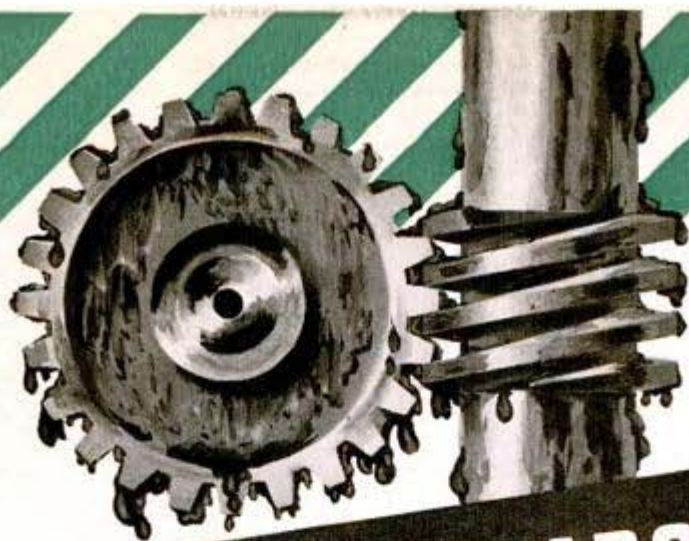
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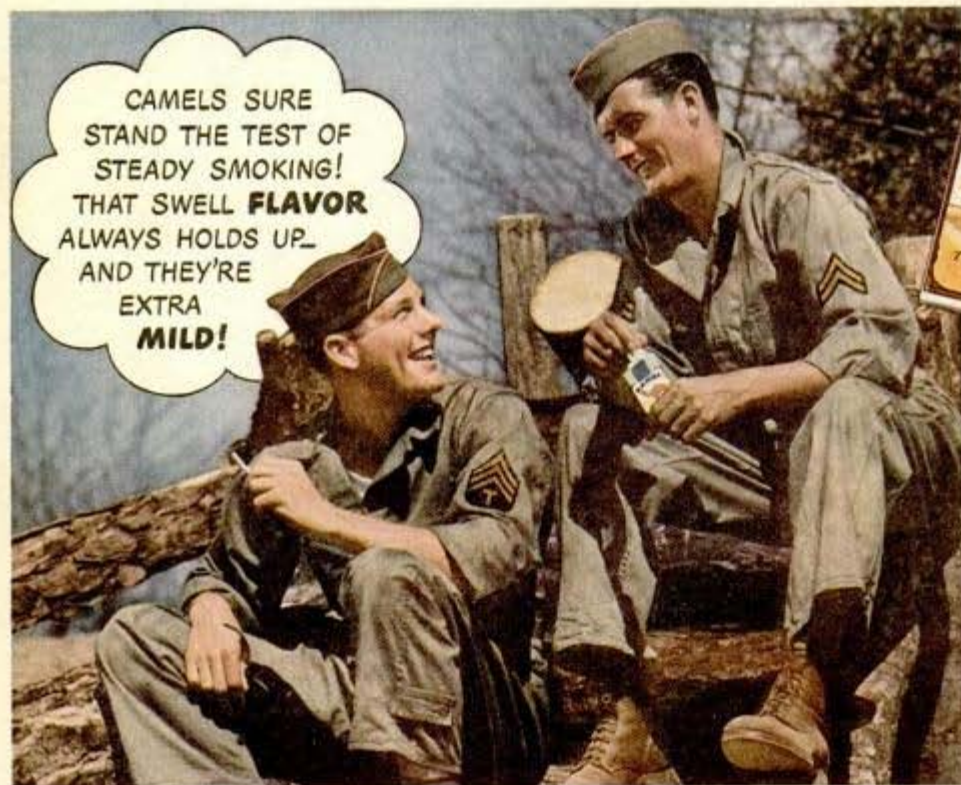
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