

Planes of 1953

POPULAR MECHANICS



MAGAZINE

WRITTEN SO YOU CAN UNDERSTAND IT

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SEE PAGE 78

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**Here's one
Nazi Broadcast
that's the
Gospel Truth!**

U. S. TANK IS BEST, SAY NAZI EXPERTS

Germany Will Doubtless Copy Gyroscopic Feature of General Sherman Tank, Berlin Radio Declares

By The Associated Press

A special new German Institute for testing captured tanks has adjudged the American "General Sherman" the best type the Allies have turned out, the Berlin radio said yesterday, adding that the Nazis "doubtless" would copy its construction—particularly the gyroscopic gun-mount, which they consider its outstanding feature.

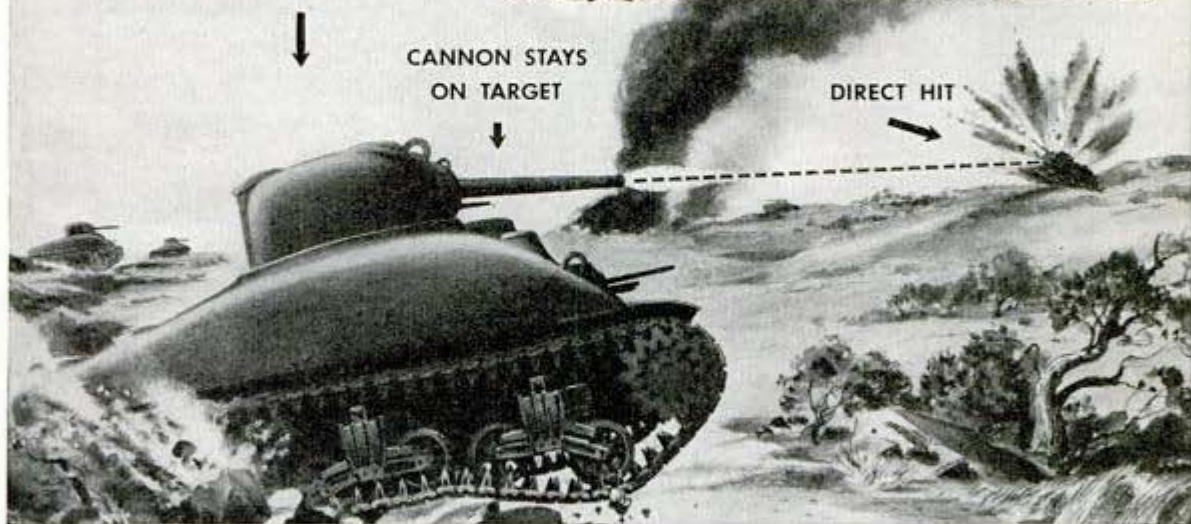
"Doubtless" Best Type

"According to the findings of the Institute," said the broadcast, recorded by the Associated Press, "the

"General Sherman" tank is doubtless the best type the allied armament industry has yet produced.

"A special innovation on this type tank, which by a gyroscopic system prevents the gun from being affected by the jolting of the tank when traveling on rough grounds, greatly interested the German experts. They believe this to be the first attempt at borrowing from the construction of warships for the construction of arms for warfare on land, and doubtless it will be copied soon."

TANK MOVES FORWARD AT
FULL SPEED OVER ROUGH TERRAIN



TANK BATTLES used to be stop-and-go affairs, because a tank's heavy cannon could be aimed accurately *only when the tank was at a complete standstill.*

Some time ago the Army Ordnance Department called for an improvement in tank gun fire control. The men of Westinghouse went into a huddle and came out with what has been called one of the greatest military developments of this War—a tank gun stabilizer that permits *incredibly accurate fire while the tank is charging ahead at full speed over rough ground!*

American tanks are now more than 500%

deadlier and this gun stabilizer has revolutionized the whole combat technique of tank fighting!

And the Westinghouse Research Laboratories, which developed the device—the Westinghouse engineers, who perfected it—and the men and women of Westinghouse who make it in great numbers—are proud as Punch.

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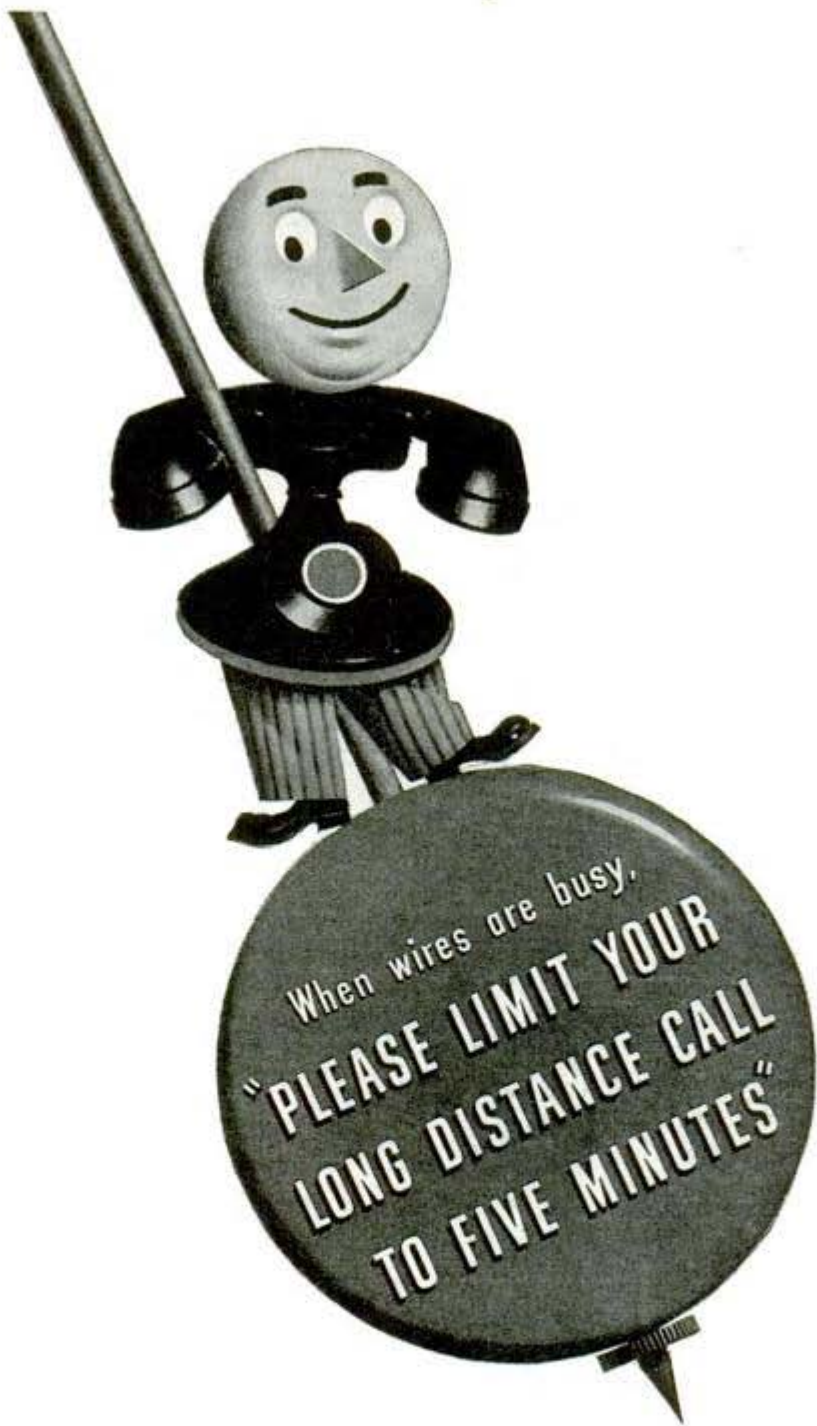


NC6Y-LQR-4P4S

OCTOBER, 1943

1A

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If you hear the operator say that, it means that the line you want is crowded and other calls are waiting. . . . We're sure you'll understand and co-operate cheerfully—in the interests of better wartime telephone service for *everybody*.



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Popular Mechanics Magazine

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H. H. WINDSOR, Founder

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

October, 1943

Vol. 80, No. 4

Next Month

EVERY man who ventures forth on or above the sea today is a hunted creature. Deadly mines, torpedoes, bombs and anti-aircraft hold a constant menace. But Yankee ingenuity has been at work to reduce the wartime perils at sea and save thousands of those forced to abandon ship or plane. New safety devices include an inflatable rubber belt that is worn by seamen as they go about their shipboard duties, a collapsible raft with waterproof signal lights, sail, medical kit, and food supplies. There are even flotation bags that keep land planes afloat for hours. A November article on "Cheating Death at Sea" tells how we are winning an epic struggle.

Mining in the Clouds

OUT on the Beartooth range in Montana, a hardy company of miners is fighting blizzards at altitudes of 8,000 feet to provide chromium for our war machines. The shining metal that is also a vital hardening agent has a fondness for lofty and hard-to-get-at places. How "The 'Forty-Niners' of '43" met this challenge and are mining precious chromite above the clouds is told in an article next month.

It's in Your Bones

ONE of the most surprising elements—phosphorus—has an evil side to its nature that is helping fight the Axis. This obliging partner of industry and agriculture in peace, is used to make smoke screens and incendiary bombs. It also builds bones. Don't miss "Industry's Dr. Jeekyll and Mr. Hyde" next month.

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"Wild Horses of the Sky"

PILOTS call it the hottest thing with wings. Aviation experts dub it "the outstanding fighter of '43." And what Hitler and Goering call it probably could not be printed. It's the North American P-51, or Mustang, that flew out of the West to pounce on Nazi Europe. Clipping treetops, this long-range fighter has played havoc with German supply lines. Mustang pilots knocked over 19 locomotives in a single week. An authoritative November article traces this "wild horse" from the drawing board to combat.

"Casey Jones in Khaki"

MAYBE you never thought of it, but knowing how to operate a railroad can be as important to the Army as the ability to shoot straight. That's why the Transportation Corps of the Army Service Forces now includes railroad battalions trained to do everything from laying rails to dispatching trains. Recently an Army crew delivered a freight train to the Russians at Teheran, Iran, after a 650-mile run from a port on the Persian Gulf. An article next month tells of the Army railroaders.

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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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LONDON'S "MIDGET MARSHAL" TELLS BOMBING THRILLER!



This true story of the blitz was told to a war correspondent by Michael Davies, Chief Shelter Marshal, London Area. Mr. Davies is famous as the smallest Air Marshal in England; his height is 3 ft. 6 in. Mr. Davies was a practicing optometrist before the war, was active in organizing youth camps, is now in charge of one of the largest air shelters in England. The shelter extends 4 acres and includes 4 miles of underground corridors. Complete with interior radio communications and sixty-five large sleeping bays, it can normally house 10,000 people—in a pinch, 14,000. Over one and a half million bricks were used to build the blast wall.



1. "Jerry had been giving it to us in fine style that night. We were out on our usual 4 A.M. patrol, picking our way between craters and smoking piles of rubbish, when we passed the ruins of a small house that had received a direct hit . . .



2. "One of my party called out: 'There's a light there—somebody must be alive!' And there was, right enough . . . a bright little sliver of light coming out from between the stones. Guided by that, we got on with the rescue work as quickly as we could . . .



3. "... and found our man, half dead from injuries and bomb shock, his hand still gripping his flashlight like a vise. Seems he'd grabbed his flashlight to show others to the basement when the bomb fell. And that—plus having fresh batteries—was what saved his own life!"

PLEASE NOTE: Don't blame your dealer if he's out of "Eveready" flashlight batteries. The Armed Forces are taking enormous quantities, and the war industries with the highest priority ratings are taking the rest.

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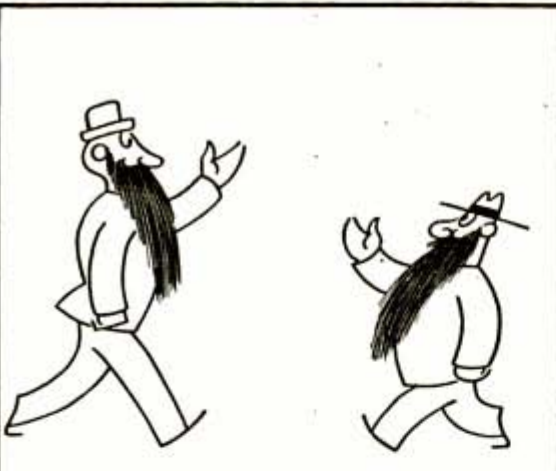
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IMPORTANT NOTICE

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C. SOGLOW



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Can this happen to YOU?

It was the President talking—telling George that while he would like to give him the job—to promote him to an executive position, it was impossible to do so.

This was a bitter blow to George—he had known for some time there would be a vacancy in his department—the department manager was moving up—a new department head would be appointed. By seniority George was entitled to the job, had been counting on it.

It would mean more money—those unpaid bills would be taken care of—the children would have more advantages—there would be travel, recreation, social activities.

George had been a fine, loyal employee for twelve years—doing his assigned tasks well—hoping by faithful service to win some day an executive position with his company.

Now all of these hopes were being swept away—as in a dream he heard his chief continue—“You see, George, in these days it is ability to produce that counts. You're not ready to take on the bigger job—you have made no preparations which would enable you to fill it properly. The man who is going to get that job is Martin. He has been with us only four years, but during that time he has not only been studying the relationship of his department to

the business as a whole, but he has been studying and preparing himself at home.”

Poor George—no one to blame but himself. Business is full of “Georges”—men who do not realize the importance of preparing definitely for promotion. They forget that long experience on one job does not necessarily prepare them for the job above. And almost never do they reach the executive job and the bigger money.

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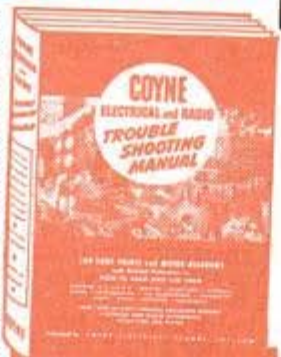
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| <input type="checkbox"/> Auto Engine Tune-up | <input type="checkbox"/> Electrician | <input type="checkbox"/> Navigation <input type="checkbox"/> Patternmaking | <input type="checkbox"/> Steam Fitting |
| <input type="checkbox"/> Auto Technician | <input type="checkbox"/> Electrical Maintenance | <input type="checkbox"/> Plastics <input type="checkbox"/> Plumbing | <input type="checkbox"/> Structural Drafting |
| <input type="checkbox"/> Aviation <input type="checkbox"/> Aviation Mechanic | <input type="checkbox"/> Foundryman <input type="checkbox"/> Heating | <input type="checkbox"/> Public Works Engineering | <input type="checkbox"/> Structural Engineering |
| <input type="checkbox"/> Blueprint Reading | <input type="checkbox"/> Heat Treatment of Metals | <input type="checkbox"/> Pulp and Paper Making | <input type="checkbox"/> Surveying and Mapping |
| <input type="checkbox"/> Boilermaking | <input type="checkbox"/> Highway Engineering | <input type="checkbox"/> Radio, General | <input type="checkbox"/> Telegraphy <input type="checkbox"/> Telephony |
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| <input type="checkbox"/> Chemistry <input type="checkbox"/> Coal Mining | <input type="checkbox"/> Industrial Metallurgy | <input type="checkbox"/> Radio Servicing | <input type="checkbox"/> Toolmaking <input type="checkbox"/> Tool Design |
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| <input type="checkbox"/> Bookkeeping | <input type="checkbox"/> Commercial | <input type="checkbox"/> Foremanship <input type="checkbox"/> French | <input type="checkbox"/> Salesmanship |
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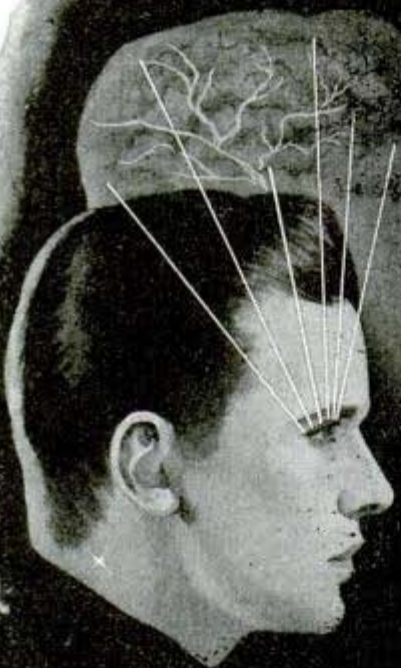
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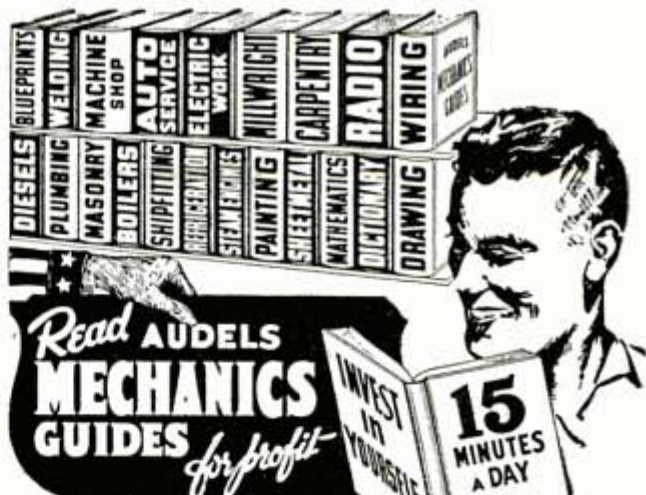
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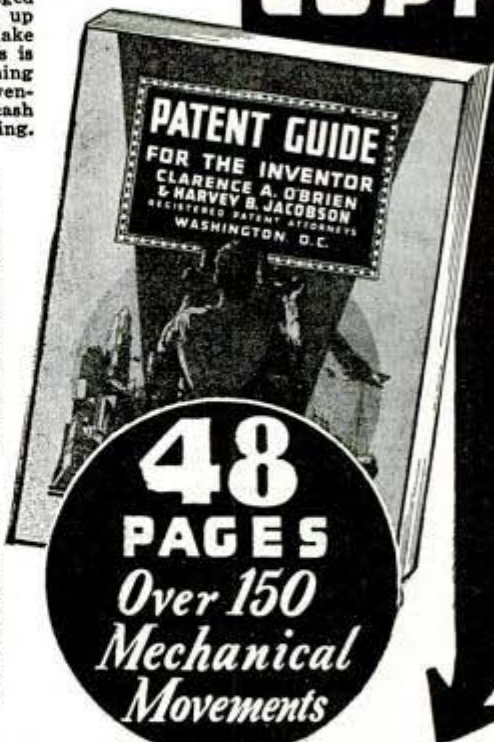
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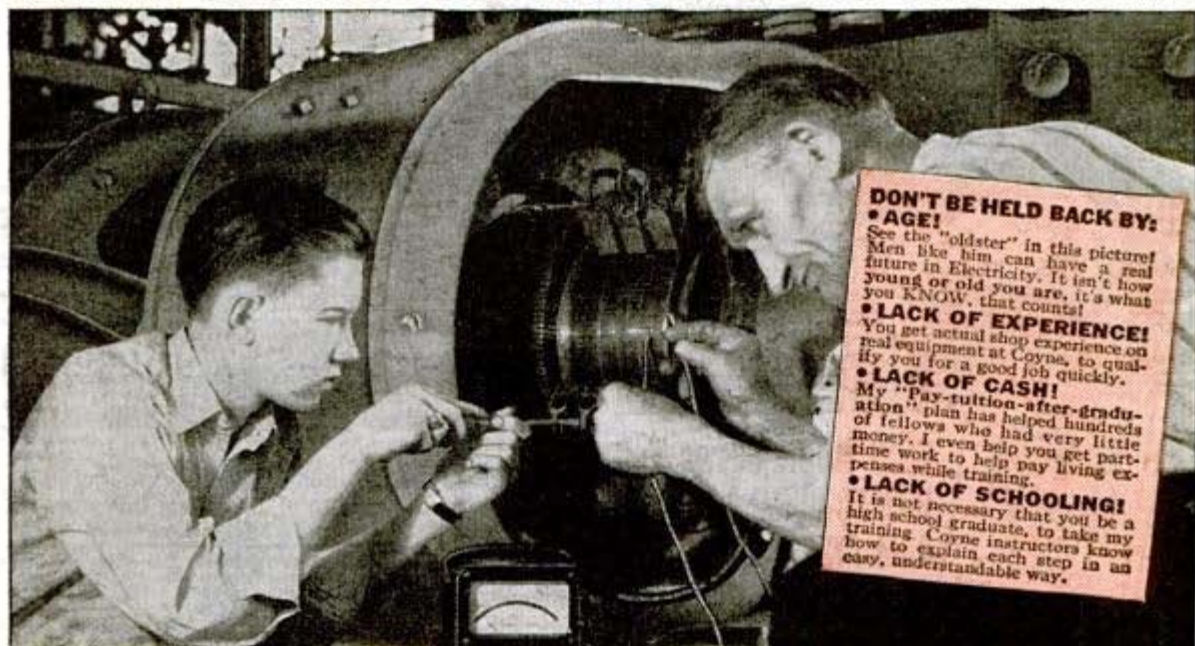
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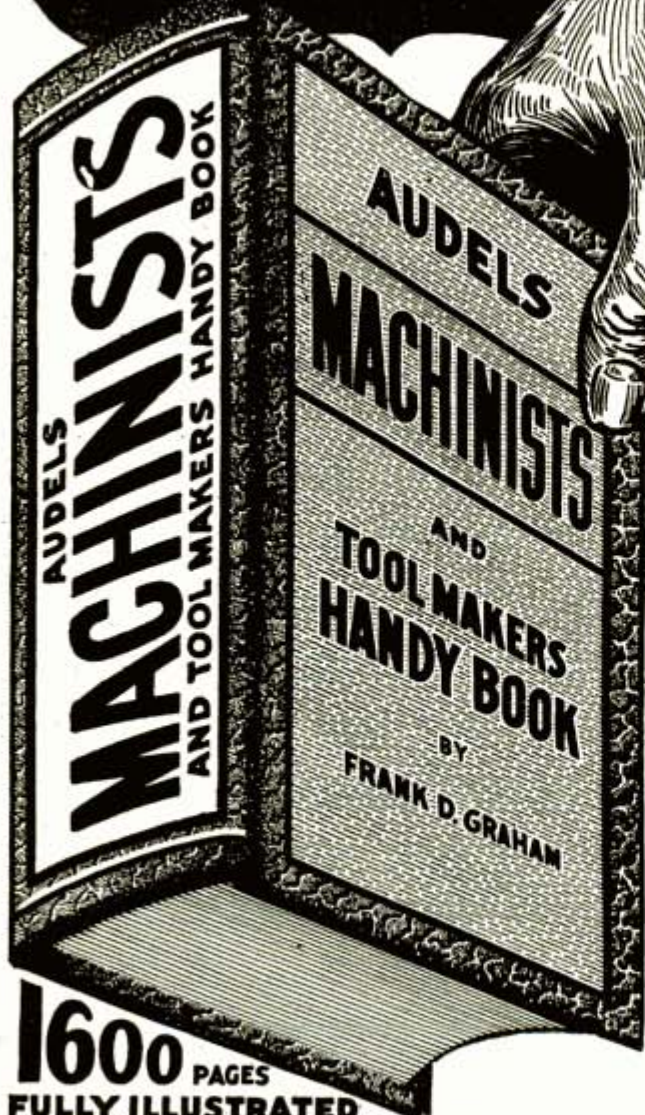
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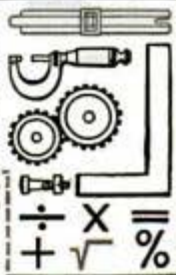
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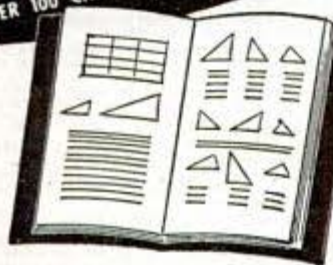
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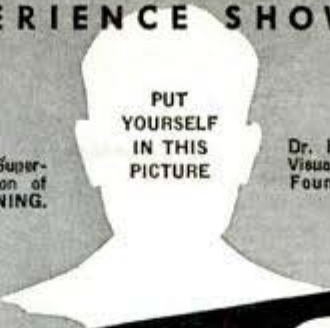
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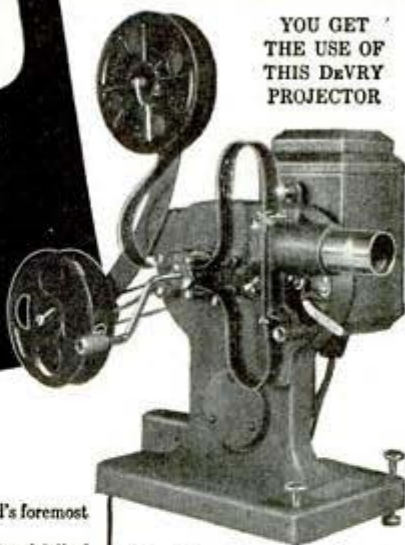
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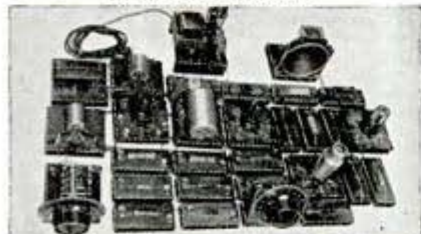
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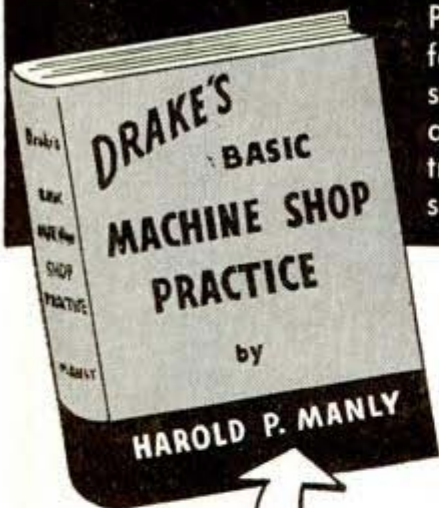
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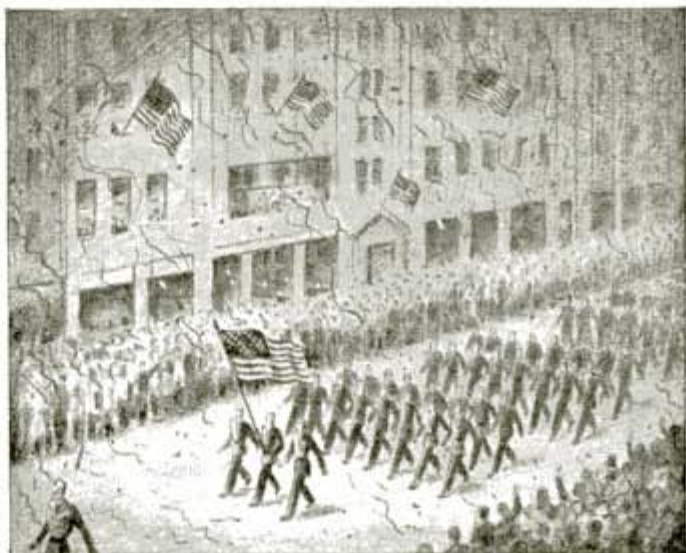
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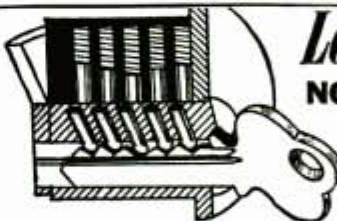
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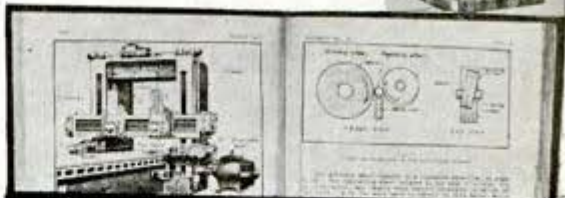
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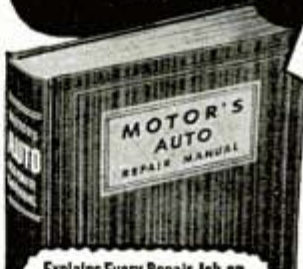
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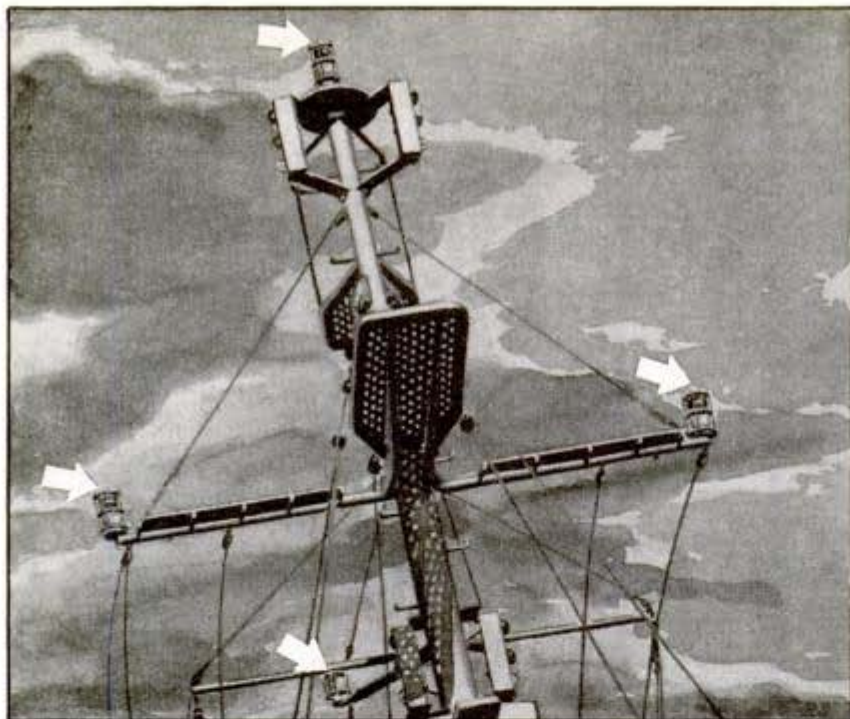
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Above is G-E MAZDA sewing machine lamp used in signal lamps in picture at left. Filament wire is finer than a human hair but special mounting provides high resistance to ship's vibration. Each signal device (indicated by arrows in drawing left) contains several of the lamps to provide for safety and give sufficient light in colored lenses.

How a Sewing Machine Lamp went to sea

Vibration-resistant General Electric lamp adapted for Navy signal devices and instrument illumination

SEVERAL years ago General Electric scientists developed a special vibration-resistant lamp for sewing machines. It came into wide use, not only on sewing machines but also on vacuum cleaners.

The vibration of powerful engines aboard

naval vessels confronted the U. S. Navy with the problem of finding a vibration-resistant lamp for signalling devices and instrument illumination.

G-E engineers suggested the sewing machine lamp. They went to sea, covered the ship from engine-room to topmast, helped the Navy put the G-E sewing machine lamp through gruelling tests. It proved to be exactly what was needed.



Making lamps for the armed forces is only one of G-E's wartime lighting jobs. Eliminating glare, gloom and shadows, in war plants, big and small, is another. Send today for a free copy of G-E's new booklet "How Light Can Help You Speed Victory". Write General Electric Co., Dept. 166-PM-J, Nela Park, Cleveland, Ohio.

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Vol. 80

OCTOBER, 1943

No. 4



Pan-American's Strato-Clipper gives a hint of postwar air travel luxury

By Ralph S. Damon

W. Grant

EVERY now and then somebody sticks his neck out and says something about the "Future of Aviation" and generally regrets it. Now it's my turn.

I propose to talk of the ten-year future, about 1953. We shall assume that major hostilities of this war shall have ceased in 1945; that victory will have been won through the overwhelming preponderance of the aviation effort of the United Nations, who today are outstripping the Axis in production fully 3 to 1. Not in production alone, but in quality of equipment and in person-

The author, until recently President of Republic Aviation Corporation, builders of the P-47 "Thunderbolt," is now Vice President and General Manager of American Air Lines, Inc.

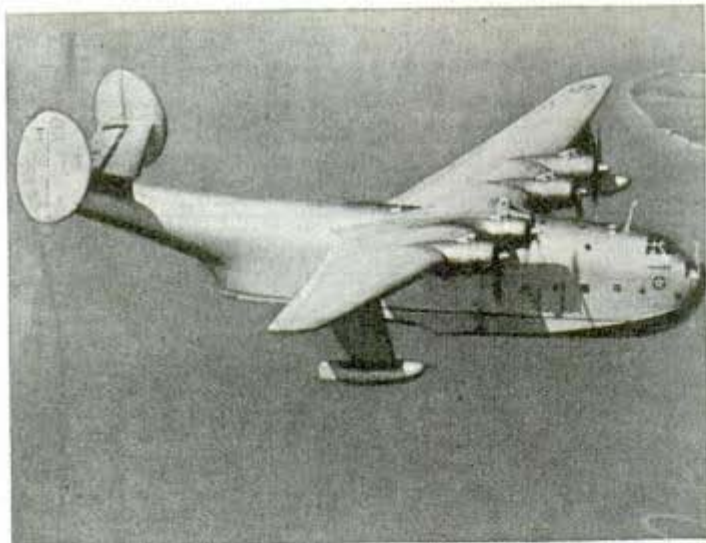
nel, as evidenced by the official box scores in all war theaters. By the end of this year our production preponderance should be easily 5 to 1 and perhaps 10 to 1, foretelling the complete doom of the Axis aggressors.

At no time has the aviation engineer stood on greater thresholds of opportunity. At the end of the last World War, the fastest pursuit plane had a top speed of 180 miles per hour. Twenty years later our commercial air liners were cruising at that speed, and one new model not yet in production exceeds it by 50 percent. Before this war

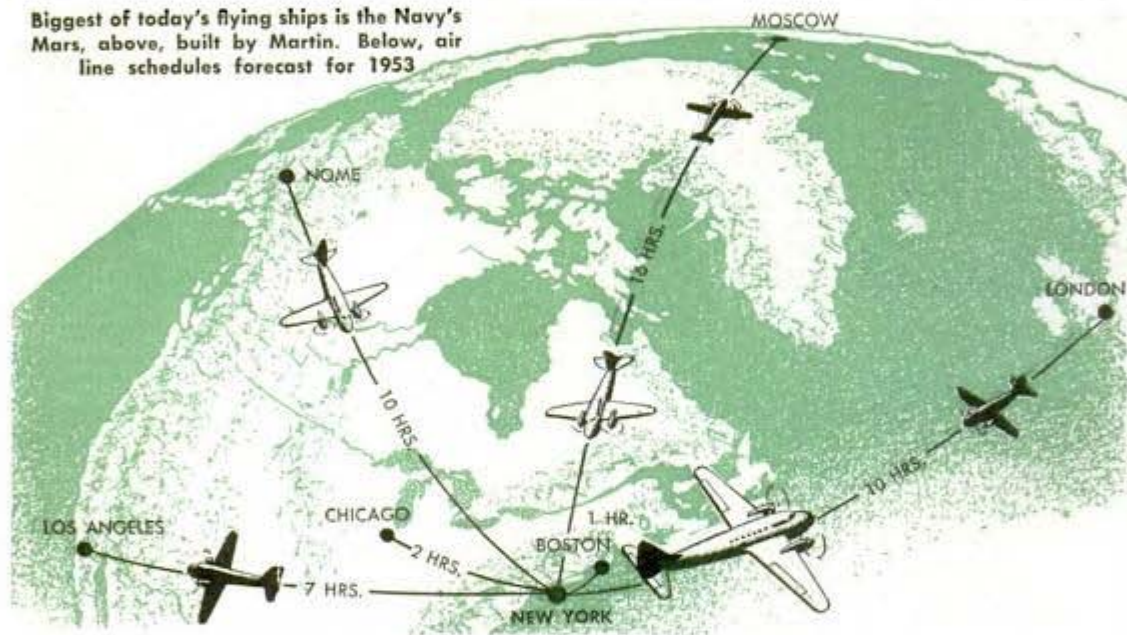
OCTOBER, 1943

Farmingdale, L. I., N. Y.

1



Biggest of today's flying ships is the Navy's Mars, above, built by Martin. Below, air line schedules forecast for 1953

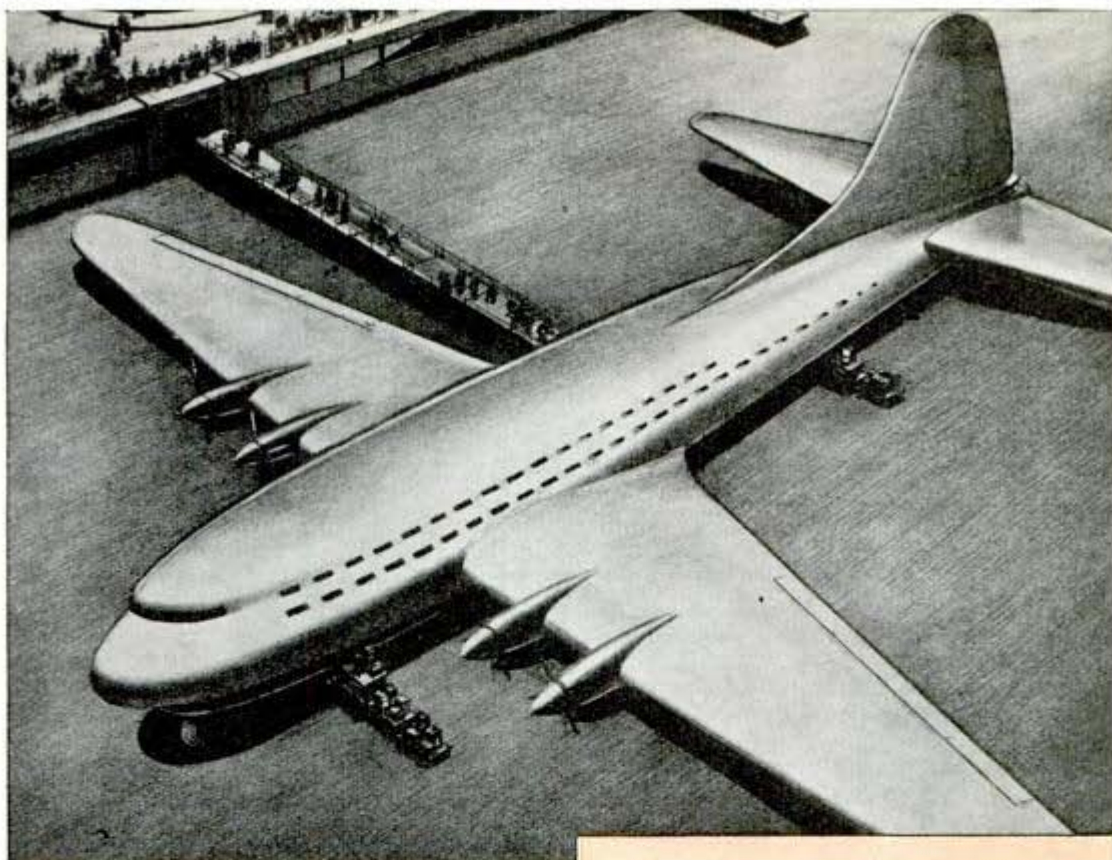


go through the speed of sound that we are now definitely experiencing the difficulties so long predicted when we would achieve this speed.

Private planes of the executive type will approximate the performance of air liners. However, with more frequent schedules on expanding transport routes the executive airplane will tend to be confined to service off the airline routes. Strictly private planes for the man on the street will increase tremendously in

This cargo carrier of tomorrow, its nose swung open to receive freight, is visualized by United Air Lines

POPULAR MECHANICS

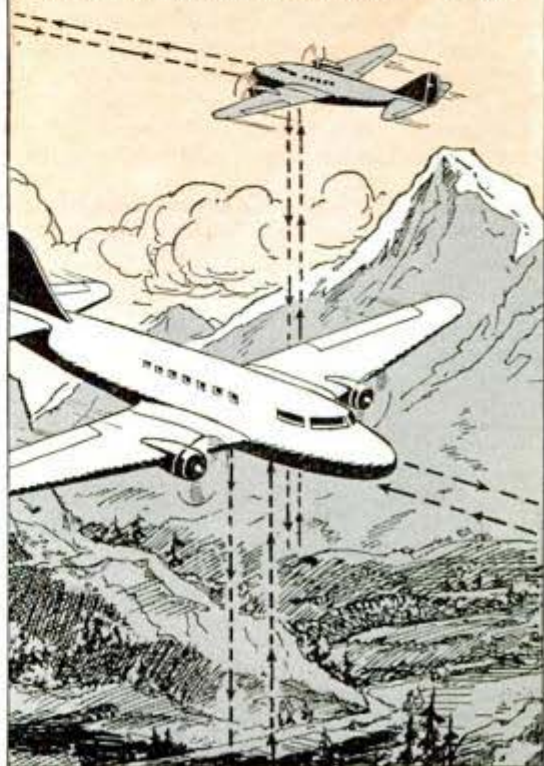


numbers and their performance will improve, but will fall short of the speeds and distances attained by the air liners and executive planes.

At the beginning of the war we had approximately 30,000,000 licensed automobiles, 300,000 licensed motor boats and 30,000 licensed planes including the military and commercial. At the end of this war our Air Force and aircraft factory personnel will be about 10 times their number at the close of the last war—some indication of the tremendous increase in people who have been familiar with airplanes and will have the urge to buy and fly private planes. Within the next decade the number of privately owned aircraft may reach 300,000, equal to the number of licensed motor boats before the war.

Strictly engineering-wise, there are so many developments, some of them so secret they may not even be mentioned, that our 1941 pre-war planes will compare with those of 1953 as the 1916 Model T Ford with the 1928 Model A. These improvements start with the fundamentals of aerodynamics, including the suppression of all external protuberances—rivet heads, air intakes and exhaust outlets. The smooth "flying wing" suppressing even the fuselage and tail will probably reach its highest fruition in the largest planes where head room for

By 1953, Mr. Damon thinks, transports may approach today's 400 miles an hour fighter plane speed. Top, a United Air Lines conception. Below, safety will be enhanced by altimeter and beams developed from war's radar





War has given the Sikorsky helicopter its chance. Here the wingless craft hovers motionless while a passenger climbs a ladder

convenience and a maximum of absolute dimension within balancing limits of the center of gravity will be possible.

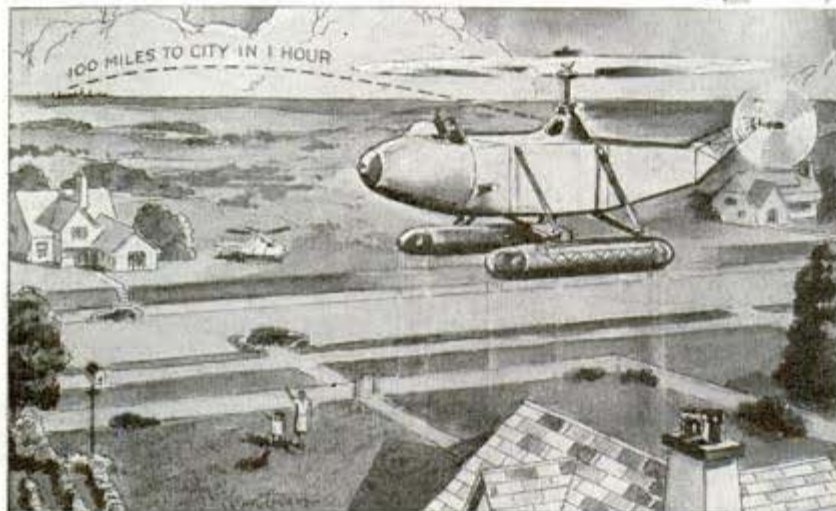
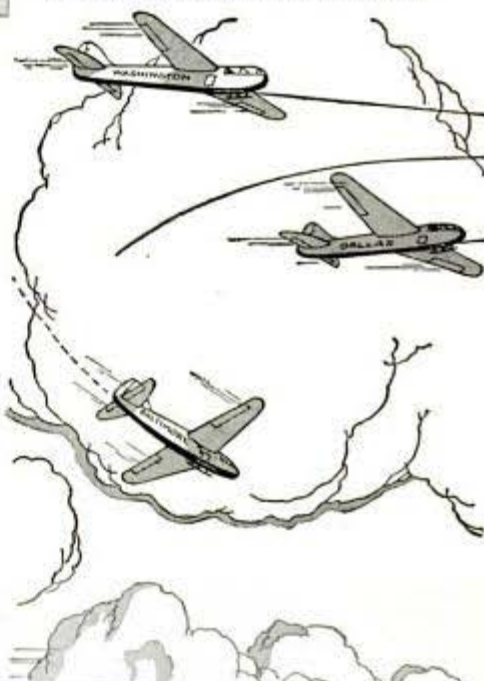
Ultimately the present engine and propeller themselves may be suppressed and replaced by the rocket or squirt type of propulsion, saving a tremendous part of today's structural weight. This type, I feel, will reach its highest potential in the high-speed supercharged high-altitude plane, whose cruising speed to be economical will have to be in what are today's top pursuit speed brackets.

If we do confound today's experts and break through the speed of sound for regular operation, it will possibly be with the supercharged flying-wing squirt type; and then we shall have many new problems, for today's classical laws of flow, lift, drag, center of pressure travel and other air force characteristics will no longer apply, and such planes will have

Its ability to alight within the circumference of its main rotor blades should popularize the helicopter with postwar suburbanites

to be designed to land and take off safely as conventional types and still fly safely at super-sonic speeds. At such speeds it appears that some phenomenon similar to a disrupted center of pressure travel to the rear appears, and the conventional trailing-edge control is not normally effective. Perhaps we shall have to go to controls in the leading edge of the airfoil, or some similar change.

The Sikorsky Helicopter and its dramatic recent demonstrations in stability and control bring attention anew to the rotating lift field, which seems best suited for the small

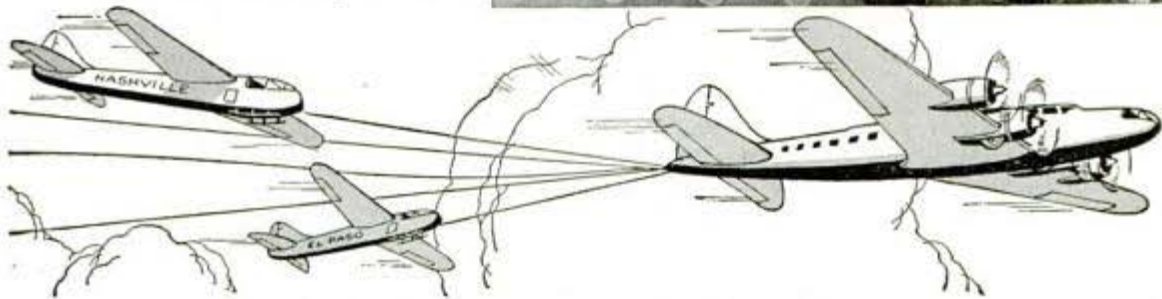
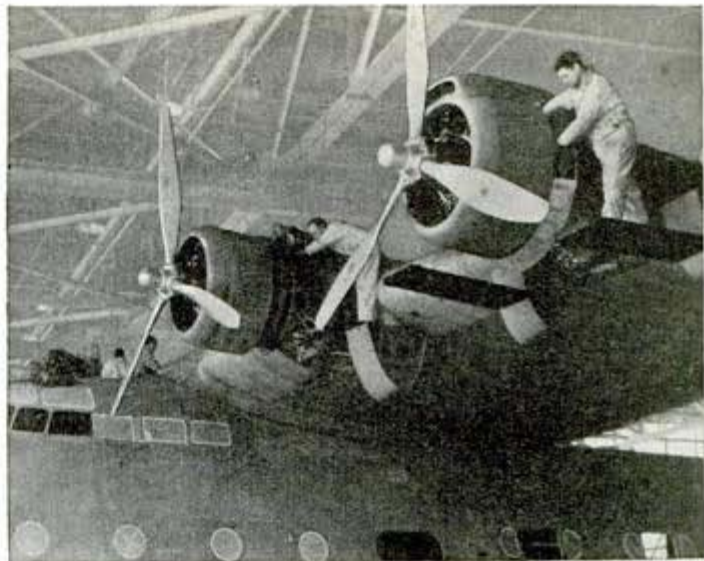


The drawing shows a cargo glider destined for Baltimore dropping from a transcontinental glider train in a westbound tow

private owner and similar activities.

Another development which should offer great promise is the glider pickup and discharge system. There is tremendous opportunity for serving small communities without airports. This development, already well started in air mail, should become of tremendous value when all first class mail goes by air. From then it should go into air express, and provided pickup accelerations can be

One of the largest transoceanic craft today is the Vought-Sikorsky 4,800-horsepower flying boat, at right, built for American Export Lines



kept at reasonable "g's," into passenger travel. Definitely the glider train appears to offer economies in cost per ton mile of goods carried, compared with concentrated loading in the powered plane.

Just beginning in the late 30's and now almost entirely absorbed by the military is the whole field of electronics, including communication and indication, such as radar. The penetration into shorter and shorter wave lengths now almost approaching infrared light for communication, both aural and recorded; the improved

staticless radio range and direction finding signals, and the use of absolute altimeters and other radar devices for spotting other airplanes in the vicinity are but a few of the opportunities possible. Standardized instrument landing devices will eliminate uncertainties of terminal weather conditions from the small percentage of flights now affected.

Power plant improvement is going forward apace. A few years ago when the "octane" rating of gasoline anti-knock

(Continued to page 158)



Republic Thunderbolts (at right) have dived at 780 miles an hour, faster than speed of sound, a feat experts deemed impossible



*Mary Jane Kent, Chief of Wilmette Beach Life Guards
Wilmette, Ill. 71474*

Lifeguard Tows "Torpedo" Buoy to Save Lives



Girl lifeguards, who have replaced many men on Chicago beaches, use a "torpedo" buoy to help save lives. The buoy is attached to a rope and towed by the guard. It keeps a distressed person afloat while being pulled to safety. With this buoy an expert swimmer can tow a man with ease and without the risk of encountering a strangle hold. It is particularly useful for a lightweight lifeguard, such as a girl, in saving a heavier or stronger person.

Lifeguard leaping from boat with torpedo buoy. Drowning person (inset) clings to it

Plywood Glider Alights on Sea With Troops or Supplies

Particularly appropriate to the United States Marines, whose hymn boasts of their fighting their country's battles "on the land and on the sea," is the acquisition of amphibious gliders. These motorless offensive weapons are capable of feather-flight takeoffs and landings on land or water. Designed to achieve lightness with strength, and to safeguard strategic metals, they are made of molded plywood.



Lightness with strength characterizes the plywood amphibious glider

"Bantam" Gauge to Test Small Screws Checks the Threads in a Jiffy

Pitch diameter and lead of screw threads are checked quickly and accurately with a

small gauge that can be concealed in the palm of the hand. It operates on a "roll thread" principle instead of the usual screw-on method for checking threads to specified tolerances.



Small gauge operates on a "roll thread" principle

"Share-the-Wire" Teletype Plan Reduces Cost of Service

By sharing a small number of trunk wires that lead into a subcenter, the cost of Teletype service is brought within reach of many offices hitherto unable to afford this service. In the subcenter the messages are automatically switched to the individual wires provided for each user. The system was developed by the Western Union Telegraph Company following a survey which showed that only a small percentage of patrons use the wires at the same time.

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Duck, Jeep's Big Brother, Is Amphibious Truck

Shown in maneuvers, Army "Duck," a truck at home on land or sea, is seen unloading troops on the beach, right, and at sea



Vehicles that are at home on both land and sea are enabling Uncle Sam to wage mechanized war along amphibious lines. Big brother of the seagoing jeep is the "Duck," an amphibious, two and one-half ton army truck. With its great load-carrying capacity, the "Duck" can run alongside a transport, take on more than a score of men and their equipment, then put-put for shore—and run right up on the sand and keep going. Its prime function is to assist barges and other units to establish beach-

heads on enemy shores. As an ocean-going version of the familiar army truck, it can carry a similar load of supplies. In loading the "Duck," cargo may be dropped aboard still enclosed in its cargo net, and unloaded ashore, still in the net, to make for speedier round trips. Without hesitation, the "Duck" can plunge back into the water for more men, or more supplies. Promise of great postwar use of such amphibious vehicles is envisioned by transportation men. They foresee their use as passenger and freight carriers on rivers of such nations as China, that lack railroads. At shallow places, or falls or rapids, the postwar jeep or duck would need only to waddle ashore and portage its cargo up or downstream to the next stage of the river journey.

71 365

Model Train on Cafe Counter Brings Customer's Order

Model railroading is more than a hobby to the proprietor of a restaurant near Detroit, for he uses his midget locomotive and flatcars as a waiter. He takes the customer's order in person, then retires to the

kitchen. Soon, without any operator visible, a model train speeds from the kitchen, each flatcar carrying a sandwich, and stops in the exact position for the diner to "unload" his car. Then the train disappears into the kitchen again. The proprietor himself is at the controls, operating his mechanized waiter by observing through a "one-way" mirror in the kitchen door, through which he can see without being seen. The model railway includes 45 feet of track, 21 feet in the dining room, with scale-model rails hand-spiked to wooden ties, which are cemented on linoleum, with the whole roadbed mounted on one-half-inch insulating board for silence. The two locomotives used are scale models of the New York Central Hudson type.



Photo courtesy New York Central Railroad
 Hamburgers arrive by restaurant's model freight; inset, the locomotive

OCTOBER, 1943

*Brooks Coffee Bar
 Woodward Ave.
 12 1/2 mi. north of Detroit, Mich.*

Thomas E. Deming, Jr.
3872 Franklin Ave.
Los Angeles, Calif.

7242



Swimming through blazing oil, cadet of maritime service clears path through fire with big splash

Right, seaman "abandons ship" feet first holding nose like this to protect it when he hits water

Holding his prized Garand rifle well out of the water, soldier crosses river using side stroke



MANY American soldiers, sailors, and seamen were drowned last year because they didn't know how to take care of themselves in the water when their ships met disaster.

Here is a story that is hard to believe: Every man on a certain ship was wearing his life jacket when the vessel was torpedoed, yet two out of every three of the men

were drowned while trying to get ashore, only a quarter of a mile away. They simply became panic stricken. When the waves hit them they opened their mouths and breathed in water, strangling to death. The story is vouched for by a ship's officer.

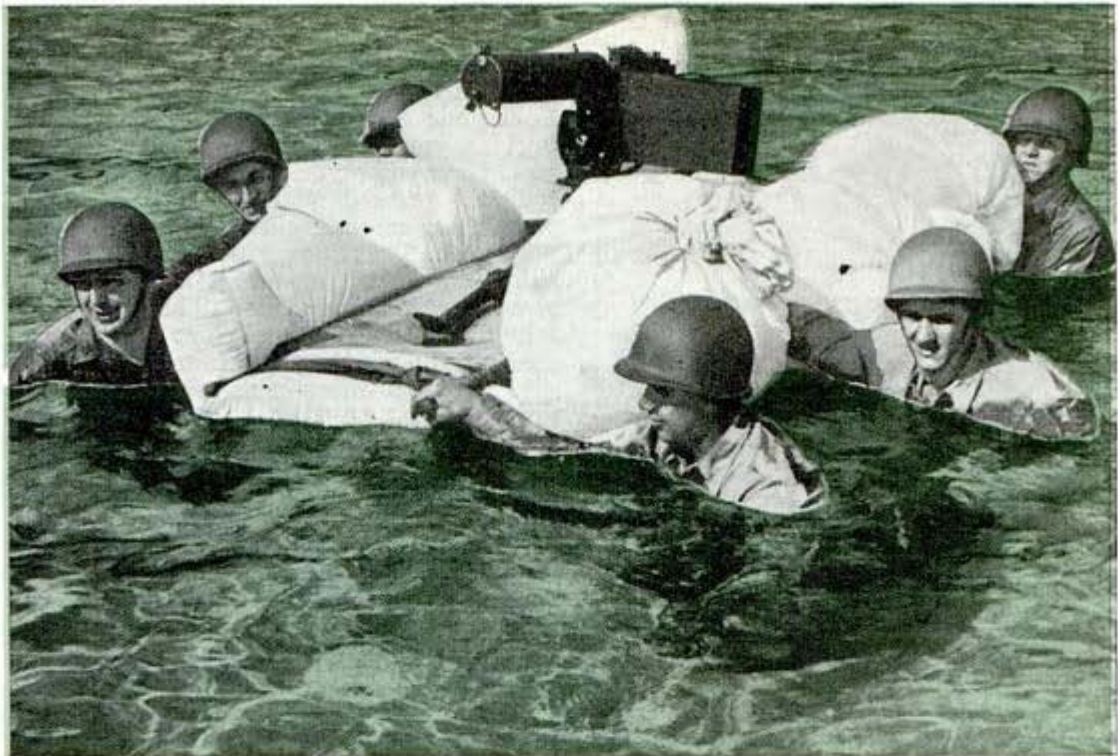
Fear of the water because you don't know the right thing to do can cost you your life. Even the information that you are reading here can help keep you afloat in an emergency. An average of more than 2,500 people are drowned every year in American lakes and rivers, and possibly most of them would be alive today if they had known a few simple life saving facts.

What to do in the water

Off. Red Cross Work: L. W. Lyndon
7 Cambridge School for Boys
Pasadena Calif.

Off. Maritime Service - Emergency Course
167 S. Vermont

Los Angeles, Calif.



Matress covers inflated like water wings serve as buoyant raft to carry light machine gun across river

and even how to swim through blazing oil without even singeing your eyebrows is an important part of the instruction the maritime service is providing officers and men at its training stations. Water safety is part of the pre-flight training given air force cadets. American Red Cross officials are teaching groups of army men how to take care of themselves in the water.

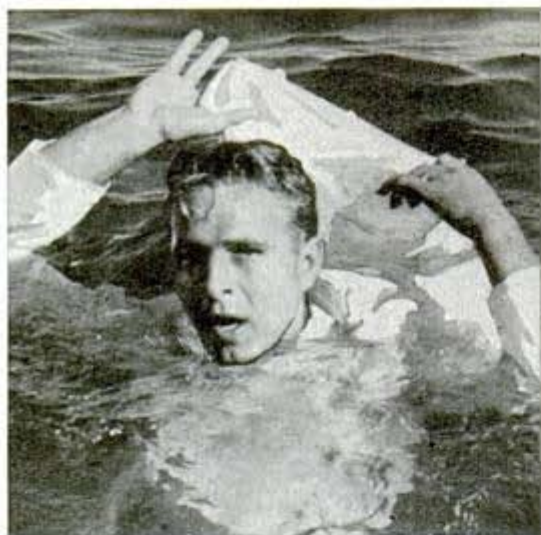
L. V. Lyndon, Red Cross water safety examiner who has participated in more than 1,000 rescues, has some tips for you that have been tested under wartime conditions. Most important of all, he says, is

your self control. Stay calm and don't let your imagination scare you into a panic when you must enter the water. That's hard to do in the excitement and shock of an emergency, yet it's the one thing that gives you a chance to save yourself.

Suppose your ship is mined or torpedoed. If you can't leave it by lifeboat, enter the water by climbing down knotted ropes that have been let over the side. Wear your clothes under your life jacket, shedding only such encumbrances as a heavy overcoat or shoes. The rest of your clothes will help keep you warm in cold water.

While "torpedo victims" hang on, maritime service cadets bail water from a lifeboat which has "capsized"





Above, swimmer swinging pants from behind head to catch air to form preserver (below) of white duck



Below, some of the 4,000 survivors from S.S. Coolidge on way to shore. Only two were lost in disaster
U. S. Navy photo



Don't jump from a ship if there is any other way to leave it. If you must jump, jump in feet first. A head-first dive might kill you if you strike floating wreckage. Fold your left arm across your chest to prevent your life jacket being torn from your body when you strike the water, and tuck the palm of your right hand under your chin, extending the fingers up over your nose. That does several things. Your chin is protected against being struck as you enter the water; you still have room to take a deep breath just before you hit the surface, and yet the protection of your fingers prevents water from being forced up your nose.

Your life jacket is buoyant enough to keep you afloat for days, so put your trust in it and paddle away from the ship. Hold your breath when a wave slaps you. A few swallows of salt water may make you sick and help wear you down. If you become cold before you are picked up you can massage yourself by rubbing one foot against the other leg and rubbing your body with your hands. It helps.

You have a good chance even if you have no life jacket and can't swim, if you can remember what to do. First, keep your hands below the surface and don't thrash around trying to climb up out of the water. Keep your chin down level with the surface and paddle along in imitation of a dog. That's the way a dog swims and you can do it too. If there is someone nearby, tell him you would like some help in being pulled along to some wreckage. When you reach a floating object, don't try to climb on board it unless it is big enough to support your weight. You'll be more comfortable just hanging on to a small piece of debris and letting it support you.



That's not a new secret weapon (above), just soldiers using their pants as water wings to support guns. Below, men go over side of stricken S.S. President Coolidge with ropes
U. S. Navy photo

Your pants will make an acceptable pair of water wings if you can get them off, button the fly, and tie or knot the end of each trouser leg. Hold the pants by the belt behind you, then sweep them overhead into the water in front of you. The air that is trapped in the legs will hold you up. Soldiers are taught to do this as a means of getting across bodies of water. They even take three mattress covers, blow them up, and use them to support a stretcher for carrying a wounded man or a machine gun across a river. You can even fill your pants with air by ducking under water and blowing your breath into them a number of times.

Merchant seamen are taught to leave a ship on the windward side if possible so that they can swim into the wind and avoid the oil that spreads mostly to leeward. Heavy oil doesn't always catch fire and if a man gets smeared with it he has some protection from the cold and the sun. But a mixture of oil and salt water



Transporting "wounded" soldier on stretcher supported by three inflated mattresses



is sickening if swallowed, so he must watch his breathing.

A man who has confidence in himself can swim through 50 yards or so of blazing oil without being burned, and seamen are taught how to do this. They jump in feet first and splash the water wildly with their arms as they ascend to the surface again. This beats the flames back and gives them a hole. Then they use the breast stroke to part the water ahead of them. This scat-



Cadets waste no time when instructor shouts: "Abandon ship!"

ters the flames, and the swimmer moves ahead in the area of clear water. He keeps his mouth close to the surface where the air is cool. He scatters spray with one hand if a headwind is blowing the flames back toward him. Flaming oil rarely blankets a whole area of water but is spotty and there are some areas that aren't covered. Highly volatile petroleum fires usually die out in five or six minutes.

It is fear of the fire, not the fire itself, that can trap a man. Surprisingly, the flames don't even heat the water.

Seamen are taught to turn over in the water and lie on their backs if there is any danger of bombing or depth charge explosions in the vicinity. A depth charge explosion even some distance away can kill you if you are face down in the water, but lying on your back helps the concussion to waste itself in your muscles instead of tearing at your intestines.

Even if you happen to be a good swimmer, don't exhaust yourself by trying to go somewhere in a hurry. In most cases help will come to you. And don't use a tiring stroke that brings your arms up out of water. Conserve your strength and lend a hand to others

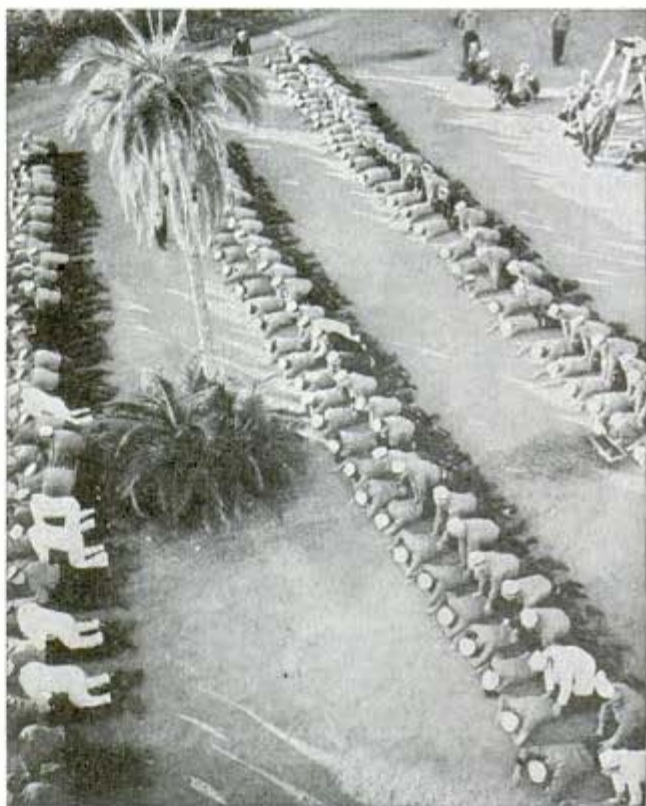
**So that some day they may save a buddy
—cadets diligently practice resuscitation**

near you. Ordinarily the breast stroke is considered the best stroke to use for rough-water swimming. It's advisable to stay in groups for ease of rescue and for self-assistance.

In shark-infested waters or where there is apt to be dangerous sea life, swimming should be done quietly with no splashing that might attract sea animals. Sharks are not apt to attack groups of men who are clustered together but when an attack seems imminent, that is the time to thrash your arms and legs in the water. That scares the fish away, usually just as successfully as any careless quick motion you may have made sometime when fishing.

No matter whether you are in the armed forces or not, it's a good idea to practice water work. It doesn't matter whether you can't swim a stroke or are a good swimmer. If you can't swim at all, get some one to show you how easy it is to stay afloat. Instinctive fear of

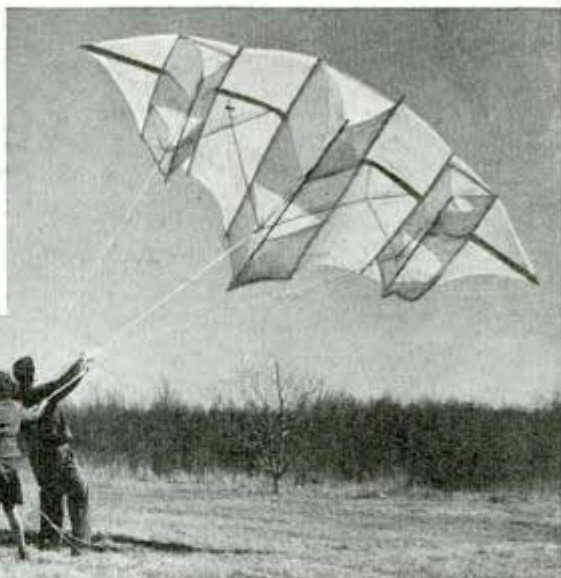
the water vanishes once you realize that staying afloat isn't as difficult as you thought. Going out and getting wet in safe circumstances will give you the background of confidence that you will need in an emergency.



Four Giant Kites Lift a Girl 100 Feet in the Air



The young lady (left) waves to her playmates as several giant kites carry her aloft. Her swing seat is attached to the kites with a stout rope. Below, the kite's inventor and assistants demonstrate the tremendous pull of a large model which is said to be strong enough to tow an automobile or a small boat



Huge kites that can lift a girl 100 feet off the ground can be used by the Army or Navy to tow life rafts, according to their inventor, Domina C. Jalbert of Woonsocket, R. I. A student of aerodynamics, Jalbert has designed and built kites claimed to have the pull of a tugboat. One of his models which is 17 feet wide dragged an automobile across a field by the bumper before the brake was applied. In one demonstration a 12-year-old girl was carried aloft in a swing seat attached with ropes to four big kites. Any one of them would keep her



flying or let her down easy, the inventor said, for each kite has a pull of 100 pounds. The kites can fly in winds from 10 to 40 miles an hour. A kite four by six feet could pull a raft for fliers forced down at sea and shipwrecked sailors, or could serve as an emergency signal, according to Jalbert.

Powered Cultivator for Orchard Protects Young Trees

To turn the ground between narrow rows of young trees in an orchard, without barking their trunks, a Missouri nursery uses a motorized cultivator that does the work of six mules and three men. Powered by an air-cooled motor, the machine's Ford Model A transmission gives it three speeds ahead and one in reverse. To move along a road between fields it can attain speeds of 35 miles an hour. Five plow teeth, one at each side and three at the rear, are controlled by levers from the driver's position. With an individual brake control for each wheel, the cultivator can turn within its own length.



☐ The Army Map Service in Washington turns out 100,000 maps a day, 90 percent of the army's maps.

OCTOBER, 1943

Homemade cultivator does the work of six mules and three men. Constructed by Stark Bros Nurseries, Co., Louisiana, Mo., for their own use.

71 502



1400-MILE RIVER of OIL

Mr. Grant
 America scored another victory on the home front with the completion of the "Big Inch," 1,400-mile pipeline between Longview, Texas, and refineries at Bayway, N. J., and Marcus Hook, Pa. The giant pipeline that touches eight states and crosses 230 rivers and streams has a daily capacity of 12,000,000 gallons of crude oil. It can do the work of 85 tankers along the submarine-menaced coast or 25,000 railroad tank cars. Above, operating a gate valve which controls Niagara of black gold



Engineer inspecting "go-devil" or "pig" used for cleaning pipeline and detecting wasteful leaks
 Right, a big ditcher rolling east preparing way for 24-inch pipe requiring 360,000 tons of steel

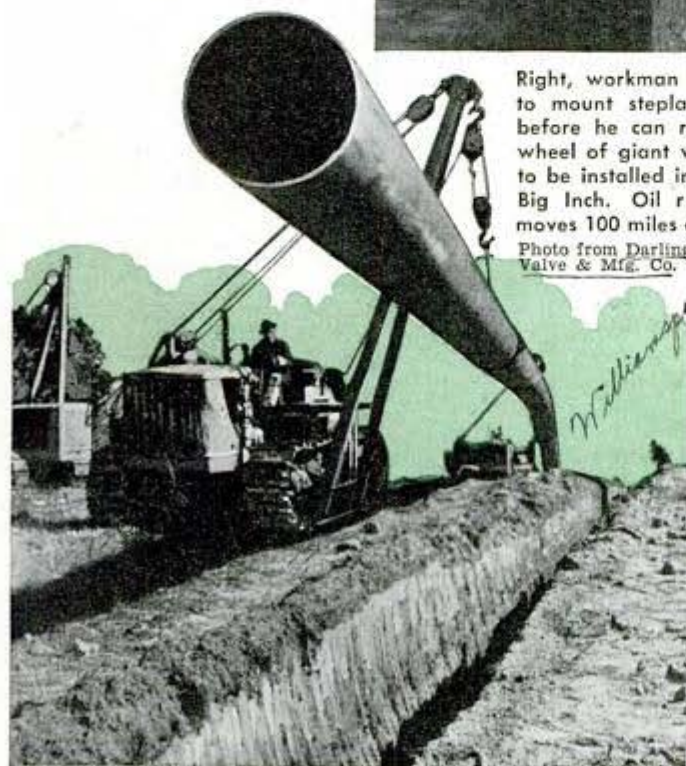
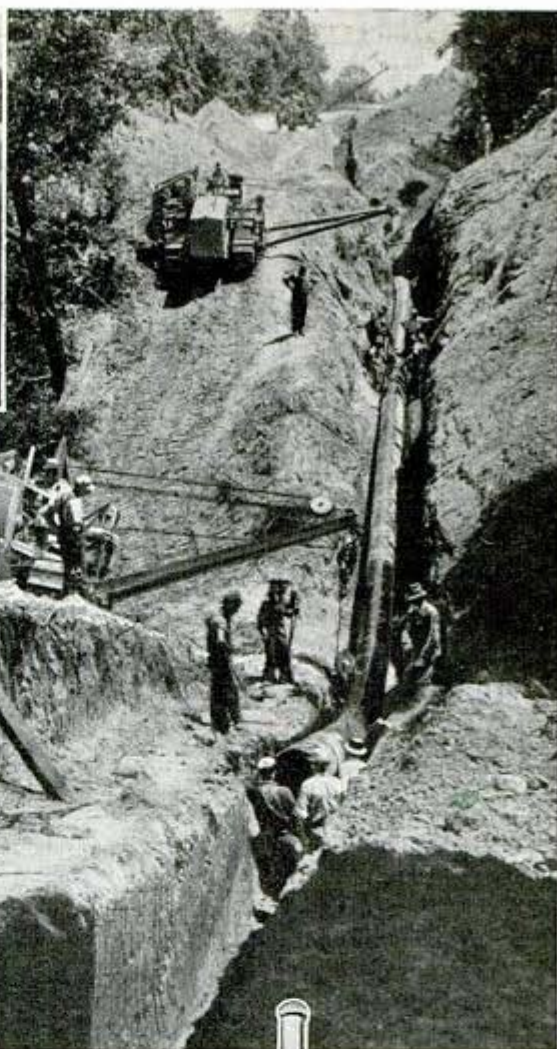




One of the 15,000 men who helped build vast project welds a terminal "plug." The pipeline was constructed in just 360 days

Through hilly country in southern Indiana, Caterpillar Diesel tractors equipped with powerful sidebooms (right) lay sections of pipe. The booms handle sections up to 118 feet in length. The pipeline, which cost about \$95,000,000, was built by War Emergency Pipelines, Inc., special agency financed by the Reconstruction Finance Corporation

The operation below is called "walking a section into place." Oil is forced through pipes by 26 pumping stations along way

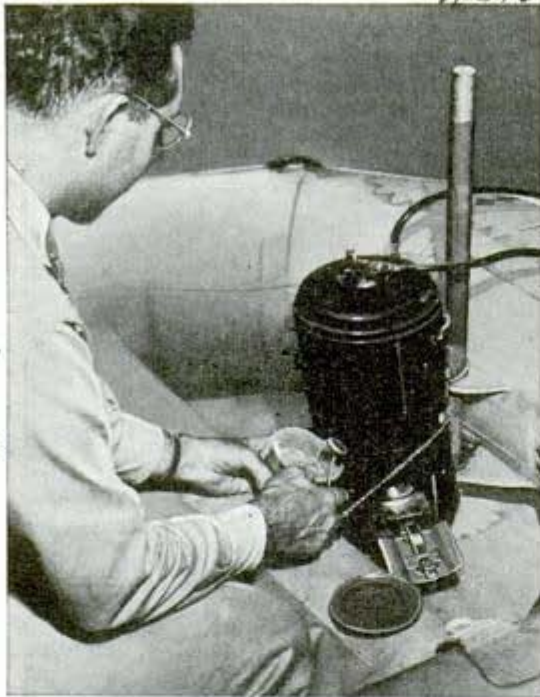


Right, workman has to mount stepladder before he can reach wheel of giant valve to be installed in the Big Inch. Oil river moves 100 miles daily
Photo from Darling Valve & Mfg. Co.



Tiny Still Hung on Life Raft Purifies Sea Water

71516



Cape Fear, N.C.

Seven-pound still makes ocean water fit to drink

Surrounding vistas of sea water need no longer tantalize thirsty men adrift in lifeboats. The Navy has developed a seven-pound still, which transforms sea water into pure drinking water. The new equipment is designed for use on rubber life rafts. With it, marooned men can distill 12 pounds of drinking water at the cost of only one pound of fuel. The still was tested in a full-dress rehearsal of shipwreck off the Carolina coast, during which men on the life raft maintained life with equipment that is already standard on such rafts, or undergoing trial. All the conditions of wartime survival at sea were simulated, except that a Coast Guard boat stood by, ready to take off the men in case of mishap.

71561

Yanks Bomb Glacier With Wire, Sink Ship With Gas Tanks

Ingenious Yankee fliers have used planes to lay telephone wire across a glacier in Alaska, and bombed Japanese ships in the South Pacific with gasoline tanks. In Alaska, the glacier, a broad river of solid ice, lay across the route of an extension of the Alaska railroad. It was decided to tunnel under the ice, but communications across it were needed in a hurry. Aerial survey showed it would be next to impossible to haul heavy reels of wire overland, so ten of the massive reels were loaded aboard an

Army bomber. Stakes were lined up in the deep snow as "targets," and the bomber's crew dropped the wire reels through the bomb bays in a flight across the glacier. Only one of the ten reels was lost. The line crew then connected the reels across the obstacle. In the South Pacific, crews of Lightning fighters, which carry droppable auxiliary gasoline tanks under the wings, came across a camouflaged Jap cargo ship. They raked the decks with cannon and machine gun fire, but the ship did not sink. So the fliers "dive-bombed" the vessel, letting loose the auxiliary fuel tanks and covering the ship with high-octane gasoline. Again they made passes over it with their guns, and the incendiary bullets set the gasoline—and the ship—afire.

"Thermometer" Voltage Tester Shows Frequency of Current

Rugged enough for "bang-around" maintenance work, a low-priced voltage tester is scaled to read like a thermometer. Showing the voltage of lines from 110 to 660 volts, the tester also indicates whether the current is a.c. or d.c., if an appliance or motor connection in the line is open, and which leg of a line is grounded. It can also be used to show if the frequency is 25 or 60 cycles, to locate blown fuses, and to indicate excessive leakage between motor and line. Requiring no meter, no switching or tip jacks, it is connected by placing the test prods across any electric line.



Voltage tester is scaled to read like a thermometer

Clipping from July 4, 1941
Copperweld
Steel Co., Chicago, Pa.

POPULAR MECHANICS
Superior Instrument Co.
227 - Fulton St.
N. Y. N. Y.

*O. F. C. Sessler Sergentius
Berry, Alabama N 416*

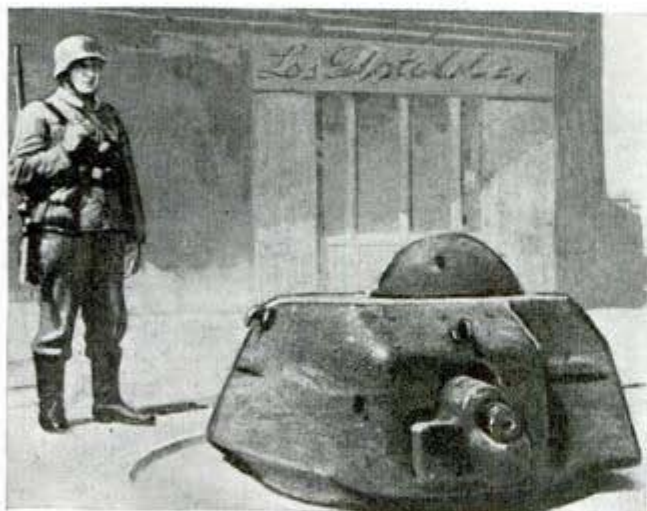
Jap Light Machine Gun Has Bayonet Attached

Captured in the jungles of New Guinea, a Japanese light machine gun is equipped with a sharp bayonet for hand-to-hand fighting. The blade protrudes from between the uprights of the bipod that supports the weapon when it is used on the ground. Like other captured Jap weapons, this cumbersome bayonet is more formidable in appearance than it would be deadly on the battlefield.

Protruding from between arms of supporting bipod, bayonet on captured Jap machine gun appears unwieldy to handle



One-Man Fort Used by Nazis Can Fire in Any Direction *N 454*

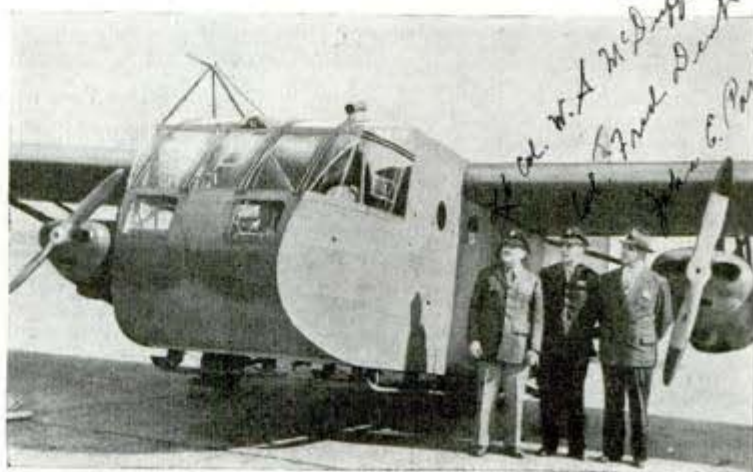


Resembling an iron turtle with a cannon for its head, one-man armored domes are used by the Germans in towns along the coast of Europe. These pint-size forts turn in any direction, according to propaganda which the Nazis have allowed to "leak" out through a neutral source. The Nazis fail to state what a shell fired from a U. S. M-4 tank would do to the domes.

Nazi propagandists would like us to believe seacoasts of Europe bristle with gun emplacements, like one-man "domed fort" shown

Low-Powered Motors Attached to Glider Convert It Into Airplane *N 401*

When is a glider not a glider is a question occupying experimental officers of the Army Air Force, since they converted a glider into a powered plane merely by the addition of small, air-cooled motors. The experiment was undertaken to determine whether gliders are capable of conversion into planes, and as a result it has created a demand for a new name for the hybrid. The pilot said the glider handled as easily as a conventional powered plane.



Equipped with air-cooled motors, this Army glider flies under own power

24. Andrew J. Hamilton
4205 Hamilton Street
San Diego, Calif.

71295

THEY PACK *the* K.O. PUNCH



Their defense against planes proved, battleships resume their roles as mistresses of the seas

IT WAS a brilliant, tropical morning. One of Uncle Sam's newest and most powerful battleships was escorting a carrier through the blue waters north of the Solomon Islands. With other American warships, they were on their way to engage a Japanese task force, reported to contain three carriers.

Captain Thomas Leigh Gatch, commanding officer of the battlewagon, spoke quietly to the communications officer: "Ask the ship's company if it is ready for action." The communications officer called for

attention on the ship's loudspeaker system and relayed Captain Gatch's message.

From all parts of the vessel, from bow to stern, from conning tower to engine room, nearly 2,000 officers and men answered—a huge, deep-throated, rumbling chorus, "Aye! aye!"

It was an expression, not so much of courage bred before battle, but serene and complete confidence in the monstrous new battleship of which they were all a part. It was the biggest, fastest and hardest-hitting vessel American engineering brains and shipbuilding skill had sent into action.

It did not fail the men that day, nor the men it.

At 11:12 a.m., the first wave of Japanese dive bombers, sensing another massacre like that of the Repulse and the Prince of Wales, swooped down. The anti-aircraft guns along the battleship's deck bristled like needles on a porcupine's back. Gunners waited tensely, and when the Jap planes got within range they let them have it. A wall of red-hot steel

Right, poison for enemy planes—a clip of shells for Bofors anti-aircraft gun. Below, coxswain pipes crew to attention



flew up to meet the attackers. Twenty Jap dive bombers came over in the first assault and 20 were shot down.

All the while the battleship was cutting circles, figure-eights and other maneuvers. Captain Gatch later said "I had less fear of attacking planes than of ramming the carrier we were assigned to protect."

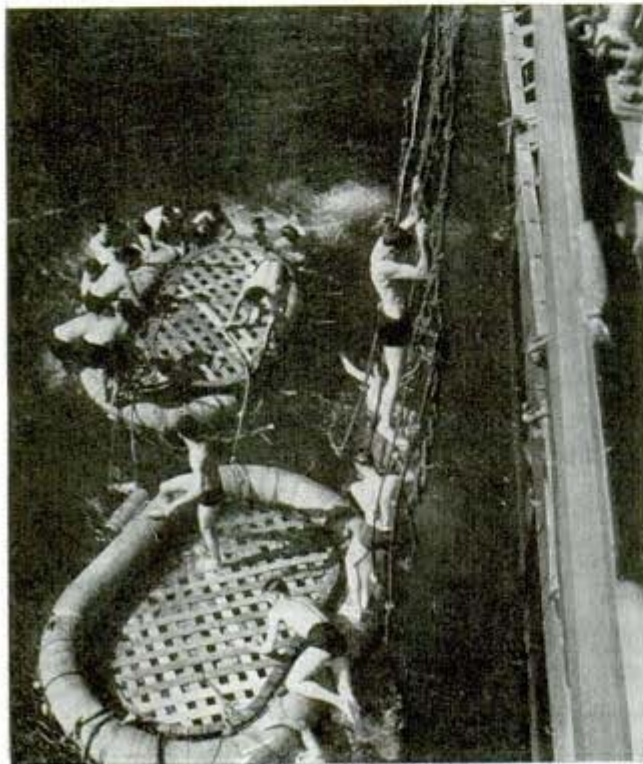
Thirty minutes later the second attack came. This time there were 40 planes—dive bombers screaming down vertically from the skies, and

Multiple "1.1's" guard battlegroup from low-level plane attack





Air defense officer on "sky lookout" co-ordinates ship's fire against enemy planes coming in simultaneously from several directions. Below, abandon-ship drill is standard practice item



torpedo planes skimming close to the water. Some of the Jap planes were shot down by anti-aircraft fire and the rest turned tail and fled.

The Japs tried to break through the wall of bullets a third time a half hour later. Again it was dive bombers and torpedo planes—24 of them. One plane, braving the murderous fire, got through to drop a 500-pound bomb on a gun turret. The concussion knocked Captain Gatch against the conning tower, wrenching a shoulder. A fragment caught him in the neck, severing his jugular vein.

But the battleship had won a clear-cut decision over Japanese air power. It had knocked down 32 out of a total of 84 planes, suffering only a single 500-pound bomb hit—which is only a scratch for a heavily armored battleship. Three weeks later the battleship was in action and Captain Gatch, his arm in a sling, was on her bridge.

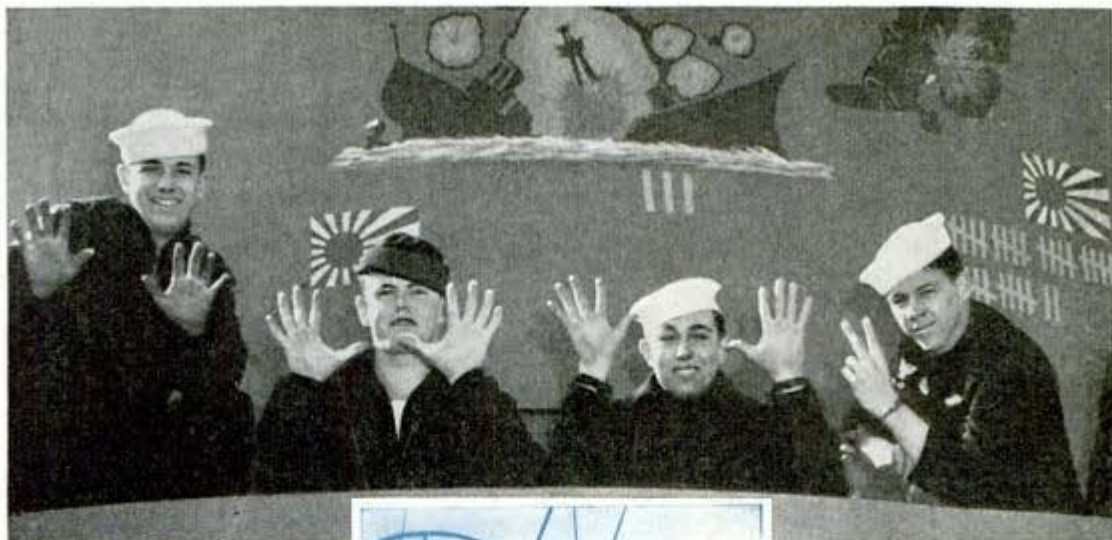
This was no fluke. Shortly thereafter, a second U. S. battleship beat off an attack of 40 Japanese planes, sending 10 of them flaming and smoking into the sea. The battleship was undamaged.

It is performances such as these that recently prompted Admiral William F. Halsey, commanding South Pacific Naval Forces, to predict that battleships will play a decisive role in beating Japan.

"I think it is going to be battleships that will win the war for us," he said simply and to the point. "And I speak as an airman, too."

Much of the confusion that has been generated by armchair strategists in arguing "battleships vs. airplanes" is due to the fact that the average man still thinks of battleships as slow, cumbersome vessels, moving into action in a long, vulnerable line.

This might have been somewhat true before Pearl Harbor, but it is no longer the case. America's newest battleships, 35,000-tonners of the North Carolina class and 45,000 tonners of the Iowa class, are speedy enough to keep up with 30-knot carriers, have anti-aircraft protection to keep away swarms of enemy planes, and are hard-hitting enough to be used in task forces rather than being employed as a fleet.



Above, battleship scoreboard—three cruisers and 32 Japanese aircraft blown to destruction

The Navy hasn't revealed how many of the six 35,000 ton vessels—the North Carolina, the Washington, the Alabama, the Massachusetts, the Indiana and the South Dakota—have been put into service. It seems reasonable to suppose, though, that all of them are now in the battle zones, plus the giant 45,000-ton Iowa which was commissioned last March.

When Japanese planes put a good part of America's battleships into the mud at Pearl Harbor and sank the Repulse and



Above, muzzle and sight of 20-mm. Oerlikon make ominous pattern against sky. Below, clad in foul-weather gear, crew of Oerlikon ack-ack gun go to stations

Prince of Wales, many persons jumped to the conclusion that the battleship was a dead dodo. But for every new weapon of warfare, a new form of defense has been devised. Our newest battleships are the answer to air power.

The reason why our latest type battleships can stand off air attack is, of course, increased anti-aircraft fire. Every square foot of deck and platform is covered with anti-aircraft weapons of





Above, at battleship's wheel; men at rear watch gauges

Life jackets, old and new models; latter is of rubber→

Below, removing snow and ice from battlegun turrets



several types and sizes. According to Rear Admiral William H. Blandy, chief of the Navy's Bureau of Ordnance, "our antiaircraft fire is better than anybody's on either side and further improvement is in prospect.

"On our latest battleships, I can state that the amount of metal thrown up by our light guns (20 millimeter and 40 millimeter) is almost 60 times as great as it was before Pearl Harbor. When you add improved fire control and the development of explosive bullets and shells, it is no exaggeration to say that it is 100 times as great."

Antiaircraft guns are really defensive weapons, and battleships must have a better excuse than beating off air attack for their \$70,000,000 cost. They have. Our newest battleships are the most powerful warships ever built—literally hell on keels. They pack a terrific offensive punch.

The Navy is wary about revealing facts concerning these super dreadnaughts, but a few facts are known. Ships of the 45,000-ton Iowa class are about 880 feet long and have a beam of 108 feet. Nine 16-inch guns and 20 5-inch guns give them a championship heavyweight's wallop.

The 16-inch naval rifle has been called a weapon of "fantastic range, accuracy and

striking power." It hurls a 2,400-pound shell a distance of more than 20 miles. Firing at a rate of about one shell every minute, our new battleships can hurl more than 600 tons of death-dealing steel and TNT per hour at an enemy out of sight over the horizon.

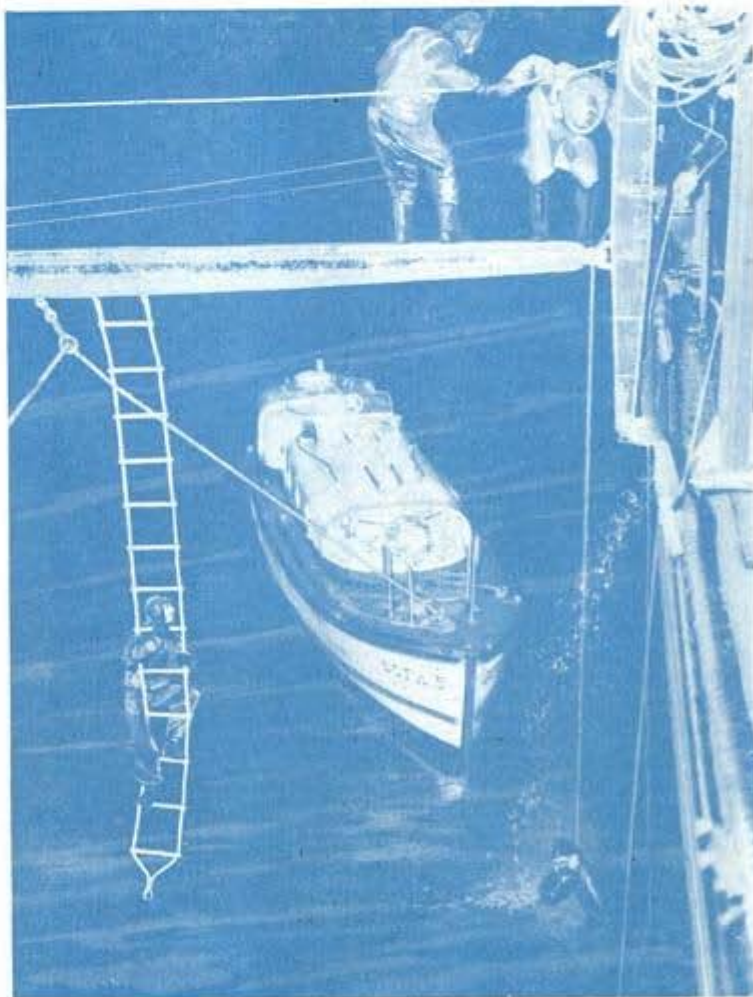
Battleship guns are set in parallel alignment and all guns of a turret fire at the same time—thus laying down a pattern in the vicinity of the target. Fire control, the mechanism which lays the gun on the target and fires the shell, has been developed to an amazingly accurate degree. Naval guns have not shown much improvement in the past 30 years, but American scientists have given the U. S. Navy the finest and most accurate fire control mechanism in the world.

Shellfire — especially from battleships — is much more destructive than bombing. Bombs are pulled earthward by the force of gravity and reach a speed ranging from about 880 feet per second (when released at 20,000 feet) to about 445 feet per second when released at 2,000 feet. A large shell, on the other hand, leaves the muzzle of the gun at 2,900 feet per second and even at extreme ranges may be traveling 1,500 feet per second when it hits the target. Thus, shells from a naval gun will penetrate much deeper than bombs of a comparable size dropped from planes.

Armor plating conforms to these facts. Among other superlative qualities, a battleship is the most heavily armored vessel afloat—up to 40 percent of the newest ships' total weight being armor plating. A battleship must be built to take it as well as to dish it out.



As if plotting sudden death for the crew of an enemy vessel thousands of yards distant, captain of a battleship's gun crew, above, sights through periscope to get true bearing. Below, quick work rescues man overboard





Gunner on U. S. battleship looks into breech of 16-inch gun

Armor plating is specially toughened steel of the finest quality. It is heaviest on gun turrets and on the conning tower, reaching in some cases a thickness of 18 inches. Newest battleships have a belt of 14 to 16 inch steel running around the vessel at the water line where it is exposed to shell-fire and torpedoes. Two armored decks, protecting the ship's vitals from bombs and high-angle shell fire, are 6 and 4 inches thick, respectively. Other areas on the vessel are armored according to their position and importance.

Additional protection against enemy shellfire and torpedoes is provided by compartmentation and false bottoms along each side of the hull. These spaces take up the blow like huge shock absorbers and prevent water from flooding the entire ship.

As this is being written, the Japanese admirals have not dared risk battleships in force against our newest super dreadnaughts.

Despite invention, sailors still use hand lead to measure water's depth as floating fortress heads cautiously into its port

When they do, they'll be in for some surprises.

They got an unpleasant taste of what is to come one night last November when Captain Gatch allowed his battleship to get caught in a Japanese "trap." The Japs weren't expecting battleships.

"They had set a trap for foxes and we didn't think it would hold bears," was the way Captain Gatch put it.

The Japs thought they had trapped, perhaps, a lone American cruiser. Three Jap cruisers moved in for the kill. Then the American battleship's 16-inch guns spoke with a flash of orange flame and a thunderous roar. All three Japanese cruisers were sunk before their own guns were within range of the American battleship.

"They never knew what hit them," Captain Gatch said.

Some naval experts have urged that the best way to defeat Japan quickly and at a minimum cost of lives is a direct attack in Japanese home waters. In this way the Japanese fleet would be flushed out of hiding and destroyed—leaving



*Bill Williams
San Diego, Calif.*

the way clear for landing of troops.

U. S. naval tonnage is increasing by leaps and bounds. With a fleet of new battleships of the North Carolina and Iowa classes, plus new carriers being built or already in commission, the United States late this year will have an unbeatable naval force.

At the start of the war, the United States and Great Britain were able to maintain control of the world's vital sea routes by a very slim margin. The American fleet had been dealt a punishing blow at Pearl Harbor and was inferior to the Japanese in carrier strength; The British fleet was wary of the Italian and German navies.

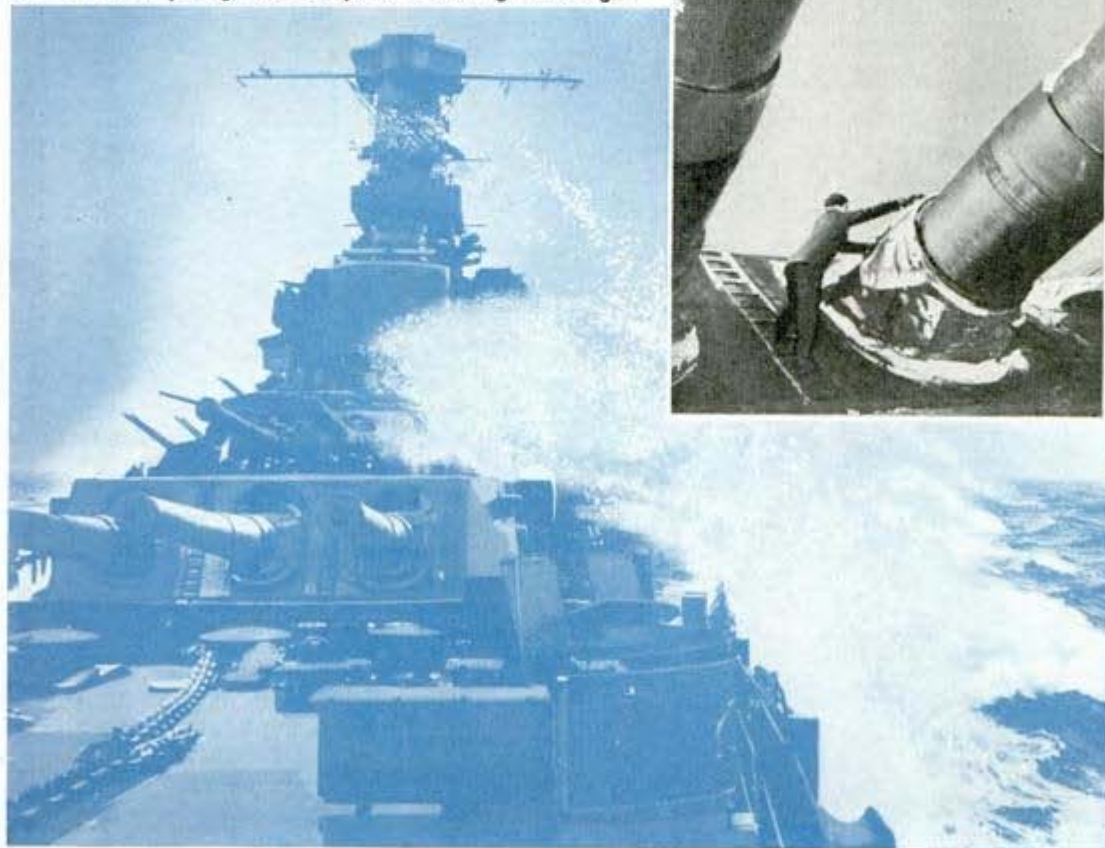
But today the Allies have a wide naval superiority over the Axis—perhaps a 2-to-1 edge. Figuring that all six ships of the North Carolina class are in service, the U. S. Navy now has 20 battleships, 10 of them mounting 16-inch guns. The British Navy has at least 15 battleships and battle cruisers in service, and perhaps, in addition, two new 40,000 tonners. Thus the Allies have a total of 35 or 37 battlewagons.

The Axis capital ships add up as follows: Japan,
(Continued to page 154)

Her 16-inchers jutting, this sea-queen is looking for a fight



Rugged as the shells behind him is this gun crew captain, above. Below, "bloomers," canvas covers for guns, are sheathed in ice



Commander Robert C. Coombs, U.S.C.A.

71455

Portable Megaphone Pinch Hits If Ship's Interphone Is Bombed



Officers' commands are amplified by portable speaker

If a torpedo or aerial bomb destroys a merchant ship's interphone system, a portable electric megaphone is used to give commands. Developed by the Coast Guard, it provides communication with the gun platforms, life boats and engine room.

71503

Jacket to Ward Off Depth Blast Floats Seaman Indefinitely

Constant fear of seamen forced to abandon ship is that the blast from a bomb, depth charge or torpedo may cause them

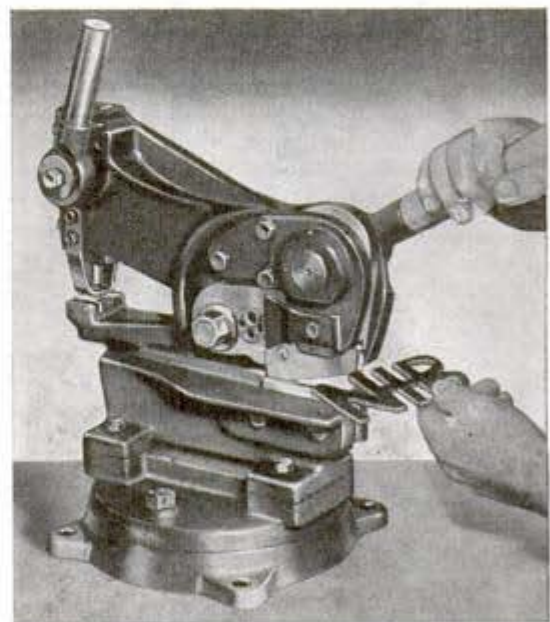


Whistle and flashing headlight help direct rescuers

critical internal injuries while they float, awaiting rescue. The pressure from such explosions is felt afar through water. To avert such tragedies, the Royal Canadian Navy has put into service a lifesaving jacket filled with kapok, and so designed as to give maximum protection to the chest and lower abdomen in the event of such underwater explosion. A pad at the back of the neck offers protection and support to an exhausted seaman, and the vestment is intended to keep the man afloat indefinitely. Among its features are an orange cap, visible by day, and a flashing light fitted atop the head, to guide rescuers by night. A plastic whistle may be used for signaling. Web handles at the back provide means for lifting the seaman from the water. In the event of exhaustion, the victim may attach himself to a raft, float, or rubber dinghy by means of a snaphook on the jacket.

71437

Combination Punch and Nibbler Saves Costly Hand Work



Single machine saves labor by performing four tasks

Four operations — nibbling, shearing, drill rod cutting, and punching—are performed with a single machine designed to save time and costly hand bench work. The hand-operated unit cuts out templates into any desired shape and cuts drill rods in sizes $\frac{3}{16}$ ", $\frac{1}{4}$ " and $\frac{3}{8}$ ". Any size punch or die from $\frac{1}{8}$ " to $\frac{1}{2}$ " by $\frac{1}{32}$ " is available. The body of the machine is made of cast steel and all wearing parts are hardened. It is made with or without a swivel base.

One ton of softwood lumber mill waste yields 20 gallons of 95 percent alcohol.

1937, Pay Lieut. Commander A. Tallidge
& Lieut. Campbell, Command of Royal Canadian
Navy, Halifax, Nova Scotia.
Made by Royal Canadian Navy

POPULAR MECHANICS

National Machine Tool Co.
1550 C. St. N. W.

71 394

Flying "Can Opener" Packs Tank-Busting Guns

James Colvin

Hurricane fighters of the Royal Air Force have been fitted with two 40-millimeter cannon for attacking armored vehicles. These exceptionally heavy guns are mounted beneath the wings, one on each side of the fuselage. In its tank-busting role the Hurricane has been nicknamed by the R.A.F. the "tin opener," British equivalent of "can opener." The guns are specially designed for aircraft, and weigh only 320 pounds each. Such Hurricanes have been used for attacks on tanks, armored fighting vehicles, and transport.



Hurricane used as anti-tank weapon mounts two 40 mm. cannon in wings

Radio and 'Biscuit Gun' in Car Aid Cross-Country Fliers

71 431

Formation flying, night training and special stage landing practice at a southern

Army airfield are directed by a radio command car.



A powerful generator powers the two-way aviation radio, and a set of batteries provide current for the "biscuit gun," or blinker signal. This is used when radio communication is impracticable, or when static interferes. The command car's four-wheel drive takes it across country to direct special maneuvers. The equipment has solved the problem of low-altitude work away from the home field, where radio messages from the main control tower won't reach. A plywood table was built in the car to carry the radio equipment, and special electrical facilities were provided.

Radio on table, foreground, and "biscuit-gun" signal light ride in Army airfield's command car

Secret "Wedding" of Molecules Gives Terrific Punch to Blockbusters

71 441

Molecules of synthetic wood alcohol wedded with molecules of ammonia form the basic ingredient of a secret explosive used in the blockbuster bombs that have thrown a military monkey wrench into Hitler's war machinery. As demonstrated at the du Pont electrochemical plant, the

chemical used as basic ingredient is tetramethylene-tetramine, or hexamine, made from ammonia and formaldehyde. The latter is made from synthetic wood alcohol and air, and the alcohol is made from coal and water. Formerly, the principal industrial use for hexamine was in plastics.

FIGHTER PLANES *by* SPECIAL DELIVERY



Ferry pilot standing on the wing of newborn Mustang fighter receives parachute he hopes he won't need

THAT high school kid who lived down the street a year and a half ago has something special on his uniform today. As a pilot who has delivered airplanes across both oceans he wears ribbons that indicate action in the American, Asiatic-Pacific, and European theaters of war. He's a flier in the ferrying division of the Air Transport Command.

In fact, he just returned from Africa last night. Today he's resting and waiting for another call in the pilots' big lounge at a military airport in California.

Among scores of other pilots in the room, some were crop dusters before the war, some were private pilots, and some were barnstormers. Others are graduates of the new Air Forces schools. Most of them, right now, are killing time by swapping tales of their recent experiences in odd corners of the world. A couple of them in a corner are listening to the story of Rick-enbacker's weeks in a rubber life boat on the Pacific, being told by one of the men who was with him.

"Lieutenant Jones, Lieutenant Squier, Lieutenant Gillespie, report to the operations office."

That's the loud speaker again. Three men head for the door, make their way along a corridor that is lined with traveling kits all packed and ready to go, and step into the busy operations office. Their faces fall when they learn their destination. They and a dozen other pilots are to board a bus for a nearby factory, from where they will ferry some brand new fighters to a modification center a thousand miles away. They had been hoping to draw an assignment for India or Alaska.

A ferry pilot never knows where he will go next or what adventures are in store. One flier who had never before been away from the United States recently found himself sitting down to a feast of buzzard eggs and a cooked goat head complete to the eyes, proudly offered him by a desert sheik. The pilot had left home just a few days before, flown to Africa, and on into the east where he had been forced down.

(P. 2) *Review Branch
 Bureau of Public Relations
 War Dept.
 Washington, D. C.*



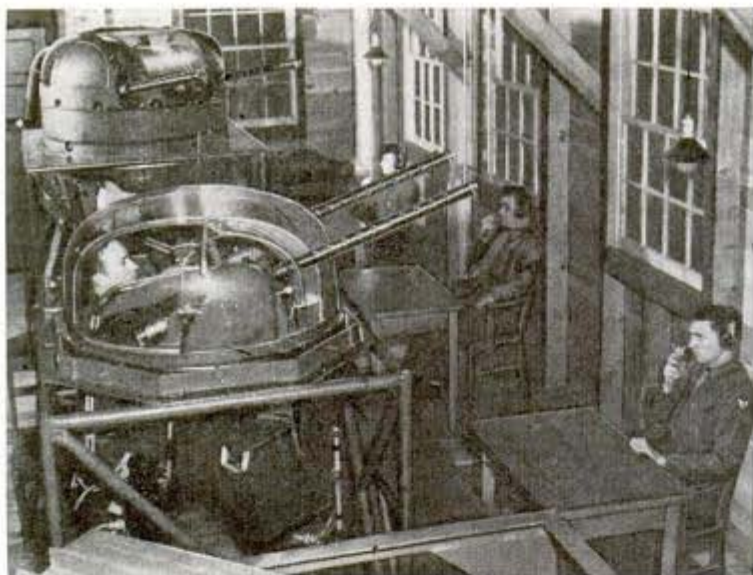
Another pilot started on a routine delivery flight and put 50,000 miles on his log book before he got back to his base. Another, delivering a new plane in Australia, made side excursions flying men and equipment into the Solomons before he returned to the United States. One pilot flew completely around the borders of the United States in three and a half days, ferrying planes to points where they were needed.

Another sat down on a foreign island for a good night's rest but had to forget about sleep when an intense storm arose. His plane was tied down to a steel landing mat and the wind threatened to lift plane, landing mat and all, right off the ground. When the storm ended he found a couple of holes in the plane's windshield, punched by rocks that had been picked up by the wind and hurled through the air.

Some of the ferry pilots have encountered storms at high altitudes so strong that the doors of their planes were sprung open. Even though they throttled their engines down, drafts

Learning to operate guns in belly turret is part of ferry course. Below, training pilots with high caliber machine guns and cannon





Ferry pilots operating turret guns in classroom; instructors use phones

of wind would lift them or drop them thousands of feet in a couple of minutes. The pilots avoid storms like that if they can. Their job is to fly with caution, over established routes, and to land if bad weather threatens. They are instructed to deliver airplanes, not to take chances with them.

The pilots lead a fast and exciting life, and yet it's a safe one. Maj. Gen. Harold L. George, chief of the Air Transport Command, recently announced that during the heaviest month so far for the delivery of aircraft, losses en route amounted to only four one-hundredths of one percent of the planes flown. This record was achieved in spite of the fact that delivery routes extend

from the east coast of the United States to Africa and on through Cairo to Russia or Chungking, and from the west coast to Honolulu and on down the chain of Pacific islands to Australia. For long over-water flights the planes carry extra gas in tanks installed in their bomb bays, or in the case of planes like the P-38, in big belly tanks under the wing.

One exasperating accident that reduced the ferry division's safety record occurred to a pilot who early in the war had been a member of the Flying Tigers in China. More recently he had transported

planes to different parts of the world, receiving commendations for his record of delivering planes safely no matter to what destinations. Then, at his home airport, he slipped from the wing of a plane he was to fly and broke his ankle.

An experienced ferry pilot can handle anything from a trainer to a Flying Fortress. Some of the pilots are flying planes that you may not have heard of, so new are some of the advanced designs being produced. In a sense the ferry pilot is also a test pilot. The plane that he picks up at the factory may have less than an hour of flying time on it. He breaks in the plane and engine during the delivery flight. He

Dummy airplane serves for realistic demonstration on fire fighting tactics given to ferry division pilots



watches the way it operates and recommends any adjustments that are needed when he delivers it.

In a sense, too, the ferry pilot is also a fighter pilot. He knows that he may have to fight for his life on his way to a distant destination and he's ready to do it. He's been trained to handle anything from a hand grenade to a 37 mm. automatic cannon. If he is flying a bomber he knows that his crew, including navigator and engineer, knows how to operate the gun turrets and how to lead their targets. His plane is ready for a fight when it leaves the ground.

A ferrying division base is as busy as a three-ring circus. It is a combination pilot pool, airport, flying school, and equipment center. Scores of pilots who are checking in and out, getting their orders and assembling their baggage, create a bustle that is similar to that of a big railroad station. Pilots return to their bases from delivery flights by air line transportation or in Transport Command airplanes. Some of them may spend 20 hours of one day in the air, going and returning. One of the facilities at their base is a gymnasium, steam bath, and massage department where they can get back into tip-top shape.

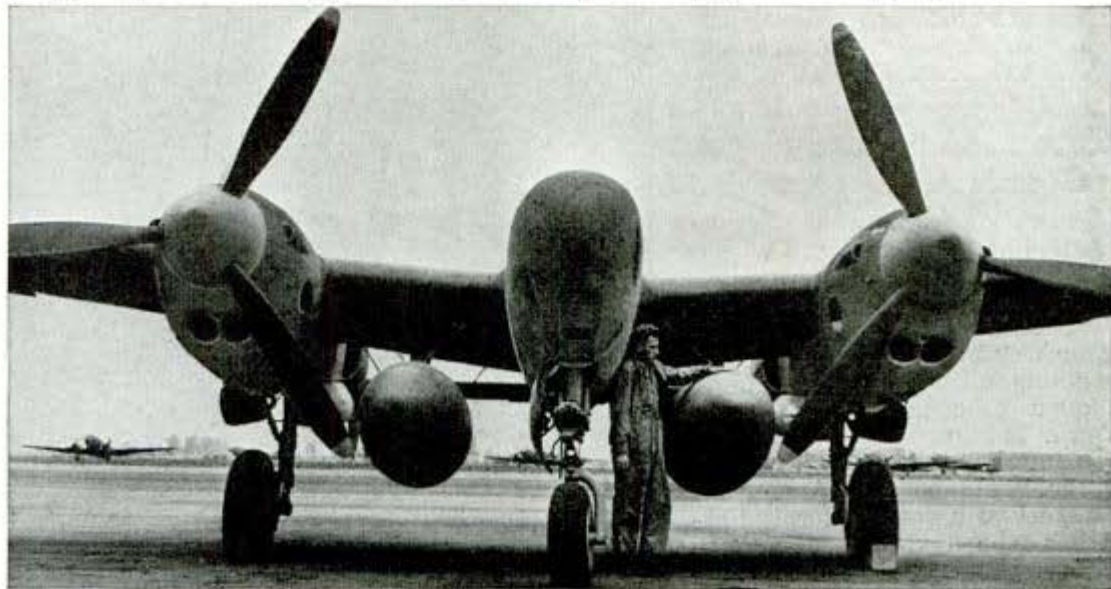
As an airport, the ferry base is so busy with hundreds of takeoffs and landings every day that the jeep drivers who taxi the pilots and their luggage to the waiting airplanes must obey the stop-and-go signals of flagmen at the different runways.



This new rubber life raft inflates automatically as it is unrolled

And the base is a flying school as well. Between assignments the pilots are trained to handle planes that are new to them. Every so often they must catch up on their blind flying in a Link trainer, and practice their gunnery at the range. They are taught to recognize enemy airplanes by their actions as well as appearances, and they are rehearsed in the methods of finding desti-

Huge belly tanks under wing of Lightning P-38 will permit ferrying it to some fighting front overseas





For a double check on that rip cord, girls test the pilot's parachutes

ground school course and is then commissioned as an officer in the Army of the United States. At the beginning of his career he is qualified to fly single engine airplanes only, then he is trained in two-engine planes. Later he graduates to the fast single- and two-engine fighters and finally, if he qualifies, he learns how to handle the big four-engine bombers and transports. At this transition school you may see a young instructor only a year out of college, showing a veteran pilot how to fly. The veteran may have thousands of hours on his

nation fields that are carefully camouflaged.

To become a ferry pilot, a man must have had at least 300 hours in the air, of which 100 hours have been behind an engine of at least 200 horsepower. He takes a condensed

log but he needs special coaching to fly some of the fast new types.

At the ferry base the pilots receive the special equipment that they need for par-

(Continued to page 156)

'Dip' Heater Warms Photo Fluid in 50-Below Darkroom

Developing solutions in photographers' darkrooms in Iceland and other Arctic bases are heated with an immersion heater. This heater can be plugged into an ordinary light socket. It is of tubular design, similar to units used in electric kitchen ranges. In a General Electric laboratory, the unit was tested in a chamber registering 50 degrees below zero. Similar heaters, some no larger than a small cartridge, are used on high altitude planes to improve the operation of delicate instruments and to prevent oil from freezing.

Current-Conducting Heel Guards Against Sparks

Protection for munitions workers and others is afforded with a rubber heel that conducts electricity instead of acting as insulation. This heel carries off static electricity in a worker's body and prevents an accumulation large enough to cause a dangerous spark. It is made of special rubber compounds slightly stiffer than the conventional heel. Among the prospective users are hospital attaches who assist in operations where electricity is involved.

32

*Goodyear Tire & Rubber Co.
Akron, Ohio*



Immersion heater similar to heating unit in a kitchen range is used to warm developing solutions in Arctic photographic labs

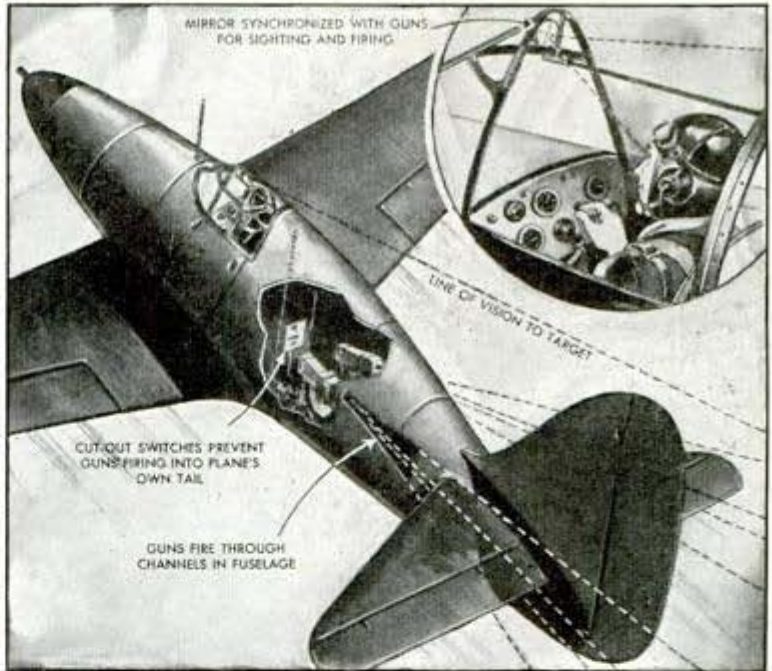
POPULAR MECHANICS

71287

Mirror Aims Rear Machine Gun in Fighter Plane

Start the Machine Gun

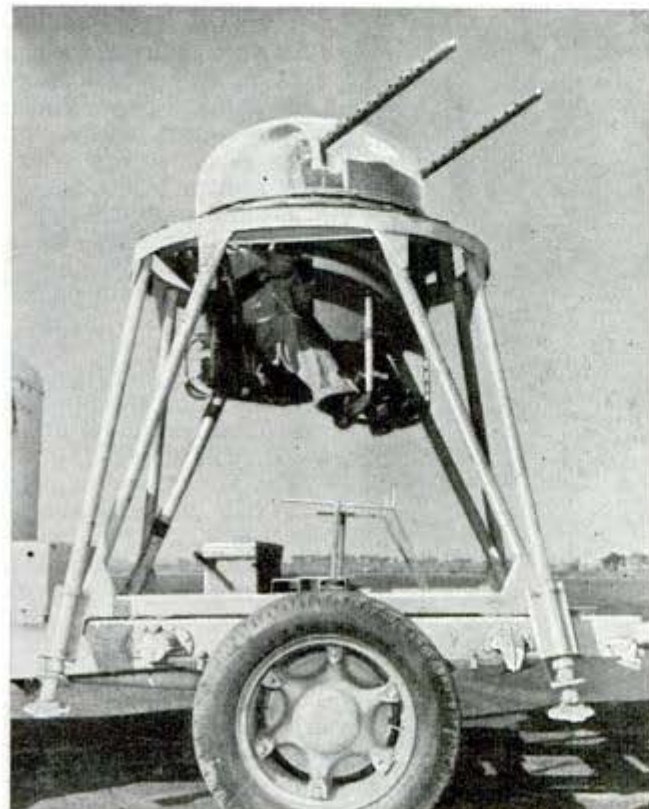
Fighter-plane defense against enemy planes attacking from the rear is provided by installation of rearward-firing machine guns, aimed through a mirror in the cockpit. The mechanism is the subject of an invention of John F. Habberlin, whose patent is assigned to Boeing Aircraft Co. The pilot under attack manipulates a cross-haired mirror until he has the attacking plane lined up. A train of gears automatically lines up the machine guns to bear on the attacker. Provision is made for a cut-out switch element to interrupt the action of the guns to prevent their firing through the plane's own tail and elevator surfaces.



Sighting through a mirror mounted in front of him in the cockpit, pilot aims the rearward-firing machine guns at plane attacking from the rear

Turret Gunner Rides on Stilts to Get Feel of Air Combat

71400



Gunner's turret is raised on stilts and mounted on a truck, to give the student practice in firing from a vehicle in motion

Aerial gunners at a Naval Gunnery School get the feel of air combat by firing practice rounds from an actual turret, rigged above the ground so that the gunner is in much the same position he would be inside a bomber. The turret is supported on stilts rising from the frame of a truck. Mounting it on the truck makes it possible for the gunner to develop the knack of "leading" his target from a vehicle in motion.

from the cockpit

Robot "Brain" on Bomber Synchronizes Engines

Engine speeds and the propeller pitch on four-motored bombers or twin-engined planes are synchronized with a device that is operated by the turn of a single knob. Formerly, the propeller control system was manipulated by four levers. The new synchronizer, which has proved successful on several fighting fronts, allows the pilot and flight engineer more time for combat problems and lessens fatigue. Synchronizing the engines and propellers reduces vibration and noise on multimotored planes.

OCTOBER, 1943

announced by George W. Brady, chief engineer at Curtiss-Wright Corp., Caldwell, N. J.



"Weighing in" diamonds on a delicate scale. Industrial diamonds are far more important than the sparkler you wear in your ring. Below, a million dollars' worth of cut and polished diamonds fresh from the factory



ONE of the toughest little friends Uncle Sam has in this war is the industrial diamond, the stepchild of the gem family which has suddenly grown into the fair-haired boy of the nation's war plants.

He was sold by the handful when his sparkling brothers were prized as individual beauties, even though tiny. He still is. He was peddled for as low as 55 cents a carat when fine white stones of the same size sold for \$700. He still is. So plentiful was he that three-fourths of the diamonds taken from the best fields were industrials and the mines lost money trying to get rid of them. He still is. He was so much like a gem diamond that only an expert could tell the difference. He still is.

But he's gone to war in overalls on our side, and practically 100 percent of the industrial diamonds plugging away at hard jobs in the factories are now enlisted in the cause of the United Nations.

Germany and Japan, after frantically smuggling all the industrials they could just before the war, have worn their tool diamonds out by this time. Now they are converting jewels into tools. So important has the diamond become that our enemies are not counting the cost any longer.

The story is the same for both sides. Harder metals are being produced. More precision work goes into war production. Speed is the keynote of the rolling wheels in this mechanized war both at the front and in the factories. Only the diamond can take the beating the modern assembly line hands out.

There are only three important sources of

these stones in the world: South Africa, the African Congo and Brazil. All are safely out of Axis hands. The only great store in Europe when Germany began her march was in Holland, center of the gem cutting industry. The Dutch departed with their stones, or hid them before the Nazi tanks rolled in. The French moved theirs to England. A lucky break for us.

The diamond, being the hardest substance known to man, can do things with fighting equipment that nothing else can do. It can grind down tungsten carbide, one of the hardest of metals, used to cut steel. It can true the abrasive wheels that give the finish to the inside of gun barrels. Pierced with a hole to serve as a die, it can draw 20,000 miles of wire before it must be rebores to a larger size.



Norton Company photo
Employing a diamond grinding wheel, the machinist above is sharpening a carbide tipped tool. There are several million dollars worth of diamonds in this pile; these jewels pay for the mining of cheaper industrial "diamonds in overalls"



DeBeers photo
Polishing a diamond with a steel wheel a foot in diameter, soaked in diamond powder and olive oil

Baumgold Bros., Inc.

Diamonds set in core bits drill down into the earth through all kinds of rock in the search for minerals and oil. Crushed into dust, the diamond grinds lenses for bomb sights, range finders, and navigation instruments; polishes tungsten carbide, and even drills holes through other diamonds.

Some of this work can be done only with diamonds. All of it is done quickest and best with them.

Industrial diamonds are found side by side with stones of gem quality in the same mines and fields. Only a person of long experience can look over the stones as they come from the ground and say this one is worth a dollar and that one a thousand. The principal difference between gem diamonds and industrials is in beauty and clarity.





Diamond Tool Research Co. photo

Here a woman technician is setting a diamond in an abrasive tool

The idea that industrials are merely the diamonds that have been rejected as gems because of "imperfections" is not the whole story. It refers only to those qualities—clarity, purity of color, and comparative absence of flaws—which make a stone "perfect" for gem purposes.

Other qualities are more important in the diamonds used in tools and dies. Some of the stones most highly prized for industrial purposes are ones with cross grains going in all directions, tough and knotty, in structure somewhat like a knot in a log of wood. Others are the relatively rare carbonadoes—black lusterless stones which an unfamiliar eye would not recognize as diamonds.

About 75 percent of the industrial diamonds are set into tools in the rough. The natural surface of the rough diamond, the "skin," is commonly believed to be the hardest part of the stone and is

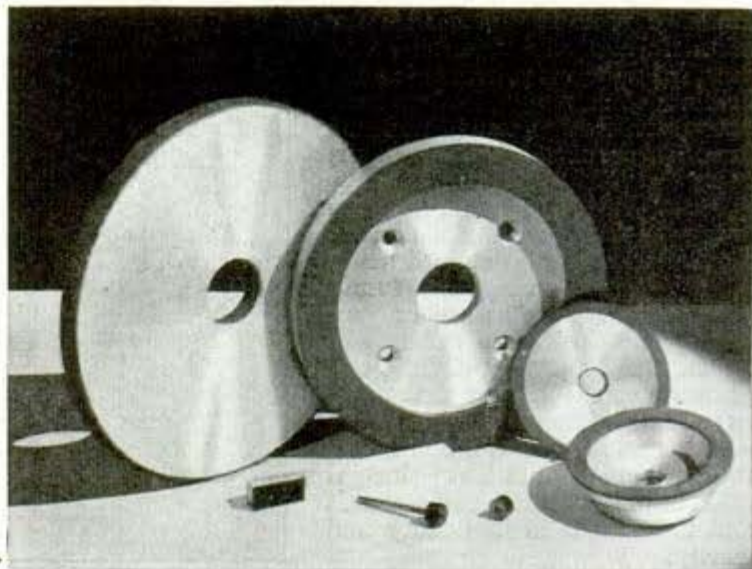
Resinoid bonded diamond wheels→

therefore carefully preserved for much of the work the diamond is called upon to do. The purpose of some tools requires the stone to be shaped and polished; the diamonds chosen for such uses are, of course, different in structure from the "toughies" most valued for use in the rough.

The flow of rough diamond imports continues without interruption. The stones arrive in little white cloth sacks, like salt bags, looking like bright pebbles. Most of them come from Africa by way of London. And they are brought by airplane—by those same magnificent ocean-spanning machines which could not be made so well or so fast without the very cargo they carry.

Although diamond tools were made in this country previously, we have increased our output about 600 percent since the beginning of the war. We are now exporting them to England, Russia, China, Australia—wherever they are needed for the production of United Nations war materials. Before the

fall of France this country produced about one twentieth the number of diamond dies it needed. Today, in spite of the greatly multiplied demand, we are producing not only enough to meet our own needs, but a surplus for export. For this tremendously increased output the United States is using this year four and a half million carats of industrial diamonds or more—over a ton





Closeup of girdling operation. Diamond dust dropping into bin is salvaged for use with olive oil for other cutting operations

of diamonds—and it has been estimated that we shall use above five and a half million carats next year.

A century ago diamond tools were used mostly to true the millstones that ground wheat and to drill holes in porcelain false teeth. Toward the end of the 19th century the development of the dynamo and other forms of electrical equipment created a demand for thousands upon thousands of miles of fine copper wire. For hundreds of years the silk industry around Lyons, France, had manufactured the fine gold filaments used in brocaded silks and gold braid by drawing the gold through tiny holes bored in sapphires and rubies. The newborn electrical industry turned to these craftsmen with its demand for copper wire. The ruby and sapphire dies which had been used for gold, however, were not hard enough for copper. So diamond dies were made, and new tungsten wire, so fine it can scarcely be seen by the naked eye, is being drawn through diamonds to the unprecedented accuracy of one five-millionth of an inch. Only diamonds can do it.

The diamond die industry remained centered in France, an offshoot of the silk industry, until the Nazis marched in. Now the industry is centered

To make telephone wires of uniform diameter, some sizes are drawn through holes pierced in a series of diamonds. This machine drills holes in the diamonds

Western Electric Co. photo

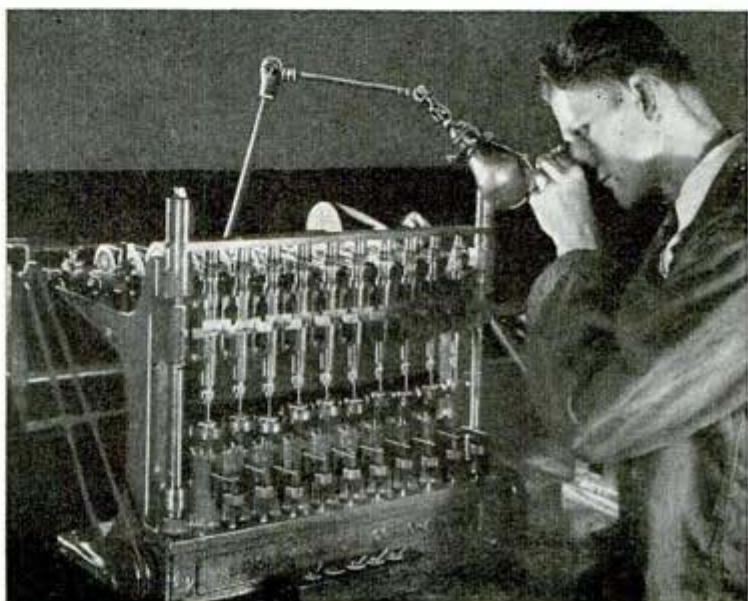


Inspecting a completed diamond tool through high-power lenses

in this country—logically enough, since it was this country which originated and developed the electrical industry that made the diamond die necessary.

More recent industrial developments which have placed the new emphasis on diamond tools are the use of harder alloys and the ever-increasing demand for precision work.

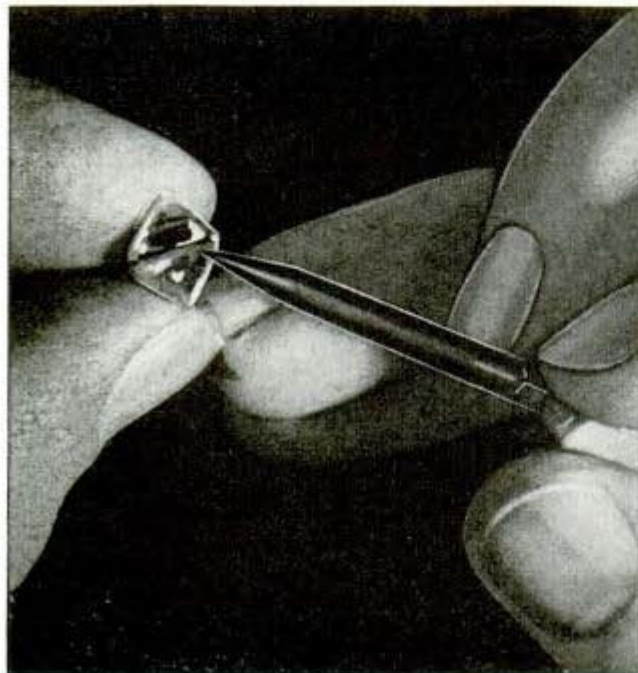
When you must machine a motor part accurately to within one ten-thousandth





Part of a single diamond, the Cullinan, shown in models. The original diamond was worth seventy-five million dollars

Before cutting a rough diamond into sparkling gems it is marked in black India ink to guide the sawer or cleaver



of an inch or better, you have to use diamonds, either on the motor part itself or to true and dress the wheels which grind and shape the part. Diamond tools are the most accurate because the diamond is so hard that it can do a substantial amount of work before showing even an infinitesimal amount of wear that would rob it of split-hair precision. Harder alloys require diamonds for the added reason that only a diamond is hard enough to do the work efficiently.

In other cases diamond tools are replacing older types because it has been found that they do the work more quickly. Where war-time experience has shown that the time required for a process can be reduced from days to hours by the use of diamond tools, it is not likely that the return of peace will mean a return to slower methods.

A few years ago diamond tools were regarded as a luxury item in industry. Today they are a prime necessity. And the development of the use of diamonds in industry has been facilitated by the sale of gems in jewelry. Because our diamond supply is ample, there are no priorities or limitations on the sale of diamond jewelry as there are on the sale of diamonds for industry.

The gem stone may lose nearly half its weight before it has been cut and polished into the brilliant solitaire sold by a jeweler who receives from \$500 to \$700 for a one-carat gem. Since about four tons of ore must be mined for every carat of diamond rough recovered, this is the chief return on the mining and sorting of nearly 32 tons of ore, the sorting and distribution of the rough stones, and the cutting and mounting of the gem.

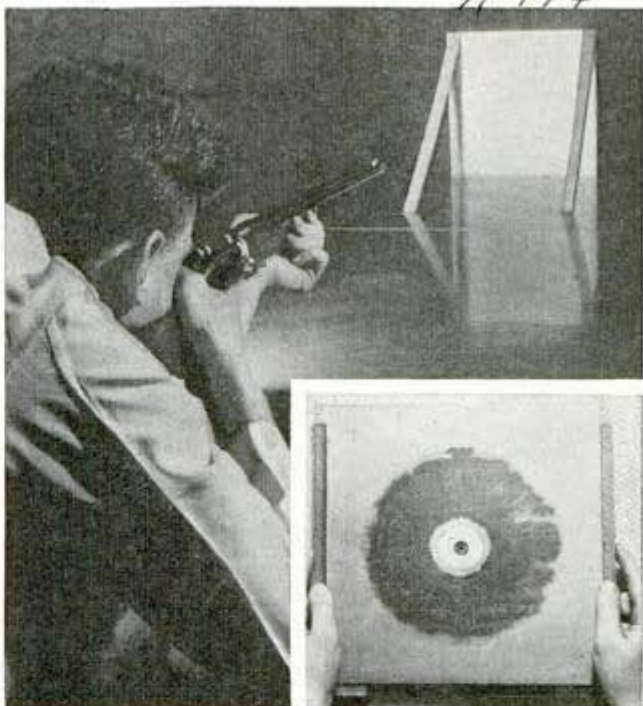
The ore that yielded a rough gem stone of two carats will have produced on the average about six carats of industrial diamonds—and the average price of industrial diamonds is about \$3.00 per carat. In other words, the sale of gem diamonds in jewelry has made it possible to put the industrial diamonds into overalls and set them to work on the manufacture of war material at less than the cost of production.

So the gem which sparkles on a finger of a soldier's bride-to-be helped pay for the diamond in overalls which in turn helped make the gun he carries.

Bullet's Footprints Show Stresses in Armor Plate

Dr. Mikko Hatanaka

To determine more accurately where and how strains occur when a bullet strikes armor plate, research engineers of the Westinghouse Electric & Manufacturing Co. fire a rifle at steel and plastic targets. These targets are coated with a lacquer that cracks under the impact of the bullet, revealing the location and the magnitude of strains in the metal. Such "footprints," tiny cracks in the lacquer, are filled in with dye to make the pattern of stress more prominent, and to reveal similar stresses in the metal coated. Some shots create a heart-shaped pattern extending six to eight inches from the spot where the bullet struck; others form a series of circles around the bullet hole. A hair-thin coating of the lacquer spread over machinery that is then subjected to the yanking, squeezing and bending of laboratory tests also helps reveal, by its tell-tale cracks, where the strains occur in the machinery.



Firing bullet at test plate; inset, "footprints" of stresses in plate

Airmen Shoot Skeet on Wheels in Rehearsal for Dogfights



Aiming the hoselike spray of bullets from a .50-caliber machine gun at a diving enemy plane from the turret of a Liberator or Flying Fortress requires skill not even attained by such legendary gunmen as Davy Crockett, because the gunner must make allowances not only for his speeding target, but also for the speed of his own "gun platform." Yankee plane gunners are given advance practice in the intricacies of such aiming at a Florida air field. There they practice skeet shooting from the deck of a moving truck, firing on a moving target which is projected unexpectedly into the range of their weapons.

Practice in "leading" a moving target is given by skeet shooting from truck

"Victory Meat" Made of Wheat Is By-Product of Alcohol Distillation

As one possible answer to the meat shortage, chemists of the U. S. Department of Agriculture have produced a substitute consisting of protein recovered by alcohol distillation from wheat. It looks like dried egg white. When wheat is treated with sodium sulphite solution, the protein clots

and rises to the surface. The cost of producing this "Victory meat" is about five cents a pound. The solution that is left after the protein is removed could be used to replace barley malt for distilling alcohol which the U. S. war machine consumes at the rate of 500,000,000 gallons a year.

Mr. James Calvin

21312

AMERICA'S No.1 WAR CROP



as the most vital material in the winning of the war.

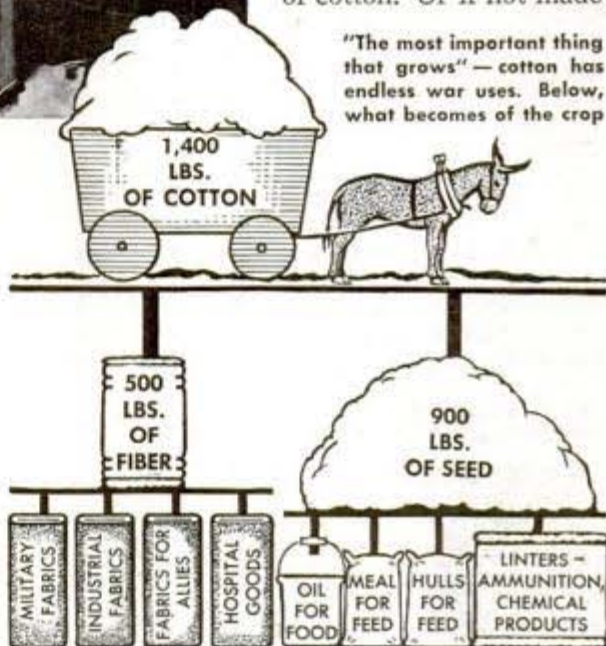
Maybe you can't see where cotton fits into all the examples in the guessing game above. The last paragraph of this article explains, if you haven't learned by then.

You could close your eyes and point in any direction, and the odds would be overwhelming that, wherever you are, your finger would be indicating something made of cotton. Or if not made

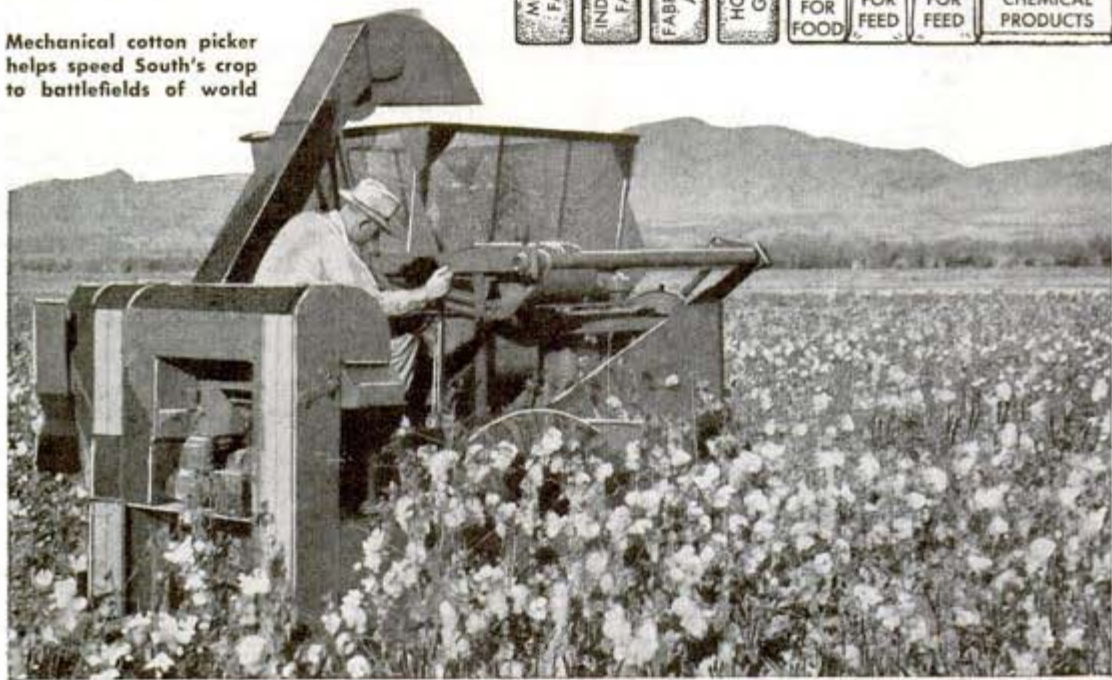
"The most important thing that grows" — cotton has endless war uses. Below, what becomes of the crop

"**W**HAT'S my name? You wear me, eat me, sleep on me, ride on me. You read out of me, look at me in the movies, rub me on your face. I make your radio play. Your fighting men fire me out of guns, race through the clouds with me in their planes, roar into combat with me in their tanks and ships, descend with me in parachutes and float to safety in me at sea. I'm present at your birth, and go with you to your grave. I've been called the most important thing that grows."

If you haven't already guessed, the name is Cotton, second only to steel



Mechanical cotton picker helps speed South's crop to battlefields of world



of cotton itself, it couldn't have been made without the cotton in the factory that made it (belting, abrasive cloths, water and air hoses), or in the mines from which it was dug (guncotton and dynamite).

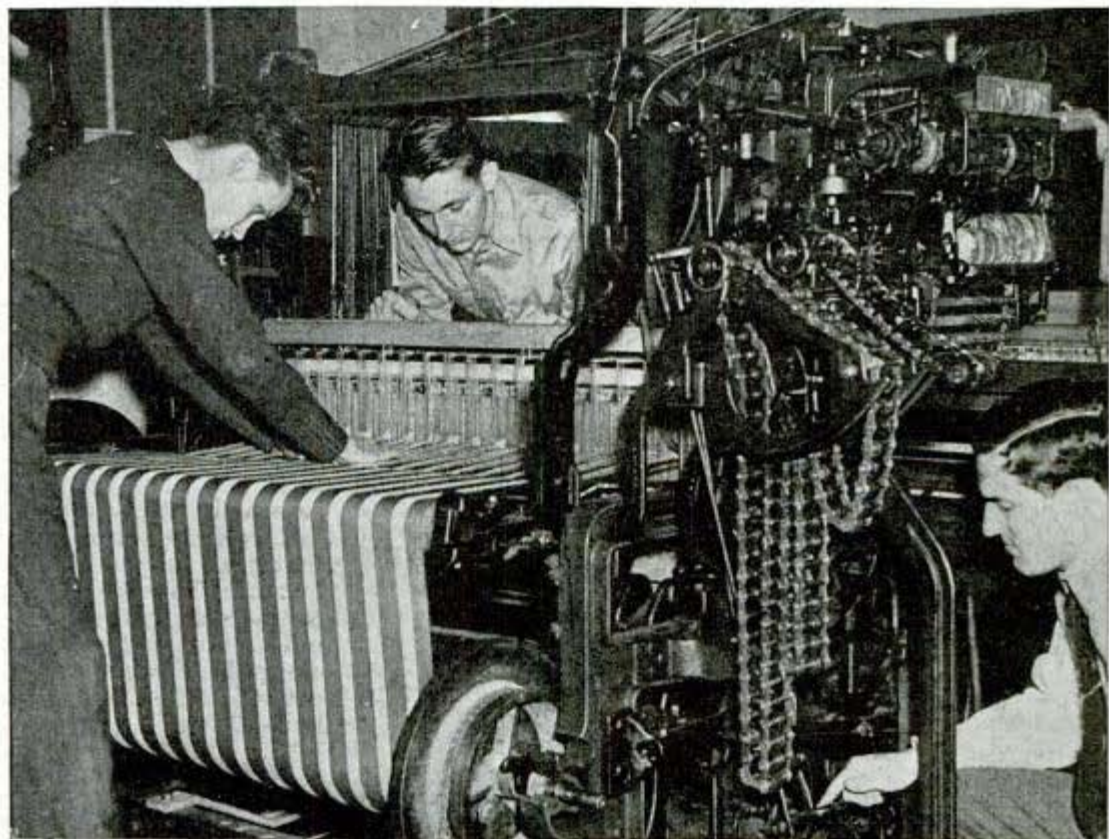
Perhaps cotton suggests to you only broad plantations, Negro spirituals, a man named Eli Whitney and something about the Civil War.

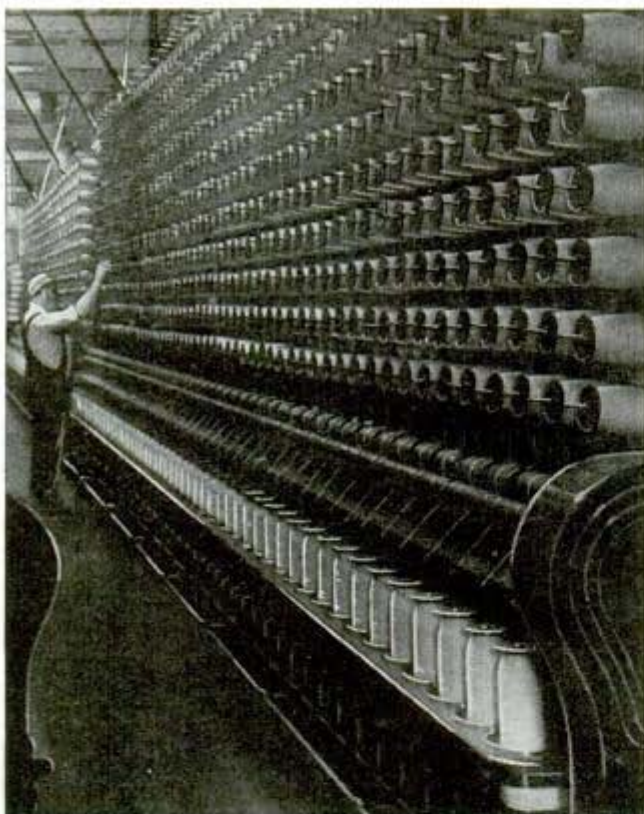
But that shouldn't be all, especially if you live anywhere south of the line extending from the Virginia-North Carolina border across the continent to the middle of California. For cotton is grown in every state south of that line—one third of the nation's land area—and largely supports 11,000,000 people and 11 whole states.

Cotton has been grown since the dawn of history for its lint, the tiny seed hairs stronger than wrought iron of comparable dimension, from which man makes cloth. Nine-tenths of the world's clothing is made of cotton.

But it was the more recent marriage of cotton and chemistry that really proved this ancient plant. Eli Whitney, with his cotton gin, 150 years ago, was trying to get rid of the "pesky" seed that adhered like a wad of gum to the fiber. A couple of generations ago cotton seed was thrown away. Nowadays there is talk of growing cotton primarily for its seed, with the lint, or fiber, a by-product. It hasn't

Paratrooper's suit, and shrouds and cords of his 'chute are cotton, right. Below, studying principles of weaving





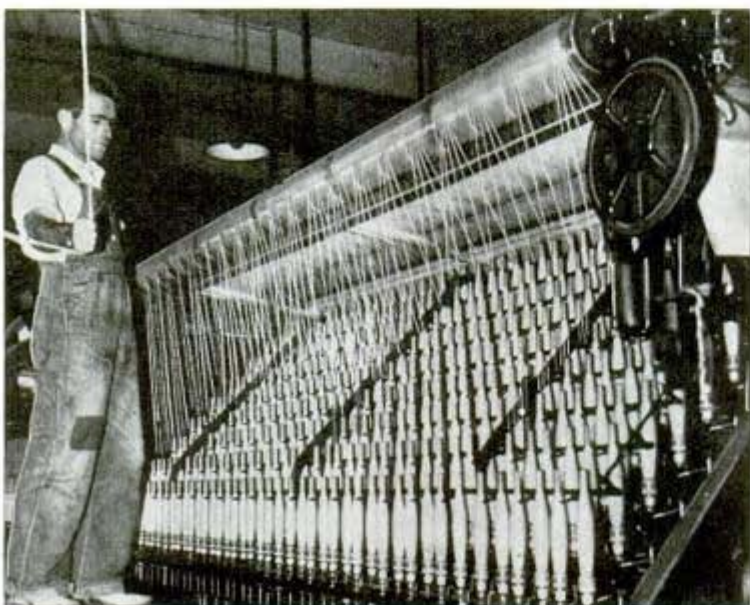
Nine-tenths of the world's clothing is cotton. Modern textile factories use intricate machinery like twisting machine shown

nearly come to that yet, but the talk shows the versatility of this oil-filled, protein-rich seed.

Cotton in the boll is an unassuming wad of fluff; even in finished materials, chances are you don't even recognize that it's there. But without its tens of thousands of uses, America's contribution to the war would

the hulls of the kernel and separate them by beating and screening. Hulls make feed, fertilizer and fiber.

From the remaining meal, crude cottonseed oil is pressed, leaving the cake, from which is made fertilizer, dyestuffs, feed for cattle and poultry, and bread, cake and cracker flour.



The oil is a spectacular performer, appearing in such roles as salad dressing, margarine, emulsion for medicines, roofing tar and cosmetics, to mention a few.

About all that is wasted in this joint effort of farm and factory is the sand and dust, which is screened out in advance.

This same cotton seed, that was such a burden last century that one southern state had to forbid its dumping where it clogged streams, now nets cotton farmers an extra half-billion dollars a year.

The National Cotton

Long chain quiller's action resembles that of a spider colony

halt overnight. Not even the guns would fire.

Cotton's major raw materials are the lint, linters, hulls, oil and meal. The lint is what Whitney's friends in Georgia sought, fiber that is baled for manufacture into endless varieties of cloth, fabric, yarn and thread.

The linters, almost pure cellulose, are the fuzzy remnants adhering to the seed after the lint has been removed by the gin. Most dramatic war use of linters is in the manufacture of smokeless powder, but from them also come plastics, varnish and dynamite, stuffing material, writing paper and even artificial silk.

Thanks to chemists who can break down the infinitesimal "building blocks" of cellulose and reassemble them, linters make such wartime items as plastics for warplane windows and noses, and myriad other plastic replacements for metal; cargo and flare parachutes; high-tenacity rayon, fabric coatings and X-ray and photographic film.

Once the linters are removed from the seed, mechanical knives, whirling at high speed, remove

Council of America in Memphis, the cotton capital, lists some details of the seed's importance:

Last year, 48 percent of all the United States production of edible vegetable oils came from cotton seed. The year's cotton oil production could fulfill the total fat requirements of the army, the navy, and 18,000,000 civilians in addition.

Thirty-two percent of all America's production of protein feed meals for cattle came from cotton seed—enough essential protein for 6,829,000 dairy cows producing fourteen billion quarts of milk; or enough to fatten 11,000,000 beef cattle producing two billion pounds of beef—besides a million tons of cottonseed hulls for roughage.

These are some of the less apparent benefits from America's No. 1 wartime crop. Cotton's more familiar use, as cloth, has an even more astonishing wartime story.

About 70 percent of all cotton textiles are now going into war goods. Cotton literally surrounds the soldier.

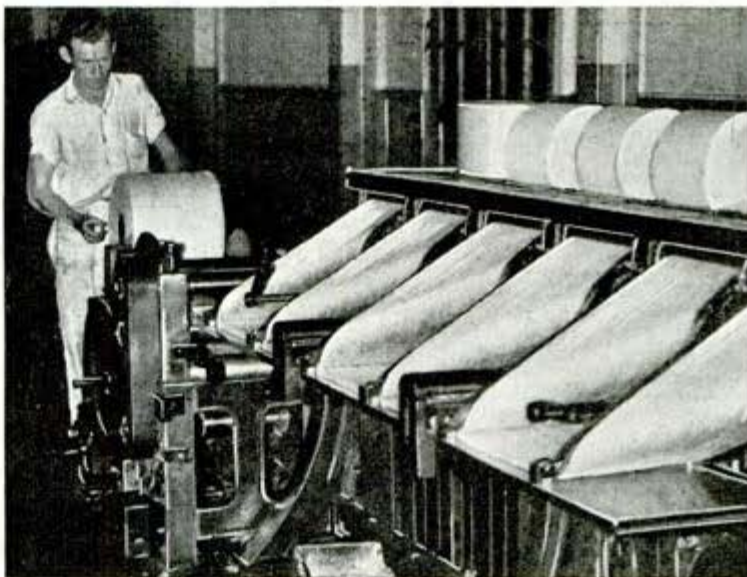
Every soldier on induction gets 29 cotton garments, including two khaki shirts, two garrison caps, two pairs of khaki trousers, two twill caps, two cotton neckties, one cotton web waist belt, four handkerchiefs, two pairs of cotton socks, one pair of web suspenders, and two identification tags on 40 inches of cotton tape.

As barracks equipment he gets 14 other cotton items: One mosquito bar, one cotton comforter, one cotton-covered and cotton-filled mattress, one pillow and two pillow cases, sheets, two hand towels, one bath towel, two barracks bags and one field bag.

Our Quartermaster Corps is the world's biggest buyer of textiles. One single order bought 351,300,000 yards of cotton cloth and 40,000,000 yards of mosquito netting—enough cloth to make a "barracks bag" that would hold Honshu Island, biggest part of Japan!

Though it is second to steel in war importance, cotton is necessary even for steel to function

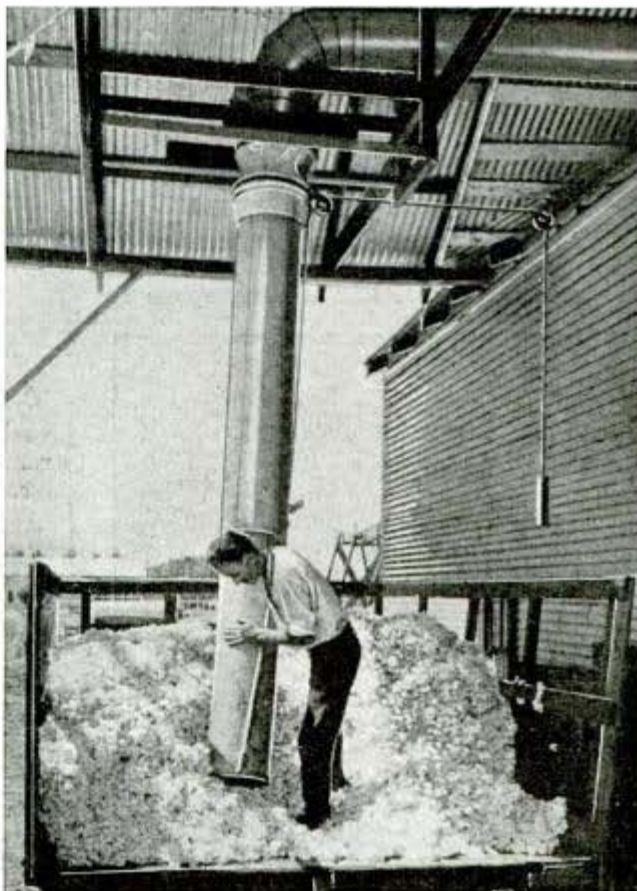
Suction lifts seed cotton from truck to gin



Industry, represented by ribbon lap machine here, has been aided by discoveries in chemistry and agriculture in multiplying cotton's many uses

properly; you can't fire a gun without an explosive; you can't run a truck without tires, which are about half cotton; tanks, half-tracks, mobile guns—in fact every vehicle and implement of war—uses cotton in

(Continued to page 146)



Portable Infant Respirator Guards Tot From Gas



Air is pumped into gasproof respirator for infants

Infants pose a constant problem to military officials concerned about the safety of civilians in areas that might be subjected to enemy gas attack. Head-sized gas masks for babies have been developed, as have gas-tight hoods or garments into which pure air can be supplied. One of the latter type is a respirator demonstrated to the New York State Medical Society. It consists of a fabric gasproof container with a transparent window for vision.

Combination Album and Letter Holds Six Photographs

Mailing photographs to servicemen is simplified with a combination letter and snapshot album. Letter writing space is



Inside of snapshot folder serves for letter writing

44 Eastman Kodak Co.
Rochester
N. Y.

provided on the inner surface of a folder that encloses three frames made of heavy paper. Two snapshots can be inserted back to back in each frame. When opened, the folder discloses a two-page letter, each page about five by eight inches. The album-letter is ready for mailing when folded and can be carried as a pocket album.

Torque Wrench Acts as Handle For Spring Recoil Tester

To gauge the recoil pressure of a spring, or to assure that springs in a set—such as valve springs for an automobile or airplane engine—are of matching tension, a spring tester uses a standard torque wrench. The testing platform is set for the length to which the spring is to be com-



Unit will test springs up to seven inches in length

pressed, and a downward pull on the torque wrench, acting as an operating handle, registers the pressure on a dial. The unit can be used to test springs up to two and one-half inches in diameter, and up to seven inches in length.

Machine Plants Tree Seedlings At Small Cost Per Thousand

Tree seedlings are transplanted with a machine originally designed for setting out small celery plants. After the machine was modified to accommodate young trees, more than a million pine seedlings were planted by this method. The cost was estimated at 46.8 cents a thousand. The tree planter is operated by a crew of three.

POPULAR MECHANICS

Details in "Journal of Forestry"
Miller Bldg. 17th & Penna. Ave. Wash. D.C.

7/374

Chemical Filters Make Car Gasproof Shelter

Any closed-type vehicle can be converted into a ventilated, gas-proof shelter by an installation devised by Lt. Col. Alvin Caldwell of the Chemical Warfare Service. This consists of filters installed beneath the hood of the vehicle, what Lt. Col. Caldwell terms an "auto gas mask." The equipment can easily be installed by the average car owner, and once it was in place the owner would have a ready-made shelter at hand, in the event the enemy should attempt gas raids on civilians.

Fort Monroe, Va.

"Auto gas mask" consists of filter installed conveniently under hood. It can be attached to any closed car to make auto gasproof



Chief Bus'n Mate J. F. Langhorne, Camp Logan, Cincinnati, Ill. 7/379 Mobile Public Address System Directs Riflemen in Field

From Electric & Amplifier Co. 1327 Washington St. Chicago, Ill.



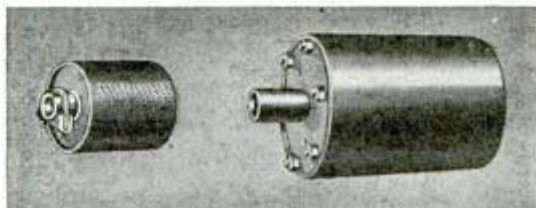
It would take a leather-lunged instructor to issue orders to men spread out over the expanse of a rifle range, or to make himself heard over the cracking of the guns. So one Navy camp utilizes a mobile public address system, by means of which the commands may be given during target practice. The mobile system is also useful in issuing orders during company drill, and could be used for directing actual combat.

Voice of instructor on rifle range or during company drill is carried to all men by mobile public address

Exhaust Line Fire Hazards Are Averted by Flame and Spark Traps

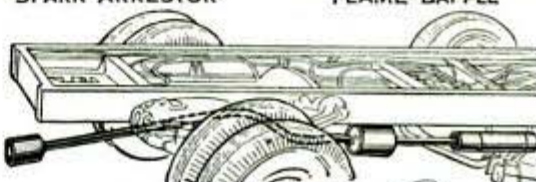
One threat to inflammable or explosive cargoes is said to be eliminated by a flame baffle and spark arrestor, which are installed in the exhaust line of the truck, bus or automobile carrying such cargo. When used in combination, makers say, the units arrest all exhaust spark and flame, which might otherwise endanger cargoes and the lives of operators. Backfires and sparks are extinguished with a quenching action that absorbs heat and diffuses glowing cinders to a dust, it is claimed.

Used in combination, flame baffle and spark arrestor are said to eliminate all danger of fire from truck exhaust



SPARK ARRESTOR

FLAME BAFLE



OCTOBER, 1943

Maxerent Automotive Products, Inc. South Island Ave. at 17th St. Chicago, Ill.

7/410

*written by American soldiers
30 Rockefeller Plaza
N. Y. N. Y.*

N 403

MACHINE GUNS *from* BACKYARD

ONE of the most amazing stories of the war concerns Britain's Sten gun—the rapid-firing, lightweight sub-machine gun that was conceived at a time of grave national emergency. They were first made in a multitude of miniature workshops ranging from disused garages and laundries to lofts, barns, and even hen houses.

When Britain's Expeditionary Force was withdrawn from France over the historic beaches of Dunkirk, it left behind great quantities of arms, ammunition and equipment. Britain found herself virtually unarmed, and many of the new units then springing up in all parts of the country possessed but one or two rifles to each company.

Local defense volunteers were swiftly instructed in the use of shotguns. Hundreds of thousands of bottles were requisitioned for conversion into gasoline, oil and "sticky" bombs. Improvisation was the order of the day. In that dark hour, there were men who

believed that if Britain could hold on for six months, or perhaps a year, the tide would turn.

Two such men were Sheppard and Turpin, the first a major, the other a civil serv-

Arthur Jones, D. S. M.

Assembling Britain's lightweight Sten gun that fires 500 rounds a minute. Parts are made in home workshops



A lineup of Stens — called the "people's gun" — await testing



ARSENALS

ice worker. They determined to evolve a sub-machine gun with which Britain's defense forces—and later her invading army—could be equipped. Within 30 days a working model was punching holes in a target.

The first Sten gun was a crude affair, lacking the finish of America's Thompson gun, and the weight and solidarity of the German Schmeisser. Only the essential parts were machined to fine limits.

But the performance of Sten gun No. 1 delighted its inventors. It fired at the rate of 550 rounds of 9 mm. ammunition a minute. That was almost as fast as the Thompson—more than the firing rate of the Schmeisser. It could be fired from either hip or shoulder. The weight was exactly six and three-quarters pounds. The gun could be dismantled easily and stowed away in a soldier's pocket. From the first it was a practical weapon, and none of the subsequent designs have differed in principle.

It was so sound a weapon that Britain's War Office accepted it officially

Belgian refugee with welding torch helps Britain's women and men making Sten parts in 300 improvised factories. No workshop makes complete unit due to danger of bombs. Below, testing the sub-machine gun that is fired from hip or shoulder and weighs six and three-quarters pounds



and asked: "What is the gun called?"

"Sten," replied the inventors.

"But why Sten?"

It was explained that the S and T stood for Sheppard and Turpin while the E and N stood for England.

The cost of the earliest Sten guns worked out to about \$12 apiece, which compared favorably with \$120, the price of German and American weapons. At present, because of efficient mass production, Stens are turned out for \$8 each, and it is hoped that this will be reduced eventually to \$6, or less.

The Sten is the simplest weapon of its type in the world. It has only 45 parts, and packs into a space 16 by 5 by 2 inches. Any infantryman can carry and handle a Sten and eight magazines, each holding 32 rounds.

When the blueprints were ready for production a young civil service worker was given the task of organizing output. Disused premises were requisitioned, and soon a whole series of improvised workshops



Sten gun, fired here from a kneeling position, is accurate at 60 yards

hummed into activity. Many, even now, would not be recognized from outside as workshops.

In one country town he decided on a disused hen house, the floor of which was deep in feathers. The place was swiftly cleaned, and a capstan lathe, a vertical drill and a couple of fitting benches were installed. A foreman with wide engineering experience was engaged, and under him a keen 18-year-old apprentice. The next step was to ask the local employment exchange for married women willing to do part-time work. Soon a score had volunteered. They were promptly trained in rough turning and drilling, as well as light fitting.

Refugee munitions workers making parts for Sten guns in a loft shop



The young man who organizes production cut all red tape from the start. Machines, some almost decrepit, were installed (for at that period Britain was desperately short both of machines and machine tools.) Machines that proved inaccurate for fine work were used for rough parts. Some workshops, of course, were equipped with excellent machines, and these coped with the advanced operations.

In a few weeks the young organizer was back in London, reporting that actual production was already three times the quantity anticipated. At

headquarters, officials were so impressed they gave him permission to push ahead as fast as he could.

The gigantic task did not appall the production organizer. Bombing by enemy aircraft was heavy at the time, so he decided not to allow any of the improvised factories to turn out a complete gun. For example, the bolt group (comprising bolt, pin, spring and extractor), was allocated to a number of small improvised factories. If two or three operations were required to finish a single part, the work was carried out in as many factories. In some of the miniature workshops, only turning or drilling was done. In others, milling, and so on.

One foreman said, "I can't make the part you want from a solid piece simply because I haven't got a machine to do the job, but I can achieve the same result by bending together strips of flat steel, and then welding them together. Will that do?"

"Excellent," he was told. "Go ahead. We don't mind how you make the parts, so long as they function effectively."

Today, more than 300 little shops throughout Britain are turning out nothing else but Sten gun parts. Workers in these shops include wives, sweethearts, brothers and fathers of men in the armed forces. The foremen who control the work range from experts

employed on key jobs to men who had been retired for years.

One fellow who retired from the naval workshops before the war had a shop making bolt-pins at 540 an hour. Then he invented a machine which pepped up production 10 times!

As parts are completed they are sent to government ordnance factories and assembled. Twenty percent, however, are retained for spares.

When the inventors designed the gun they decided on the same bore as the German Schmeisser, so that when Britain's army invades Europe it can use captured German ammunition. But in order to prevent the enemy using captured British ammunition, they so designed the rim of the cartridge that it cannot be gripped and ejected by the extractor of the German gun. Sten ejectors, on the other hand, would throw out German bullets.

Like all sub-machine guns, the Sten is not an accurate weapon beyond 60 yards, but it will kill at 200 and injure at up to 600. It is meant to be a surprise weapon, to blast an enemy who looms up round the corner: a hose for spraying lead. It is ideal for street fighting.

Those who see the Sten for the first time and note its lightness and fragile appearance, wonder if it will stand the strain of battle. It has been tested in Commando raids with brilliant success. The Germans have captured a few of these deadly guns during Commando raids, and know exactly what they can do.

The Sten has one peculiarity. During the first hundred rounds, the bullets are likely to jam and eject in a solid stream. A brisk bang on the cocking handle will correct this, and as the gun warms up the fault cures and is never repeated. The first Sten made is still in excellent condition, although it has fired more than 5,000 rounds.

Only one complaint has been made about the gun. A Canadian Commando used a Sten as a club after his ammunition was exhausted, and the slender skeleton butt caved in. He complained that the Sten was not solid enough to be used as a club!

The Sten is truly a People's gun, for almost every part is produced by civilians.

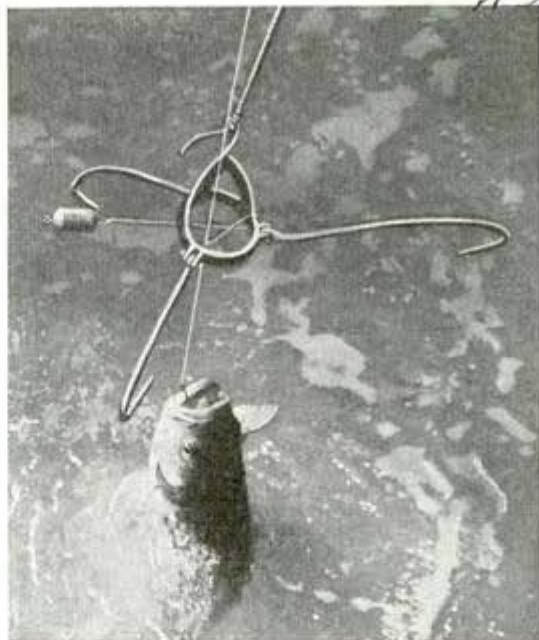
Cow's Tail Hair Pads 'Chutes And Lines Combat Tanks

Among the items listed as vital to the war effort by the War Production Board is the hair from the tail of a cow or horse. Such hair is used in making parachute pads, saddle pads, and tank linings. Another barnyard item is goose and duck feathers, tons of which are used in sleeping bags and hospital pillows.

OCTOBER, 1943

Three-Way Mechanical Gaff Lands Bass on Smelt Line

21 349



Gaff slips down over fish's head to prevent escape

Fishing from a pier for smelt, a California angler hooked a six-pound striped bass on his light line. After a 10-minute battle the bass was brought to the foot of the pier, but there remained the task of heaving it 15 feet to the top of the pier. Another fisherman produced a "mechanical gaff," which when attached to the line slipped down over the fish's head, making escape for the bass impossible. The gaff's three hooks close in on the prey.

21 443

Black Bath Shows Gauge Wear And Retards Corrosion

Amount of wear of gauges used for close-tolerance work now can be ascertained with the naked eye by means of a bath that blackens the metal without otherwise affecting it. Immersing the gauge in the black bath causes the color to penetrate



to a uniform thickness. When the blackening wears off, bright metal indicates visually that the tolerance has worn away. The manufacturer also asserts the bath saves up to 50 percent in checking costs, retards stain and corrosion, and shows flaws in the metal and burrs on it.

Mitchell - Broad Chemical Co.
2416 Main St.
Bridgeport, Conn.

No. Allen Warren Gillett
7 Park Lane
N.Y.

11 283



GET FIT TO FIGHT

Photos courtesy of W. W. Norton & Company

In learning to fight, there's no substitute for the other fellow's muscles. Below, bare-foot trainee practices "walking" up a wall

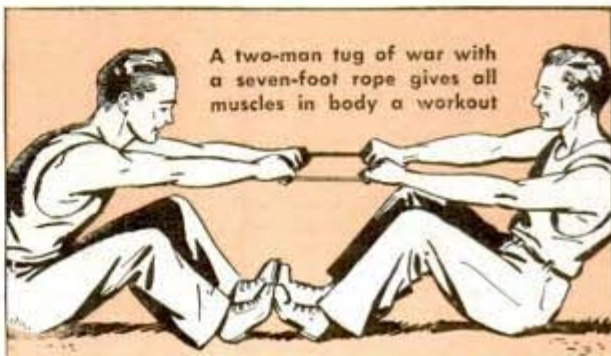


NO MATTER how brilliant is the technical skill of the American soldier, his value is questionable if he cannot stand the great physical strain of combat.

Our foes in this war are hard and fit. They are in better physical shape, both in the factory and on the firing line, than average Americans.

These warnings come from one of the leading experts on physical fitness, Lieut. Col. Francois D'Eliscu, the army officer who pounded home the "get tough" theory long before it was realized how strong, brutal, crafty and determined the average Axis soldier had become through years of training.

Colonel D'Eliscu is not satisfied with warning you. He has worked out a comprehensive, but simple program of getting yourself fit to fight. If you are a serviceman or expect to be one, he's aiming his program right at you. If you are contributing to the war effort in a factory or any other strenuous job which puts you



A two-man tug of war with a seven-foot rope gives all muscles in body a workout

Book: "How to Prepare for Military Fitness" by Lt. Col. Francois D'Eliscu published by W. W. Norton & Co., Inc., 70 Fifth Ave., N. Y. N. Y.

under pressure, you can modify his schedule to fit your needs and age.

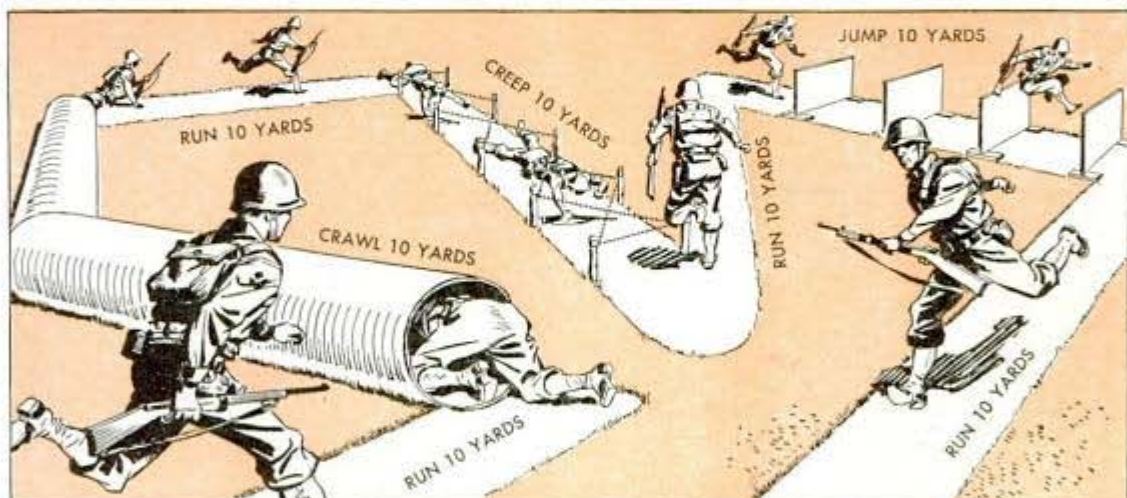
He has even worked out an examination which you can take yourself and thus determine if you are as fit as an average American soldier should be for a minimum grade. You pass this grade when you:

Can throw a baseball 125 feet. Toss a basketball 60 feet. Vault a four-foot fence. Run a quarter mile in 87 seconds and a half in three minutes and 15 seconds. Walk two miles in 23 minutes and 30 seconds. Do the 100-yard dash in 14 seconds. A running high jump of three feet 9 inches. A running broad jump of 12 feet. A push-up climb of 20 feet from the ground.

You should also be able to chin yourself six times, climb a 20-foot rope in 20 seconds, do a standing hop-step-and-jump of 18 feet and a running variety of the same feat for 22 feet. Your standing broad



Wrist twist and neck hack (using side of hand) downs opponent



Sketch from "How to Prepare for Military Fitness"

This zigzag commando course can be laid out in small space. Below, "leg break" grip is an effective way to hold foe down

jump should go six feet, your standing backward jump should carry you two feet and eight inches. You should be able to take a running long dive of five feet six inches. And jump vertically 13 inches from a flat-footed stance with arms above your head.

If you can do these things, you can salute Uncle Sam and say: "I'm ready." Or you can do a real day's work in a war plant without tiring if you happen to be the man behind the man behind the gun.

The Colonel, who can do these things with ease though he is old enough to be the father of many



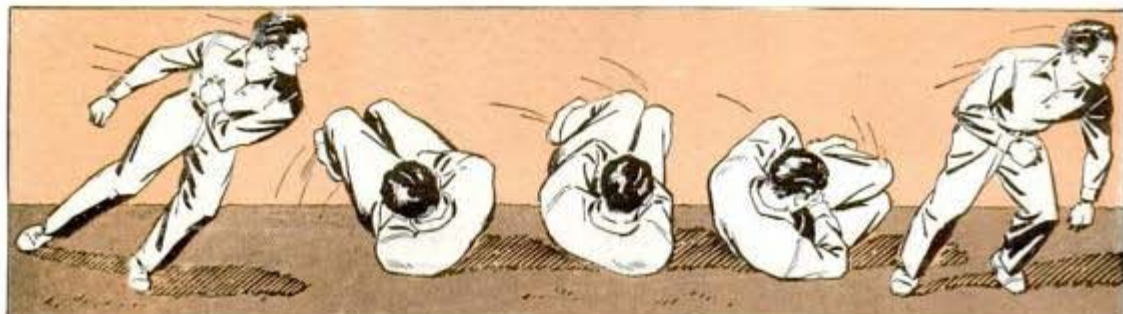


Body scissors and "side smudge" will make any enemy yell for mercy

six circles 2 feet in diameter spaced irregularly like stones or sandbanks in a stream, or tufts of grass and high spots in a field. The last 10 yards are covered by fast running, as in charging the enemy for the kill.

These movements, done against time, require coordination and precision of the same type that are met in actual field combat.

Calisthenics, exercises, wrestling, judo, savate (an old form of boxing in which blows are delivered



of the men he trains, has written a book, "How to Prepare for Military Fitness" (W. W. Norton and Company, New York City) in which he has worked out his theories in an interesting manner.

From his instructions, any man or group of men can lay out what might be called a "commando testing course" in a gymnasium, playground, or in a vacant lot or open field. It's only necessary to pace off seven 10-yard paths, changing the angle at the end of each 10-yard section to mark the spot where tactics change. Contestants are timed as they take turns.

The first 10 yards are covered by fast running from a standing start. Proper falling and creeping on hands and knees—as through protective bushes or high grass—are used to traverse the next 10 yards. From this position, the individual quickly gets on his feet and again runs 10 yards—as through open spaces in a field or woods—then again falls flat, simulating the situation of reaching cover on the far side of an open field.

An army in the field must move frequently through short grass or brush. This must be done by creeping on the stomach with no part of the body being revealed to the enemy. In this test, the stomach crawl is continued for 10 yards; the man then springs to a standing position and jumps with both feet together through a series of

Shoulder roll with head well tucked and feet up is done at high speed with running finish. Below, the hand on wall keeps soldier from hitting structure



with either feet or hands), tumbling, and swimming are a part of the program in Colonel D'Eliscu's book, but an old-fashioned physical culture expert would hardly recognize their wartime version. The emphasis is not on body beauty and bulging biceps. It's on toughness. Opposition to the muscular strength of another man is one keynote.

Take two men and a seven-foot piece of rope with the ends tied. Have them sit on the ground with their feet planted firmly together. Let each man hold the rope with both hands. By pulling and hauling and shifting, nearly every muscle in the body can be put to work. Or, bend their knees so they are closer together and pass the rope around the necks of both. There's a situation for a contest of strength and balance.

If the rope is too tough for the hands or neck, a pair of belts buckled together will do. Two sticks tied together in the center with a piece of rope can be held in the hands of both men until they get toughened. A whole series of exercises can be worked out with a single stick and two men seated, propped away from each other by their feet.

Wall scaling has great conditioning value and it increases a man's confidence in his fitness as he improves his co-ordination and timing. The important thing to remember is to face the wall as you land so you can use at least one hand to push away for safety. Two men working as a team can help each other scale a wall as tall as their combined height.

Rope and tree climbing will test your strength. If you want to get an idea of what a Jap sniper puts up with for a shot at our troops, take a piece of rope and a few sticks and hoist yourself into a tree. With the sticks you can make a seat on a crotch, padding it with a blanket or your coat. Child's play? Men in uniform are doing it by the thousands today. It's not as easy as it sounds.

A good soldier, says Colonel D'Eliscu in his book, is constantly alert. So is a good workman. An average American does not possess very acute sense perceptions and it is no fault of his—especially

(Continued to page 152)



Diving on dry land is a good muscle stretcher and trains men for making surprise pounce on an unwary sentry. Below, Col. Francois D'Eliscu, author of "How to Prepare for Military Fitness," gets a firm arm lock on one of his young trainees

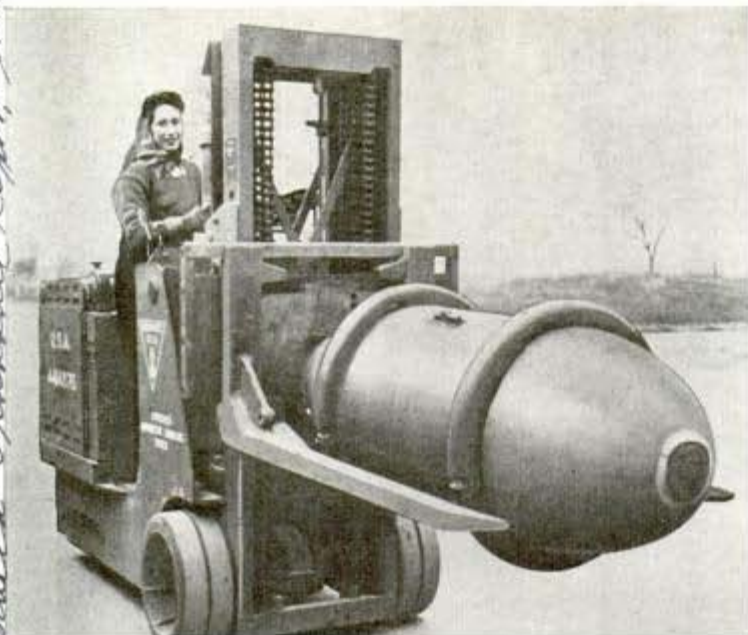


71 274

Bomb Cart Totes Block Buster Between Its Arms

Two-thousand-pound "block buster" bombs, of the type that have caused such paralyzing destruction on Allied targets in captive Europe, are trundled about an Eastern ordnance depot by a specially designed ammunition handling truck, that lifts the giant bomb in mechanical arms to carry it from place to place.

Strength of the woman operating bomb buggy is multiplied hundreds of times by machinery that lifts the block-buster to carry it to a new site at eastern ordnance depot



*Mrs. Louise Lencake
D. Terakian, N. H.
America Ordnance Supply, Columbus, N. C.*

71 268

Crawling Painter Applies Tar Paper Overcoat to Pipeline

Speeding the construction of the world's longest pipeline, 1,388 miles from Longview, Texas, to New Jersey, workmen employ a machine that straddles the pipe before it is laid, to paint its surface and wrap it in tar paper. With this protection against the elements applied, the huge tube is laid into the trench prepared for it.



Huge pipeline is protected against weathering by coat of paint and tar paper, applied by machine that straddles the tube

71 419

Chameleon-Like Camouflage Paint Deceives Aerial Infrared Camera

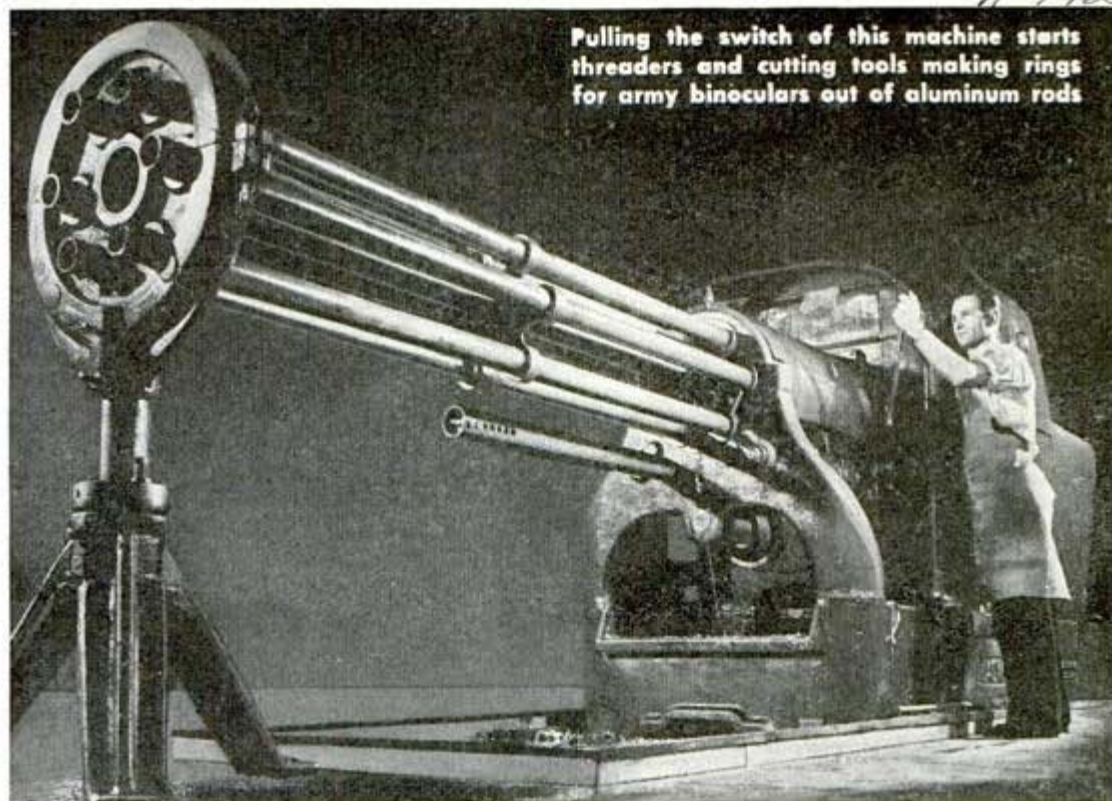
Camouflage paint that will make a military target appear as vegetation even in an enemy's aerial infrared photographs is a development of the du Pont Company. The camouflage finish reflects infrared rays, showing up light instead of dark in aerial infrared photographs. Ordinary green paints would show up as dark, and would reveal to the infrared film painted surfaces that, to the naked eye, would seem to be vegetation. Most green vegetation

reflects infrared light, and so does the new green camouflage paint. So the camoufler may use green paints that not only match surrounding natural greens, when seen by the naked eye, but also equal the natural foliage's infrared reflecting powers, and accordingly match in the infrared photographs as well. Other colors—olive and field drab, loam black, earth red, brown and yellow—are also possible in the range of paints.

*Wilmington, Del.
Public Relations Dept.*

Six-Barreled "Gun" Shoots Out Threaded Rings

71 442



Pulling the switch of this machine starts threaders and cutting tools making rings for army binoculars out of aluminum rods

In appearance suggesting a monstrous, multi-barreled rocket gun, an automatic machine tool at a Westinghouse plant converts aluminum rods into threaded rings that go into army binoculars. The rods are loaded into each of the machine's six "bar-

rels." Automatic drills, threaders and cutting tools then go into action, and the erstwhile "ammunition" is spewed out as threaded rings. More than 1,500 of the perfectly finished rings are produced by one machine in each eight-hour shift.

Elect. & Mfg. Co. Mansfield, Ohio.

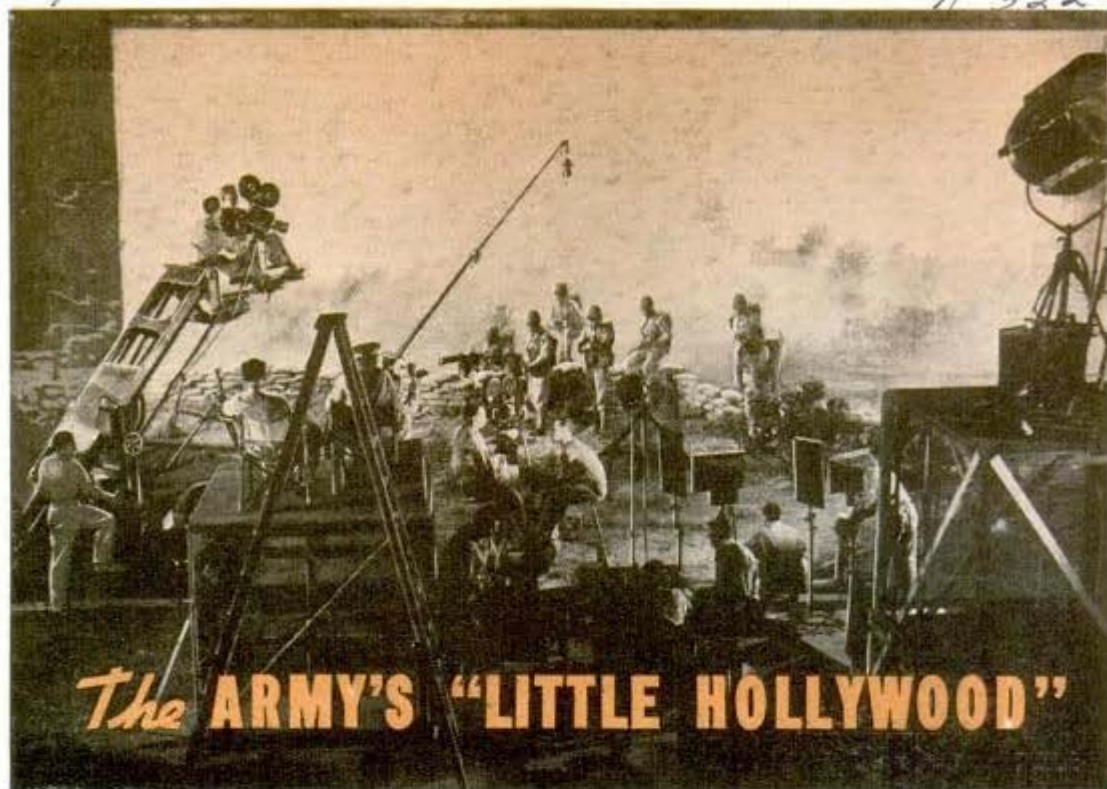
Television Teaches Gardeners How to Grow Vegetables

Every stage in the preparation and planting of a victory garden alongside the studios of WRGE, the General Electric television station in Schenectady, was telecast for instruction of gardeners in that upstate New York area. While the gardening expert proceeded with his work before the camera, he also gave a running commentary through the microphone.



Instructor shows step-by-step progress in the growing of a Victory Garden

Every mile of new concrete highway requires about 1,000 pounds of dynamite for clearing the right of way and supplying stone and cement.



The ARMY'S "LITTLE HOLLYWOOD"

On a giant stage in the army's movie studios at Astoria, L. I., soldier-actors wearing gas masks face the camera

Putting the finishing touches on model of barrack for a training film. Many miniatures are made in this shop



By Wayne Whittaker

MEN in the ranks call them "nuts-and-bolts" films. Educators refer to them as "audio-visual aids." The Signal Corps, which makes them, just calls them training films. In any man's language they are tops when it comes to speeding up a training program for a rapidly expanding army.

The films, which range from military courtesy and discipline to finding booby traps or sniping, have reduced training time 40 percent in some cases. The Signal Corps' movie chiefs, who don't have to lie awake nights worrying about box office appeal, have already turned out more than 500 training films—the exact number is a military secret—and they are still producing them at the rate of about one a day.

The army's "Little Hollywood" from whence these pictures stem is the Signal Corps Photographic Center, a \$10,000,000 block-long studio at Astoria, L. I., once a major production unit of Paramount Pictures. The vast stages, both silent and sound, where the Marx brothers, Gloria Swanson, Rudolph Valentino and other stars once emoted and cavorted, have been taken over by young soldier-actors. They never have to strain for realism when the cameras

grind. The soldiers chosen to act in the films—99 percent of the actors are picked from the ranks—are experts in their roles because they are performing jobs for which they were carefully trained in the army.

If you were to wander about the Astoria studio on a typical "shooting" day, permissible only with a military escort, you would see some amazing sights. Your escort would explain that many production units are out on "location"—perhaps Fort Knox, Fort Belvoir, Florida, Colorado. All films come back to the studio, however, for final editing and sound effects.

Life "back stage" at the studio is an odd combination of Hollywood and military discipline, of army officers, shirt-sleeved civilians and Klieg lights. Propelled along the corridors and ramps by sweating crews, one encounters whole trees, jeeps, big cameras on wheeled mounts, great painted backdrops of outdoor scenes, machine guns, parts of dismantled buildings, a couple of live horses, a thatched roof, portable floodlights, a miniature desert set shunted off to one side on a platform, a husky soldier wearing Hollywood makeup and carrying an ax, a helmeted soldier in German uniform. Your guide explains that the studio "props" include uniforms of every rank and nationality, not to mention a complete arsenal.

A bell rings.

"Shooting sound on Stage 3," says the guide.

Pausing before another stage, the visitor sees a European farmyard scene. There is a weatherbeaten stable with sagging door ajar showing a glimpse of manger inside and part of a broken old cart. Two chickens and a rooster peck at some corn scattered in the dust near the door. On a pile of straw before the stable sits a soldier in Nazi uniform, his rifle beside him. Strapped across his chest is an expensive German camera, its leath-



These "stills" are from a film on booby traps. Above, U. S. soldier reaching for an expensive camera on a "dead" Nazi. Below, his hand is caught just in time by an experienced officer familiar with German tricks, for lifting the camera will set off a hidden explosive





This crew on "location" didn't have far to go for they are shooting scene before barracks behind studios

er case hanging open. Blinding white lights are turned on. The soldier sprawls on his back in a position of sudden and violent death, the expensive camera in full view on his chest.

"Action! Camera!" shouts the director.

The cameramen start to grind, shooting the action from two angles; technicians keep an eye on the actor; the script clerk consults a scenario.

"This is a sequence in a booby trap production," says the guide.

Around the corner of the stable an American soldier appears. At sight of the dead Nazi, he stops. His eyes are fixed on the expensive camera. He approaches carefully, kneels and reaches out to take the prize, but the hand of another soldier, more experienced with German tricks, grabs his arm in time.

"Cut!" orders the director.

The camera on the soldier is attached by wires to a pull-type booby trap that will set off a powerful explosive. When shooting resumes, the detail of the trap is shown and millions of men in training camps who will see this scene will have a lesson dramatically imprinted in their minds.

A glance at the script reveals that other sequences in the film deal with booby traps under porches of abandoned houses, behind pictures hung on walls, in clocks, connected with kitchen faucets, in autos and tanks.

The professional procedure on this set is the real McCoy, for many of the technicians, recruited from Hollywood, are the

best in the business. And why not, they ask? In many respects making a training film is more difficult than producing a glamor movie, for the army demands—and gets—perfection in every detail.

Col. Melvin E. Gillette, director of the Astoria photographic center, explains that the army does not view the films as a separate department in the training program. The films are co-ordinated with lectures and actual lessons learned in the field. They become as much a part of a soldier's life as his rifle or his top sergeant. Before the recruit's heels are cool at a reception center he has been treated to a triple feature: "Military Courtesy and Customs," "Articles of War," and "Personal Hygiene." During his army education, whether he is assigned to infantry, artillery, engineers or armored force, he will view about 50 more training films.

If he goes to Fort Belvoir for engineer training, one of the first things he will see in a makeshift projection room on the Pioneer training course is a movie on handling high explosives. This will be accompanied by lectures and followed by actual practice on the demolition range. If he goes to Fort Knox, he will follow his first tank crew in combat on the screen. Wherever he goes, he will study films on every weapon with which he comes in contact, pistol, rifle, field artillery, anti-aircraft. These films are designed to make complicated mechanics as easy to understand as "nuts and bolts." Simplicity, clarity and accuracy are Astoria watchwords. If the recruit elects to

become a company cook, he will be shown how to knead bread, cut a hunk of meat and cook a tasty stew by training films, accompanied by the usual lectures and actual practice.

There are films on health, first aid, map reading, the compass, camouflage, military law, and chemical warfare. There are films of general information and technical training. The studio has a corps of artists who produce animated films.

The first step in making a training film usually starts with a letter from an officer at a training center to the War Department. Perhaps the engineers' school at Fort Belvoir desires a film on laying anti-tank mines in the desert. The War Department approves the idea and turns it over to the Signal Corps. An engineer expert on anti-tank mines is sent to the Astoria studio to work with a writer on a scenario. After the script is approved by the War Department, production gets under way. Crews are assigned, and sets are built in the studio's well-equipped carpenter shop. In this desert film, miniatures will be used with everything built to scale from tiny mines to American M-4 tanks and German Mark VI's.

When the sets are ready, the actual shooting begins. Various sequences are shot, the film edited, titled, and sound tracks with an instructional text dubbed in. The technical officer from the particu-



In the cutting room, soldier inspects films with a "moviola"

lar branch of service for which the film is produced stays with the production until the last retake is made. The final product is viewed in the studio's luxurious little theater, a carryover from the old Paramount days. The film is sent to Washington for approval by the War Department which turns it over to the Signal Corps' Visual Aid Section. Hundreds of prints are

(Continued to page 154)

Removing top of miniature German tank to place explosive which will lend reality to desert training film



Inspector's Lenses Magnify And Leave Hands Free



Eyeshade magnifies object three times actual size

Designed to afford the wearer comfort, freedom and visual aid, the "Magni-Focuser," a plastic headpiece in which are mounted lenses of optical glass, is intended for use where magnification is necessary in production or inspection work. Into each lens is ground a prism to relieve eyestrain. Lenses give a magnification about three times actual size. Dual mounting brings objects under observation to sharp focus at approximately 10 inches from the forehead. The eyepiece provides considerable magnification as comfortably and normally as with the unaided vision.

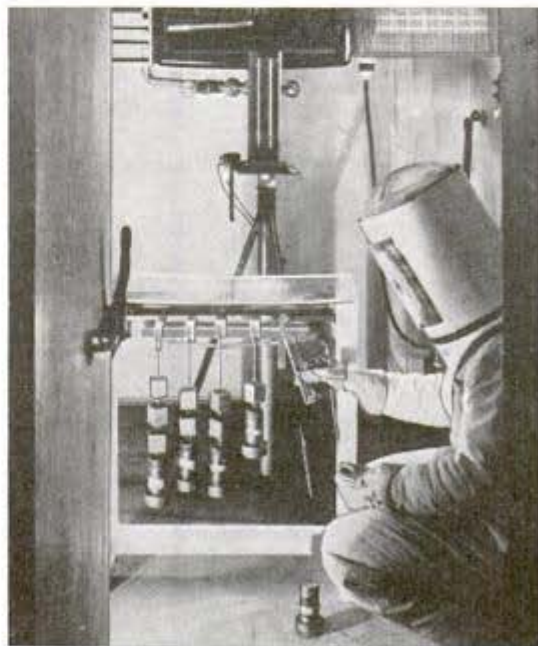
"Red-Hot" High-Pressure Steam Gives Edge to U. S. Warships

Steam so hot that the pipes carrying it glow red, and under such pressure that it can be used repeatedly in a series of turbines, has, in effect, increased the size of the United States Navy. The new design saves as much as 35 percent of a warship's fuel-oil consumption, thus increasing its cruising radius by up to 1,000 miles. This has the effect of creating more tonnage, because more ships are kept on the line at all times. The most modern ship installations superheat the steam to about 925 degrees Fahrenheit, at pressures of nearly a quarter-ton per square inch, before it enters the turbine. The steam is used several times before it has spent its force, by introducing it through several turbines op-

erated in series. The speed of the turbine, however, is so great with such an installation that it must be reduced 10 to 12 times by reducing gears before power is applied to the propeller shaft. The U.S.S. Somers, contracted for in 1934, as finally built was operated on a steam pressure of 600 pounds at 850 degrees F., which is 369 degrees of superheat. Success of the Somers impelled the Navy Bureau of Engineering to raise the steam pressure of the battleships North Carolina and Washington from 700 degrees to 850 degrees F. They had already been designed for 600 pounds pressure. In 1939 the four-stack destroyer Dahlgren, re-engined and re-boilered, was equipped to use steam at 1,300 pounds pressure and 925 degrees F. in the main engine, which resulted in a fuel economy of 10 percent.

Sub-Zero Room Tests Plastics For Plane's "Greenhouse"

Plastics to make transparent noses and blisters for fighting planes that operate in the sub-stratosphere are tested in a temperature chamber at 67 degrees below zero. Wind machines in the room produce a 200-mile-an-hour gale, and humidity can be controlled from 10 to 100 percent. The men who conduct the tests wear electrically heated clothing and plastic helmets. In this sub-zero room, metals shrink and rubber becomes as brittle as glass. The chamber, which is in the Rohm & Haas Company plant at Bristol, Pa., is also used for "desert" tests on Plexiglas at a temperature of 130 degrees above zero.



Plastics cold-tester himself wears a plastic helmet

POPULAR MECHANICS

60 Branch Magazines Book Sec.
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71. 2/1, 71. 4/1

Thomas C. Stinson, Jr.
3872 Franklin Ave.
Los Angeles, Calif

21 4 36



Fliers in the Aleutians face a double foe, the Japs and the weather, but planes like the P-38's above and pilots like the one at right have proved a winning combination

THE American fighter squadron was boring down through the overcast to strafe the Jap base when suddenly a radio order came through on today's frequency.

"All fighter planes rendezvous north end of Kiska. All fighter pilots go to rendezvous."

The command was in good English without a trace of accent but each pilot grinned when he heard it. The message was a phoney and they knew it. If they complied with the message they'd probably find a gang of Zeros at the rendezvous that would keep them occupied, leaving the oncoming bombers without protection.

The Jap double-talk didn't work, nor did the next radio trick that the Japs tried. All through the rest of that raid the Nips recited poetry, cursed the Americans, and sang songs about the "poor little P-38's." They were jamming the frequencies to prevent our pilots communicating. It didn't work any better than the first trick. The American squadron leader had known what to expect and had coached his men carefully before the raid.

With the ALASKAN JAP-FIGHTERS



All they had to do was follow the schedule.

Jap interference isn't the only kind of radio trouble that flyers in the Alaska-Aleutian area encounter. Words may be garbled by local distortions. Voices fade in and out. The influences of metallic masses in the mountains split and bend the directional beams from radio range stations. Compasses, too, are affected by the

OCTOBER, 1943

By: Wm. Dept.
Bureau of Public Relations
Washington, D. C.

61



Snow clogs motors of Navy patrol bomber being readied for an Aleutian flight (above). Camouflage tree (below) is festooned with strange fruit—tin cans!



and no one had a bath for months on end. Supplies of all kinds were scarce because of transportation difficulties. The only camouflage available was of the tin can type. Empty food and ammunition tins were split open, coated with dull paint, and draped with moss to simulate brush and help hide air base installations.

Under these rugged circumstances the men beat off Jap attacks and initiated raids of their own against Attu and Kiska. Lieut. Col. Jack Chennault, son of General Chennault who was fighting the Japs in Burma and China, was ranking officer at one of the Alaskan air bases for a time and harried the Japs in the sub Arctic just as his father fought them in the tropics.

Col. Chennault and the other ranking officers, their flying crews and ground crews, had a double fight on their hands. To beat the Japs they first had to whip the weather. Weather in western Alaska and the Aleutians means bitter cold, rain, snow, fog, ice,

Canvas slipover sleeve protects the propeller while crews use tug-of-war technique to start a cold motor



and almost constant overcast that may lift to 1,000 feet on a "nice" day. Possibly there's a glimpse of the sun every few weeks—or months. Snow lies at sea level all winter long, and above the 600-foot level stays on the hills and mountains even in the "summer."

Translate such weather into a background for air operations and it means a number of things. It means that ground crews who must service planes and keep them in combat condition may have to work in the open in the teeth of a 50-mile gale and at a temperature of 20 degrees below zero. It means that pilots have to learn to land all over again, because in the damp dense cold air their planes hang on and float instead of settling down to the runways.

It means that often enough a pilot must take off blind, on instruments alone. Frost builds up on the windshield and canopy during the first few yards of his take-off run. He can't see out until he pulls up a few hundred feet where the frost disappears. Fortunately, blinding frost rarely accumulates on a plane that is coming down to land.

Other times he may have to make an instrument take-off because the steel mesh landing strip may be flooded with water and his propellers beat up a spray that rises like a curtain on all sides, higher than his cockpit.

Typical weather conditions mean that a pilot may go up for a 15 minute test hop, and find himself unable to get down to his field. Even in that short space of time fog may close it in. By a coded radio message he receives the designation of an al-



Fighter pilot fills out report of mission on return to ground. Heavy clothing guards him against cold of Arctic high altitude

ternate landing strip that is still in the clear.

The weather means that a group of fighters on a long range mission may need to be led to their target by a special navigation plane. Even if the fighter pilots had the time to spare they haven't the instruments necessary for the precise navigation. So a B-24 goes along, carrying a full-time navigator who uses radio triangulation and other methods to check his position. Even in the middle of the day the B-24 may need to burn its wing tip lights, so that pilots of fighter planes huddled close to the bomber may follow it through the murk.

Fighter planes arrive at the enemy base ahead of the bombers to bomb and machine gun anti-aircraft installations. The oncoming Fortresses and Liberators carry the big bomb loads for larger targets.

Shipping in the harbors, Japs on the ground, are all fair game to the fighter pilots. Depending on the visibility they hug the ground as closely as they dare and weave back and forth across the tar-

Snow all but covers Quonset huts that are home to Aleutian pilots





Two reasons why the Aleutian battlefield is called the world's worst for planes—grim peaks threaten the unwary flier, and soupy fog blinds him

get area. Low level attack is the rule except when they try skip bombing a ship or a submarine lying on the surface.

In skip bombing the pilot releases a bomb before he reaches the target with the idea that the bomb's terrific forward speed will skip it across the waves and right into the target. It's a devastatingly accurate way to bomb and to do it the pilot pulls up 50 or 100 feet above the surface. Otherwise, if the bomb smacks a wave at just the wrong angle it might bounce back up into the air and crash into the plane that dropped it.

On some raids over Kiska the traffic of American fighters and bombers and Jap Zeros has been so thick that an American fighter pilot has hesitated to concentrate

Welcome sight in Aleutians is arrival of Seabees, Navy fighting builders who follow landing forces ashore to engineer camps and fortifications



on his gun sight for fear his inattention to traffic might cause a collision. Under these circumstances a good combat pilot fires a short burst of tracer to line himself up with his guns, then swings his plane to lead a Zero and fires another burst. Even with this rudimentary kind of snap shooting, pilots have succeeded in taking a toll of Jap planes.

New pilots assigned to the Alaskan area are told that above all they must maintain formation. After his first mission the new pilot knows why. He must stay in formation to avoid becoming lost on

the way out to an enemy base; he must hold formation during the raid for mutual protection, and he must maintain formation all the way back again so he will get home.

If he does stray away from his group his orders are to use volcanos for navigation. That is, he is to pull up a few thousand feet for better visibility and then fly along the Aleutian chain, counting the tops of the extinct volcanic peaks as he passes them until he reaches the island or area on which he is based. Thus the jagged peaks of the Aleutians are both death traps and marker "buoys" to the bomber and fighter squadrons.

A PBV flying boat acts as a rescue plane. It cruises around at the edge of the combat area to pick up the crews of any American

planes that might be shot down. Other planes may settle to the water or crash-land on an island during the return trip and usually the crews can get off a radio SOS to the PBV before they land. The rescue plane cruises around until it spots the men, then picks them up.

The Japs have paid a high price for occupying some of the western islands of the Aleutian chain. Now that these are being taken away from them a way is being paved for the Air Forces to move on to the heart of Japan itself. Already the first dagger has been thrust with the bombing of Paramushiro.

Cattail "Parachutes" Tested for Wartime Use

Fibers of the familiar swamp weed, the cattail, which spring open like a parachute to float seeds away from the dried spike, have been found by Dr. C. F. Burgess, of Burgess Battery Co., to have industrial promise for both war and peace. A pilot factory produces five tons of the fiber each week, and industrial firms are experimenting with it as a possible replacement for scarcer fibers. Tests of a life preserver, in which cattail fibers could substitute for kapok, showed it maintained buoyancy after more than 100 hours of submersion. Compressed cattail fiber also has shown good heat-insulating qualities. It has been used in soundproofing, and has shown promises in various applications as a filter. Its excellent felting qualities make it adaptable for experimental use in linings, quiltings, and in stuffing toys. Indians, in fact, used the same fiber for bedding and wound dressings. Chief

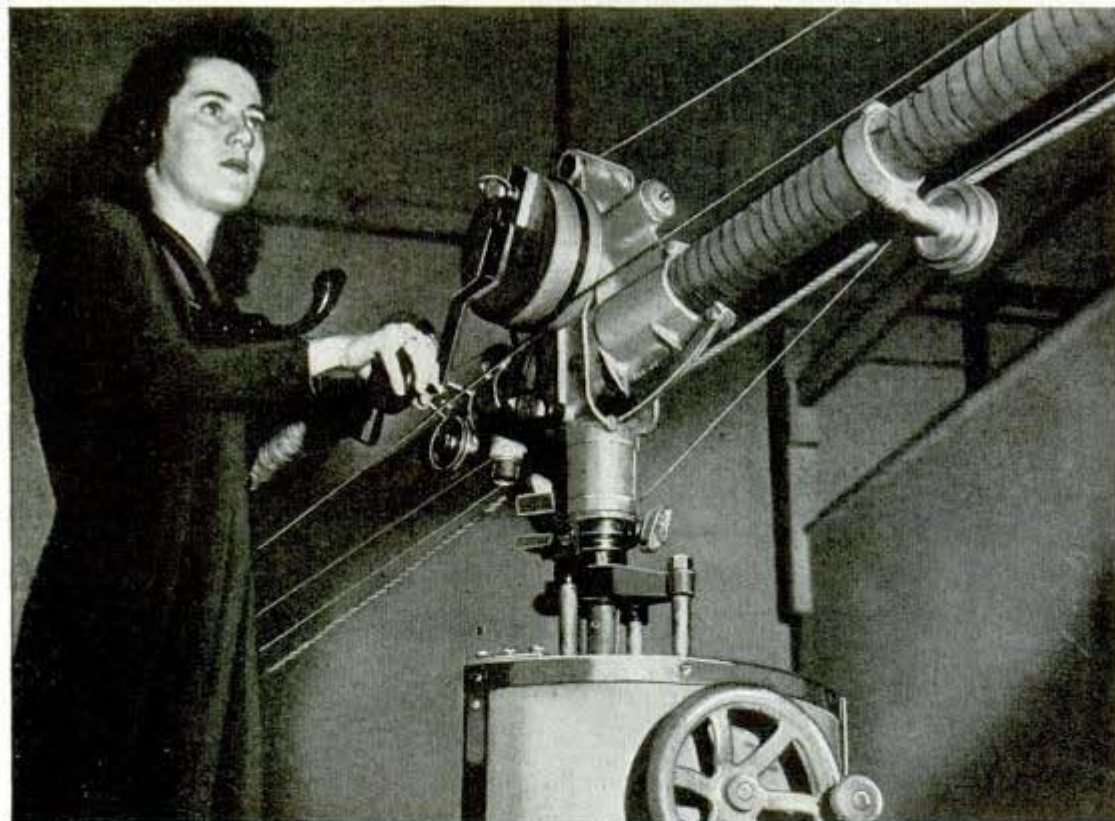
*C. F. Burgess Laboratories, Inc.
180 N. Wabash Ave.
Chicago, Ill.*



Cattail fluff, top, pads objects in center picture. Seeds that adhere to the fiber are beaten out (left)

promise of the cattail is its availability. In the area around the Burgess experimental plant, where machinery was devised to beat out a big proportion of the seeds adhering to the fluff, several plots of marshland were located which each averaged from five hundred thousand to several million plants suitable for processing. Interested in conservation, Dr. Burgess points out that turning marshlands into cattail "farms" would discourage the draining of swamps, with its occasional upsetting of the area's wildlife, besides giving hitherto useless land an economic value. Cattails are often harvested in winter, when frozen swamps make access easier to the shores where they grow.

TELEVISION -- *The* NEW WAR BABY



With a turn of the crank, boom operator moves microphone forward during closeup shot in television studio

AND remember, folks, tune in to your favorite television station for the opening game of the World Series this afternoon."

That's the kind of radio announcement that we can expect to be hearing two or three years after the war is over. It will take no longer than that, television experts believe, for television to sweep the country just as radio did in the late 'twenties. Estimates have been made that television is to become a billion-dollar-a-year industry.

The fact is, television is here already and except for the war more of us might now be arguing with the man next door over the relative abilities of our radio vision receivers. About a dozen television transmitters are broadcasting on regular schedules in the United States and there are well over 6,000 receivers in use.

When television receivers are put on sale again, what will they be like? A typical set might be a console cabinet model priced at from under \$100 to as much as \$600. It will include static-free frequency modulation circuits coupled automatically to the television picture channels so that one tuning knob brings in both sight and sound. There will be a standard all-wave radio

sound receiver in the cabinet as well, and possibly a record playing attachment.

The fluorescent face of the cathode ray tube that serves as the viewing screen of the receiver may be from five to 20 inches in diameter, on which a brilliant image will appear without flicker or distortion. Larger viewing screens similar to motion picture screens no doubt also will be available, the television picture being flashed on this screen by a special high-intensity scanner.

This general forecast is an easy one because receivers such as these have been built and used although they are not now being manufactured for sale. After-the-war television will further improve when the results of electronic research now being conducted for military purposes become available. The television industry has agreed that transmitters and receivers will continue to be of a uniform design in the sense that all receivers are able to pick up all transmitting stations within range.

Among the future improvements that can be foreseen is simpler tuning. At present a television receiver requires a number of controls, including a channel selector, a fine tuning knob, contrast adjustment,

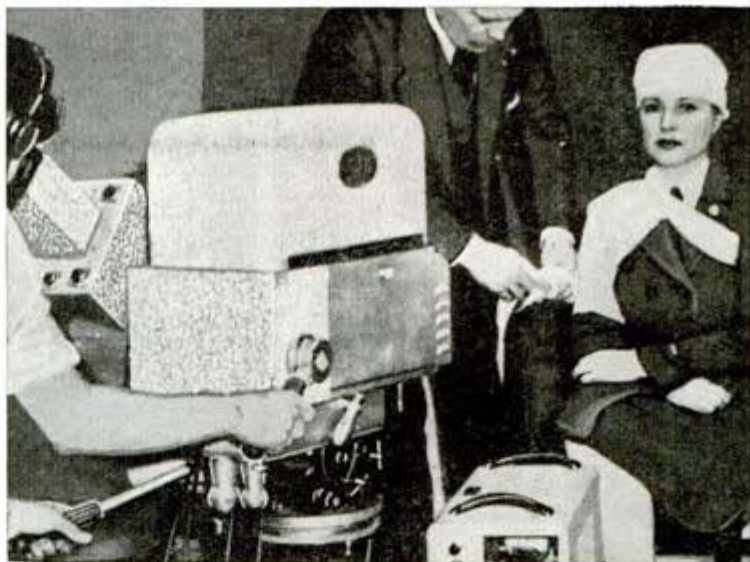
Ref: Klaus Fenderberg, Director, W6XYZ
Paramount Studio, 5451 Marwick St.
Los Angeles, Calif.

brightness or intensity control, synchronization controls to "lock" the picture in its position on the screen, a focusing control that concentrates the electron stream inside the cathode ray tube, and a volume control for sound. Automatic regulation of some of these adjustments is expected.

Another probable improvement will be elimination of interference such as is caused by nearby diathermy machines or automobiles. An integral electronic color system seems possible. Color transmission and reception have been done successfully but engineers aren't sure that the simplest, most satisfactory color system has been developed.

For a look at a modern television transmitter, let's visit W6XYZ, owned by Television Productions, Inc., and located at Paramount studio in Hollywood. W6XYZ uses DuMont equipment augmented by apparatus and improved circuits developed by Klaus Landsberg, the station's director.

This television station at present devotes its regular bi-weekly broadcasts to civilian defense subjects. It radiates sight-and-sound demonstrations on how to seal your home against poison gas, how to extinguish incendiary bombs, and tips for air raid wardens. Experts in first aid show how injured people should be cared for, and once a week an instructor in judo and self defense gives a complete lesson on some aspect of personal protection. On a mat in front of the television camera he shows how an attacker might strike at you, then takes up step by step the defenses that you could use. Television receivers at sub stations



Red Cross instructors teaching first aid by television. Below, twin receivers in transmission room are used to study picture being radiated





Cathode ray tubes of various sizes used in television receiving sets

of the Los Angeles police department are tuned to W6XYZ during the broadcasts so that police and auxiliary police may watch the lessons.

Putting on a television program combines the intricacies of making a motion picture plus the mechanics of operating a radio broadcast station. A program requires experts in lines ranging all the way from makeup to sound and picture transmission. Operating with a minimum staff during the war, W6XYZ uses men for only the most technical posts. Girls act as stage



Touching up backdrop for a broadcast. Below, judo instructor goes before camera

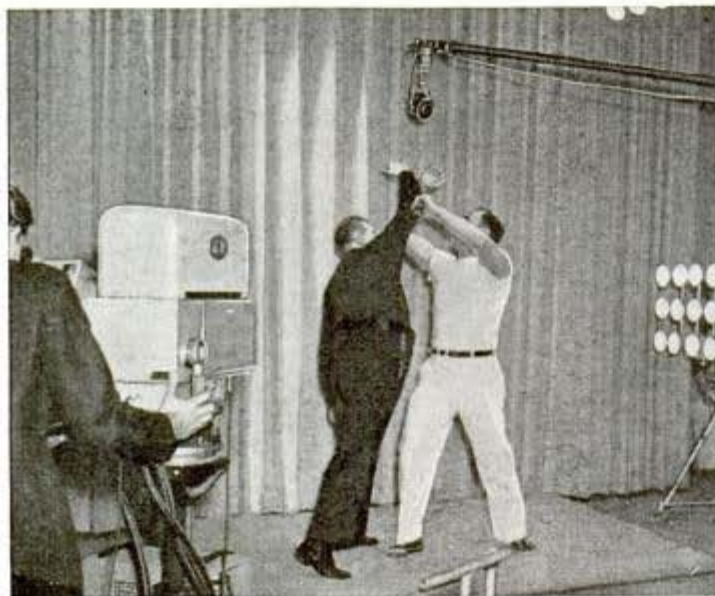
managers, and as camera and microphone boom operators.

Several rehearsals of each program give the actors time to work out their actions. At the rehearsals certain areas are assigned to each action and the stage manager carefully observes that the action remains in the focal plane of the cameras. The lighting technician, who also serves as stage hand, uses light banks that are not as bright and glaring as were required several years ago. New camera tubes that have greater sensitivity require less light for the scenes. The final dress rehearsal a few hours before broadcasting time is complete in all details except transmission.

When W6XYZ goes on the air it first radiates a test pattern and recorded music so that the television audiences can adjust their receivers to greatest fidelity. Two television cameras are used during the program so that the broadcast may be switched

from a long shot to a close-up or to a change of scene without interruption. The camera operators pan their cameras to follow the action, keeping the scene in sharp focus. The microphone boom operator swivels the overhead microphone back and forth to pick up the speech of the actors.

Behind the cameras, Mr. Landsberg watches the action and directs the staff from his post in the glass-enclosed control room. All the technicians wear earphones so that the director can talk to each without interfering with the program. In the control room, too, are the sound control operator and the picture control oper-



ator. This last technician sits behind a bank of instruments that include picture monitors that show the scene being viewed by each camera. He makes electrical adjustments to eliminate distortions, to provide the right amount of contrast, and to control the brightness of the pictures. He watches a cathode ray oscillograph to keep track of the wave shape patterns, and switches the transmitter feed from one camera to the other as the director calls the shots.

Final control of the television picture is exercised by the transmitter operator at the panels in another room of the station. He has two television screens in front of him, one that shows him the picture as it comes to him direct from the control room, and one that shows the picture that is being radiated through the air. His job is to keep the transmitter adjusted so that the picture being broadcast agrees in quality with the picture coming from the control room. This outline, of course, tells only part of the work of operating the station.



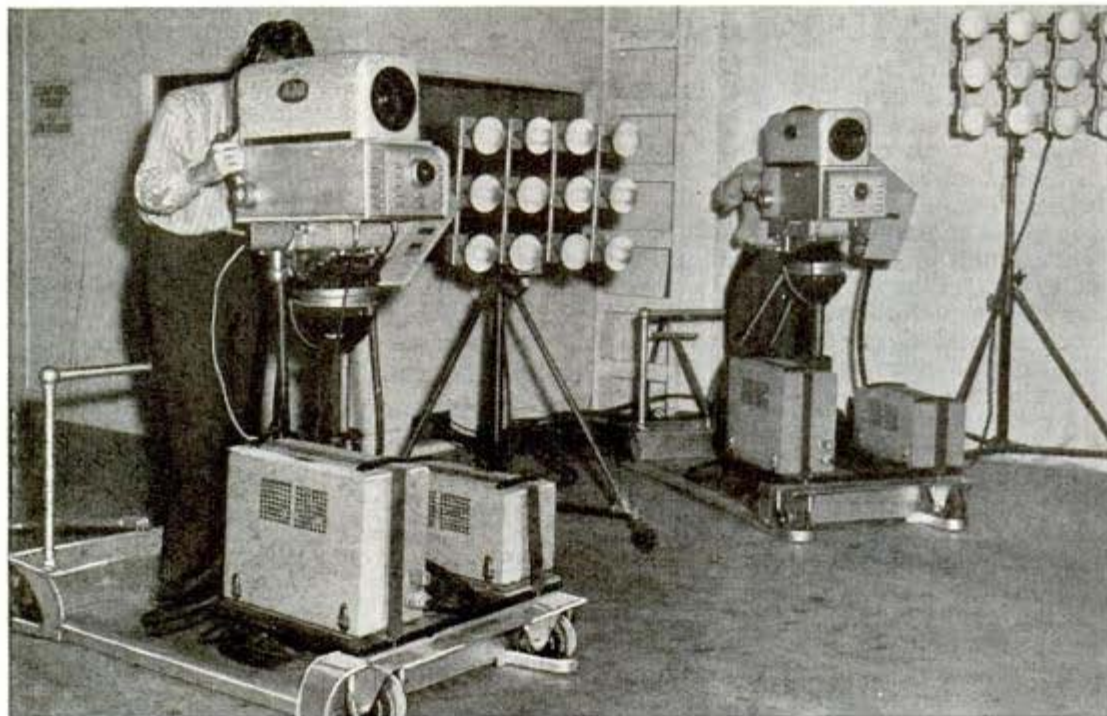
Busy picture control operator keeps sharp eye on the instrument board

The average range of a television transmitter is from 50 to 80 miles, although pictures are sometimes received as far as 150 miles from a transmitter. The short range is due to the ultra high frequencies used for television. The ultra short waves travel in straight lines and in theory are limited to the transmitter's optical horizon.

Actually, some receiving stations that are beyond the optical horizon or that are

Mobile television unit mounts cameras on top of truck and beams picture to main transmitter for broadcast





Backstage at a television studio combines intricacies of movie studio and radio station. Here are two rolling cameras and banks of stage lights, the microphones (not shown) are above

blanked off from the transmitter by intervening hills sometimes receive satisfactory pictures. These exceptions suggest that methods may be found by which the range and "coverage" of transmitters can be increased. In the future it may be that national networks of television stations will be hooked up through relay stations or by co-axial cables, each transmitter then radiating the same program to receivers in its adjacent territory.

Directional, two-element receiving antennas are used for receiving greatest sig-

nal strength. Because of their optical quality, television waves are frequently reflected from the surface of an obstruction. Thus a receiving station near the foot of a mountain sometimes gets its best picture when the directional antenna is turned so as to pick up the ultra short waves that are being reflected from the mountainside. A similar phenomenon sometimes causes the television picture on the screen of a receiver to suddenly increase in brilliance when an airplane is flying overhead. This is because the surfaces of the aircraft reflect the waves down to the receiving antenna. Occasionally a passing airplane causes a "negative" picture to show on the receiving screen.

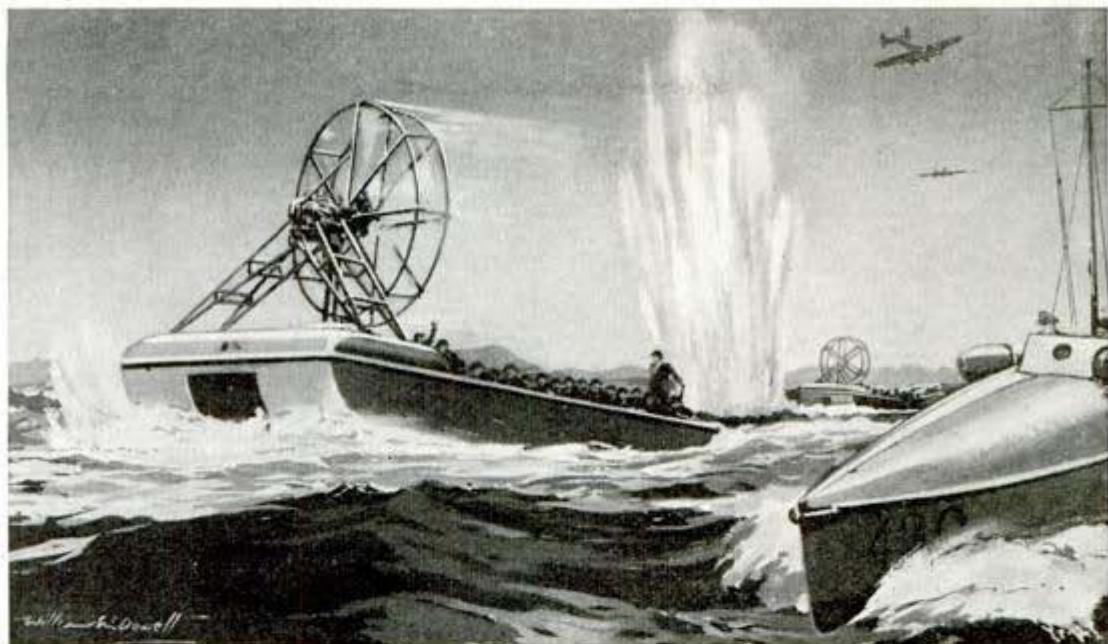
Motion pictures, stage plays, spot news and sports events, and educational sight-and-sound features are some of the things that television can put on the air. It won't be long, now, before you will be watching these programs on the screen of your home receiver.

Testing a television receiver by means of a signal generator and a cathode ray oscillograph in laboratory at station W6XYZ



Giant Fan Drives Nazi Torpedo-Proof Barge

71 405



Though protected by its shallow draft from torpedoes, Nazi twin-hulled barge proves vulnerable to bombs

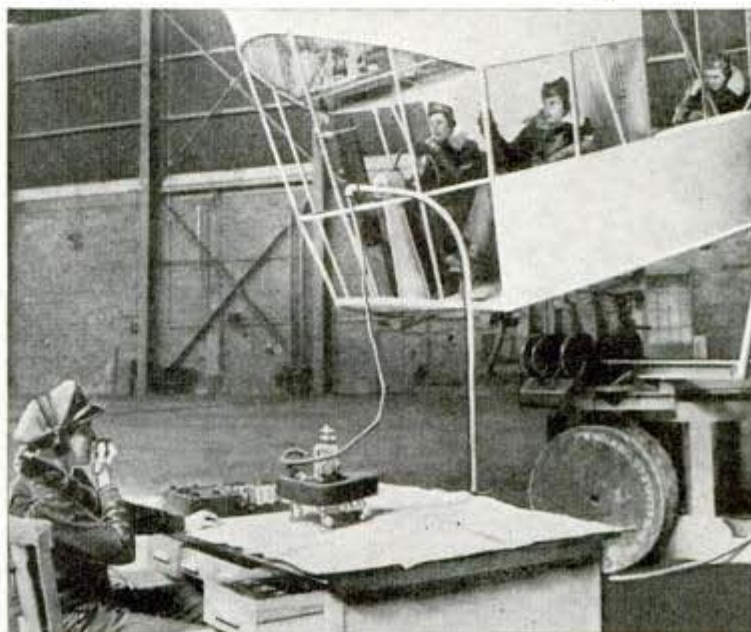
Thinking to outwit Allied torpedo craft, the Nazis have resorted to the use of giant, twin-hulled barges for over-water reinforcement of their armies. These 80-foot craft are of such shallow draft that they are fairly immune to torpedo attack. But their size and relatively slow speed makes them "sitting ducks" for bombing or strafing attack by United Nations airmen. Carrying

a large number of fully equipped soldiers, the German barges can skim over extremely shallow water. To avoid the danger of fouling a propeller on the bottom, the craft are driven by a giant airscrew, set in the bow. These big props are housed in a framework to prevent accident to the crews, increasing their resemblance to an oversized electric fan.

Mechanical Crab Maps Course for Student Blimp Crews

71 331

Navy crews for lighter-than-air craft, the familiar blimps that are one of Uncle Sam's answers to the submarine menace, are trained at an eastern field in a dummy gondola. Equipped much as is the gondola of a patrol blimp, the cab is set up under the watchful eye of an instructor, who communicates with the student pilots by radio. Progress of their "flight" is checked by a mechanical crab, a device that reveals how accurately the crewmen keep to their course.



■ In disembarking from troopships, American soldiers move off at the rate of 40 a minute.

"Crab" on table by instructor, left, tells if blimp crew is "on course"

Lakehurst Naval Air Station
Lakehurst, N. J.

O.K.-TO A GNAT'S EYEBROW!



To a precision engineer, little things have big jobs. Comparator at Wright engine plant magnifies image of a cutting tool

"Wrong" might mean that same gyro-compass, thrown off balance by the weight of a fingerprint; or a bearing spoiled by a speck of cigarette ash.

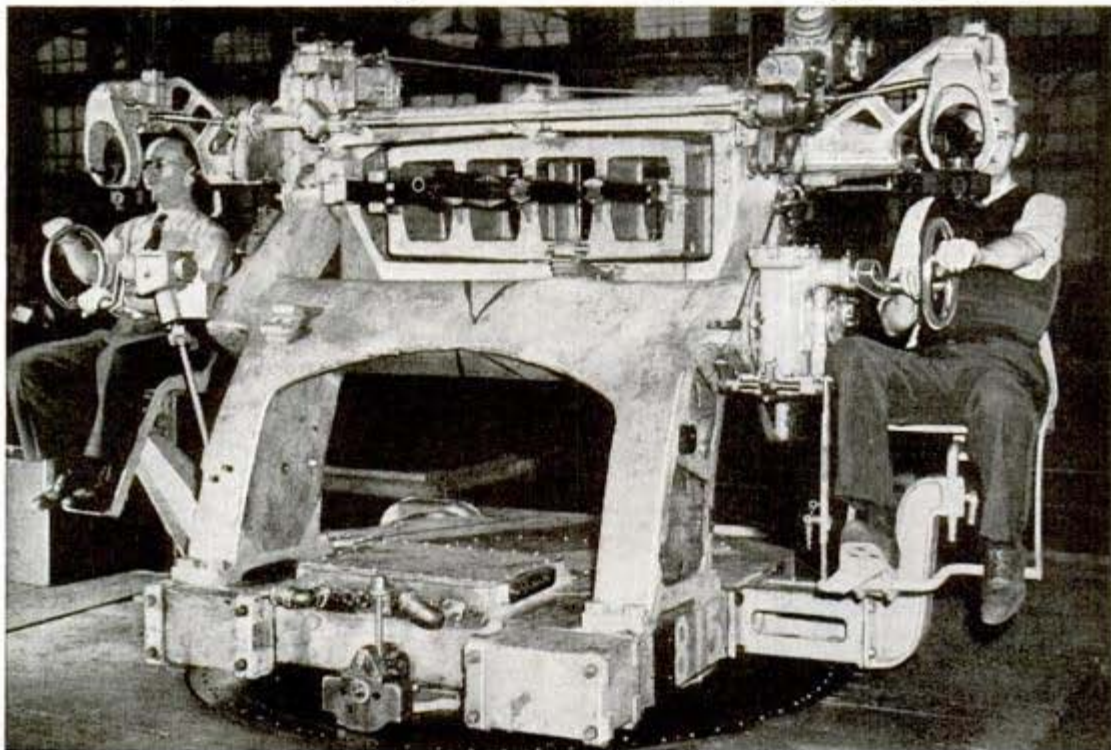
It is common for a single war device to undergo thousands of inspections, many of them to ten-thousandths of an inch, some to millionths. Accuracy is the secret weapon of America's production lines.

An electronic eye can distinguish between 2,000,000 different colors; an electrical ear can spot defects in shell fuse heads; robot fingers precisely measure aircraft engine parts, assuring such close fits that vibration and even wear may be almost eliminated; an aviator's "sixth sense" is

By James Colvin

TO THE precision engineer there is no such word as "almost." If a measurement isn't dead right, it's dead wrong. "Right" might mean a spinning top of a gyro-compass, whirling 6,000 times a minute, yet so delicately balanced that a nickel will stand edgewise on its surface; or bearings so smooth they might never show wear.

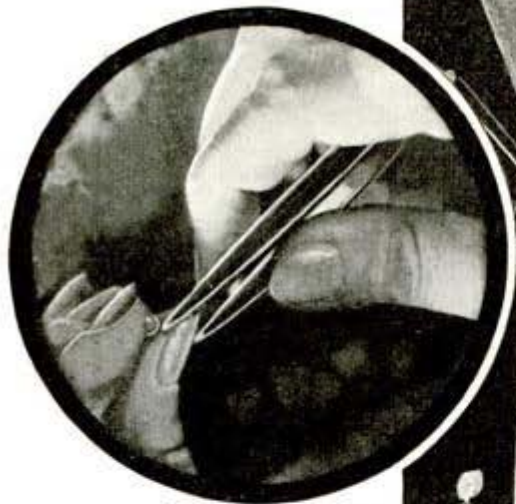
Mount for Navy 1.1 inch antiaircraft gun is tested for microscopic accuracies by Westinghouse inspectors



Blomfield, H. J.

Wright Aeronautical Corporation

Mirror (right) is scaled to permit continuous measurement of width of steel plates being rolled. Below, inspector's view of shell fuse part



supplied by a device that determines whether a nearby thunderhead contains electrical charges that might cause danger from lightning.

Spokesmen at Chrysler, whose engineers developed the process of "superfinishing," believe that if an engine is made of superfinished parts, dimensionally accurate and properly fitted, it should actually never wear out—provided it is kept properly oiled and clean.



Dr. G. A. Wilson

Superfinished bearings are virtually perfect surfaces, and the machining scratches remaining may be reduced to a depth of less than a millionth of an inch. Such parts require no "breaking-in"; they are made to fit.

Inspectors for one aircraft engine factory use a "profilometer," which can distinguish between two surfaces varying in smoothness by a millionth of an inch as readily as the hand can distinguish between a window pane and a picket fence. It is a diamond-tipped device which probes into scratches, its point having a contact area of only .0000000003 of a square inch.

There are 8,752 separate parts in a 14-cylinder airplane motor, and these inspectors must check them all, often dealing in terms of millionths of an inch.

Supreme court over the accuracy of the gauges in daily use are master gauge blocks, little chunks of highly

Spinning top of Sperry gyro-compass produced by Dodge whirls at 6,000 revolutions a minute



Richard G. Knight

Frank Hamilton

Arthur Sackett

Albert Hiram

*Chrysler Corporation
Detroit, Mich.*



Magnifying eyepiece is used to inspect intricate parts of electric instruments (above). Below, what appear as stout bands of cable are really Westinghouse lamp-filament coils enlarged 65 times and pictured in a projection on a screen



polished tool steel so accurate, and consequently so subject to slight expansion or contraction by heat or cold, that they are used only in temperatures of exactly 68 degrees Fahrenheit. Under such conditions they are accurate to within two-millionths of an inch. The 120,000 other gauges are from time to time checked against the master blocks to guarantee their continued accuracy.

Sometimes inspectors use mirrors. Sometimes they magnetize a part and "paint" on a coating of oil and iron oxide powder; the powder will cluster around and outline any surface flaw. They may use a spectroscope to analyze a carload of sand or a fine pile of radio-tube filaments.

Westinghouse uses mirrors and magnifying lenses in a "comparator" to speed the inspection of acorn-sized commutators that go into aircraft-radio dynamotors. Tiny copper and mica strips, only 18 to 50 thousandths of an inch thick, must be exactly parallel or static will result. Inspectors formerly toiled over them with microscopes, but now the comparator magnifies the image of the commutator 22 times and throws its picture on a glass screen. Besides ending eyestrain, the device sped production 20 percent and dropped the number of rejected parts to one tenth of what it was.

Westinghouse Electric Elevator Company manufactures gun mounts carrying four rapid-fire antiaircraft guns, which were praised as "most effective" against Jap raiders at Pearl Harbor by Rear Admiral William R. Furlong, commandant of the Navy Yard at the Hawaii base.

Each 14,000-pound gun mount must pivot freely on its revolving base to train streams of metal at enemy planes—and they do, thanks to precision insured by 4,800 inspections.

In the field of airplane design, "flutter," vibration that increases until such parts as wings or tail surfaces actually fly off in the air, had always been an aeronautical mystery.

As planes grew bigger and faster, it became evident that flutter would have to be licked before flight, and not after some test pilot untangled himself from his 'chute

*Dept. of Public Relations
Baltimore, Maryland.*

and reported: "I was making about 200 when I felt the wings start to go."

Glenn L. Martin Company engineers set up a vibration department, which designed "electric ears" to run flutter down to its various lurking places, and eliminate it in the design. Flutter appears, for example in a wing, when the vibration of the wing itself "gets together" with a part attached to it, say an aileron. When that happens, parts are pretty sure to fly off the plane.

What needed to be done was to chart the vibration of the wing and the parts connected with it, and predict at what speed they would "get together"—when their frequencies would come into fatal harmony. If that speed was well above any speed the plane could possibly make, then the wing was safe.

The "Shake and Shudder Boys" were able to record the various vibrations on graphs, which tell an engineer just what he needs to know about the danger of flutter in the model being tested. The technique was applied to the largest flying boat ever built, the Martin Mars.

Sperry gyro-compasses, among man's most intricate tools, are meeting one of the war's critical emergencies. Axis magnetic mines were licked by fitting ships with a demagnetizing belt, but the belt also ended the reliability of magnetic compasses. Gyro-compasses were not affected, so ships plying mine-infested waters clamored for them.

Dodge Division of Chrysler Corporation, in quantity production on the gyro-compass, has found that certain parts have "tolerances of nothing"—machining must be exact to the hundred-thousandth of an inch.

Heart of the compass are the "spinning tops," which appear to be absolutely stationary on the balancing line—you can, in fact, balance a nickel edgewise on them—yet a glance at the indicator shows they are spinning at some 6,000 revolutions a minute.

The tops are suspended by strands of hair-thin wire, and after assembly the strands cannot be touched, for the moisture from a single fingerprint might cause rust affecting the weight or balance of the entire strand.

Far from being mere fussiness, or blind devotion to detail, precision of this sort pays off—in terms of tons of replacement parts that need never be made; years of repair work that need never be spent; more tools for scrapping with less scrap metal, less production time, less of the taxpayers' money. For precision is the deadly enemy of waste, and an invaluable ally in total war.



Allowable error in spacing of these gear teeth (above) is 1/10,000 inch, 1/50 the thickness of paper of this page

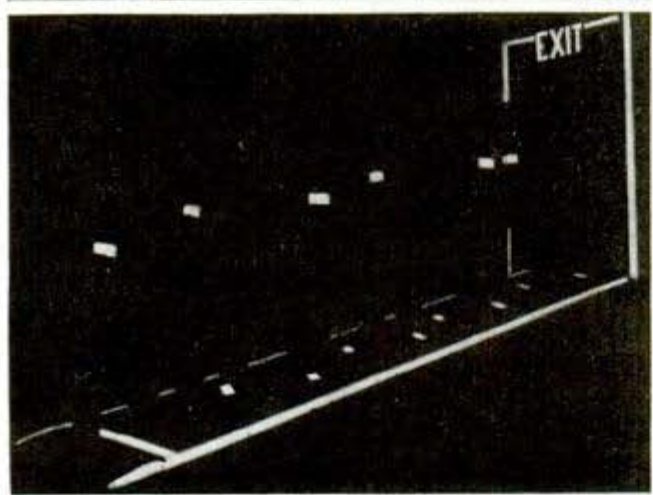
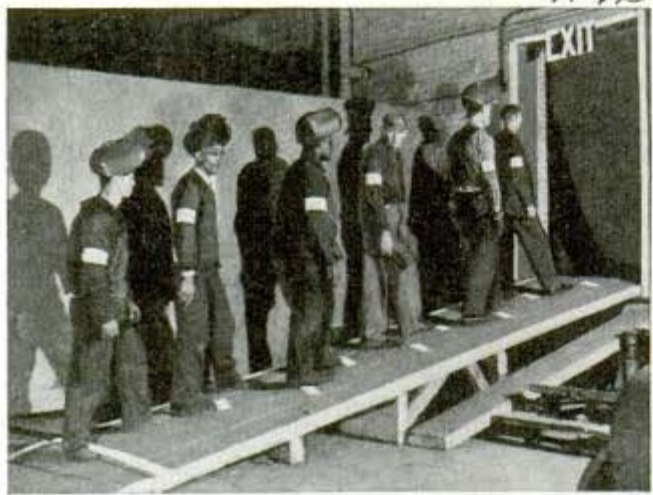
"Hear no evil" is the hope of inspectors at Stewart-Warner plant, who can detect by ear a defect in shell fuse heads



Submitt, Mich.

Luminous Paint "Blazes" Trail To Exits in Blackout

N 415



Two photographs, taken from same spot, show how markers on workers' arms, around door and on ramp, glow during blackout

Safety markers made of luminous paint will guide war workers to exits in a Philadelphia plant in case of sudden power failure or blackout. The markers, hardly noticeable in daylight, shine in the darkness and illuminate safety areas as well as exit doors and corridors. Safety experts installed the markers in a campaign against America's "seventh column"—carelessness that breeds accidents.

N 477

Static Neutralizer for Radio Aids Radar Performance

Perfect radio reception despite lightning storms and other disturbing elements is claimed for a radio static neutralizer developed in the Goodyear Research Laboratory. The neutralizer is used by

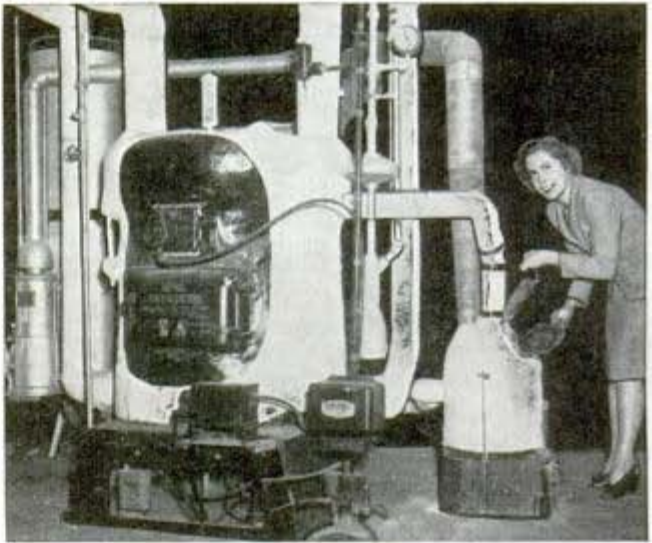
76 Akron, Ohio.

the armed forces to improve the performance of radar and to better communications between planes and ground stations. It also is used in transmitting military maps and reconnaissance photographs for it eliminates black spots and streaks on radio-transmitted pictures. The device has small electronic tubes which automatically control the amount of static that can pass through the radio set and discriminate between static and the desired signal. It will be available for civilian radio sets after the war.

N 337

Coal-Fired Water Heater Helps Keep House Warm

By connecting a coal-fired water heater to the heating boiler of his oil-fired heating system, a New Jersey home owner found he could keep well within his restricted fuel-oil ration and still keep his house warm. Total cost of connecting the coal heater to the boiler was \$57, contrasted with an estimated \$400-plus that he would have paid to convert his system to coal for the duration, and back to oil after the war. The water heater, fired three times a day, maintains the water in the heating system at about 105 degrees on the average winter day. Thus, the coal heater carries the base load of the system, and the oil-burning furnace is called upon only to boost the water temperature additionally when the outside temperature drops.



Coal heater attached to oil furnace carries home-heating load

Mr. C. C. Bennett
395 Ludlow Ave.
Ridgewood, N. J.
POPULAR MECHANICS

Pennsylvania Range Electric Co. Phila., Pa.

Mr. C. Moore
1362 N. Dearborn St.
Chicago, Ill.

U. S. Navy

77419

Kit Helps Castaways Obtain Water From Fish

With a foolproof fishing kit that is standard equipment on all lifeboats, rafts and airplanes of the Army and Navy, castaways can catch fish for eating and "drinking". Fluid squeezed from flesh of the fish provides drinking water. Below, seaman wearing compact kit which boasts seven sizes of lines, hooks, folding net



Following complete set of instructions printed on waterproof paper, seamen (in top photo) cut a large fish into filets preparatory to squeezing juice from its flesh. The cut pieces are placed in porous cloth (above at right) for next operation. The cloth is then rolled and twisted, forcing out natural juice into can (lower photo). This fluid will help keep castaways alive for weeks. Aside from net and hooks, the kit contains small and deadly spear. Bait is also included. The kit was developed by civilian fishermen who were inspired by stories of the suffering of men in rafts



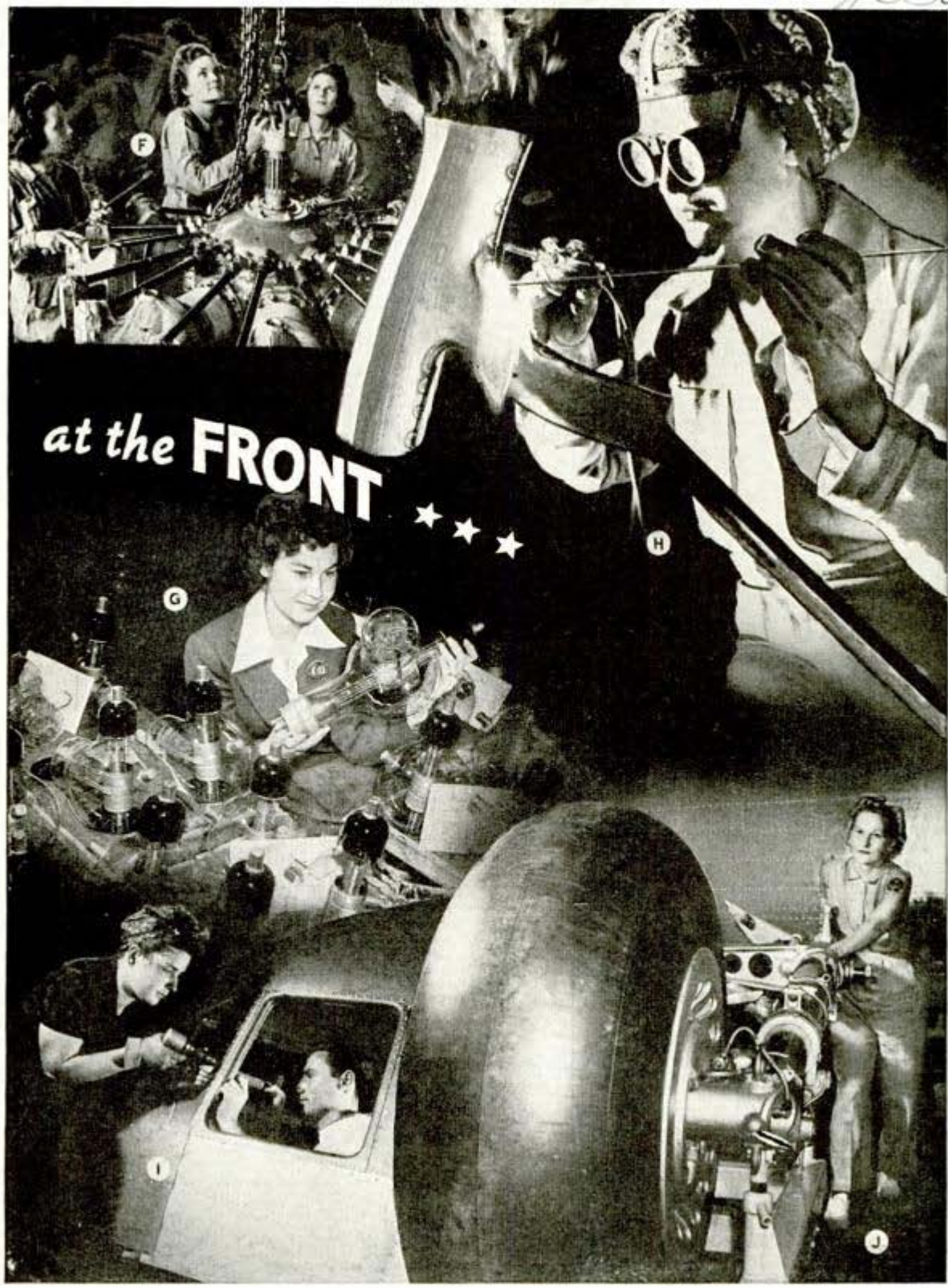


They **BACK** the **BOYS**

Grace Janota

This month, Popular Mechanics Magazine joins other publications throughout the nation in paying tribute to America's women war workers. Some of the thousands of jobs they are performing to help beat the Axis are pictured here. Many of these jobs, such as

locomotive engineer, (A) are normally man's work. In B, two young women are putting the finishing touches on the glass nose of a Flying Fortress, an operation similar to that shown on the cover of this magazine. The girl at the lathe (C) is machining parts



at the FRONT

for planes, and the worker in D is making adjustments in the wheel well of an inner wing. Resembling machine gunners, are the inspectors (E) in a binocular assembly room. The women lowering an engine onto a block (F) are learning skills that will relieve

men for military service. Inspecting high power radio transmitting tubes (G), welding a part of the exhaust system of a training plane (H), riveting (I), and jobs like rolling a landing gear onto a final assembly line (J), are performed by patriotic women.

Portable Grain-Loading Machine Made From Old Auto Parts

71 387



Parts of old farm machinery and of three different autos went into grain-loader (top), also pictured while at work (bottom)

A North Dakota farmer took a long step toward solving the problem of manpower shortage by devising a grain-loading machine out of old automobile parts. For a frame he used a Chevrolet axle, on which he mounted an Overland motor, connecting it to a radiator from a Whippet. By mounting an elevator from an old threshing machine separator, he completed a machine that would load 250 bushels of wheat in 20 minutes. With it he can move several thousand bushels of grain a day, and he can take the loader into his field by tying it to the rear of his truck.

Grainless Steel for Shells Runs Through Die Easily

With steel increasingly substituted for brass in the production of military cartridges, the Western Cartridge Company has turned over to the government a patent for processing of ammunition parts

80 *Cast Alton, Del.*

from "nondirectional" steel. Ordinary steel has a "directional" grain like wood, and under the tremendous pressures required to draw cartridge cases and bullet jackets from this metal, there is a tendency to crack along the grain lines, or to draw unevenly. Under the Western process, "non-directional" steel, in which the grain does not run in a single direction, produces smooth, even draws. In many cases, also, the same equipment used to draw brass cases can be adapted to the drawing of this steel. In the cold-draw method, cartridge cases and bullet jackets are shaped by forcing metal through a successive series of dies.

Railroad Ticket Machine Makes Six-Second Sale

End of the familiar ticket rack in railroad ticket offices may be forecast by the "automatic ticket machine," installed at a terminal of the Pennsylvania Railroad. Though those now in use dispense only the five tickets most in demand locally, the machine can be designed to hold up to two dozen types of tickets, and 4,000 of each type. Together with a change-making machine, the automatic ticket machine has cut the time of issuing a ticket from 17 to six seconds.

Newark, N. J.



"Automatic ticket machine," used in an eastern railroad ticket office, can hold 24 different tickets, and 4,000 of every type

*George Grayson
Fiddler, N. Dakota*

71 447

*Butler 1077. D.
Kansas City, Mo.
71 393*

"Circus Tent" Airplane Hangar Built in 12 Hours



Canvas and steel are the materials from which this portable, quickly erected, combat-type hangar is made

Roof and walls of a hangar for combat planes in forward areas are made of canvas and are hoisted into place much as the circus crews hoist the "big tops." With a steel framework that can be erected, it is claimed, by inexperienced men, the hangar provides a lightweight shelter for planes. It can be readily camouflaged. With the framework in place, the canvas roof-wall

sections are spread on the ground across the building "floor" in their proper locations, and joined by lacing. Ropes hung from pulleys are attached to rings on the canvas, and the big fabric is hoisted into place. First raising of the canvas in a hangar 130 by 150 feet required eight minutes, the whole erection job requiring 12 to 18 hours for a crew of 90 to 100 men.

"Taxi" Plane Trains Mechanics to Pilot Ships on Ground

Built of salvaged parts of Curtiss P-40 fighters, a two-place plane that doesn't fly is used to train aircraft mechanics to pilot ships on the ground. The plane has a rear cockpit with duplicate controls, an inter-communications system, and a tricycle landing gear that prevents nosing over. The special trainer was built at the Army Air Force Technical Training Command School at Buffalo, N. Y. *Camp Curtiss*



Mechanic with instructor at duplicate controls prepares for "takeoff"

Rusty Tapwater Leads Chemist to Formula for Pure Nitrocellulose

In his search for stable nitrocellulose, to be used in smokeless powder that would keep its hitting power in any climate, a Western Cartridge Co. chemist was guided to success by a test-tube full of rusty water. Having run out of distilled water, he filled a test-tube from the water tap in the laboratory. Rust that had scaled off the pipes stained the container. However, he found that impure nitrocellulose—in which minute particles of sulphuric and nitric acids remained—when treated with rusty

water produced a more stable product than ever before obtained. He concluded that rust behaved like a dye. Experiments with other dyes, of all shades of the rainbow, confirmed the idea. Certain dyes belonging to the chemical group of amines actually chased the impurities out of the nitrocellulose in the initial stages of manufacture. Discovery of the purified product led to the practice of manufacturing smokeless ball powder under water, at a rate five times faster than before.

OCTOBER, 1943 *East Abroad.*
Dr. Fred Olson



The **BOMBER**
that **FIGHTS**
ANYTHING

Not speed to outrun enemy fighters, but guns to outfight them (above) and motors capable of outclimbing them far above the clouds (below) protect the Flying Fortress on combat missions



THE good gremlins ride with the Boeing Flying Fortresses.

They were with Lt. James Dieffenderfer on his 31st mission to the Japanese, when his Fortress laid its eggs over Rabaul and then went into a power dive to escape the swarming Zeros.

They were at 2,500 feet when the rear gunner yelled: "The left elevator's gone!" Then, "My gosh, so has the right one."

The control wheel was jerked from the pilot's hand and the big ship went into a nose dive. Dieffenderfer couldn't budge the controls. Finally he and his co-pilot braced their feet against the instrument panel and hauled back with every ounce of weight. Miraculously, the Fortress responded at 100 feet above the sea. Then they began a 500 mile flight without elevators to the home base, where Dieffenderfer made a perfect landing on gear that had been torn to shreds during the takeoff. Climbing wearily from the plane, he remarked: "I don't believe it. I must have had some good gremlins with me."

The Fortresses are becoming a



legend. "Yankee Doodle," flagship of Brig. Gen. Ira Eaker, led the first squadron of the Boeing B-17's over Occupied Europe on August 17, 1942. The ball turret gunner of "Birmingham Blitzkrieg" became the first American to shoot down a Nazi fighter. "Butcher Shop" dropped the first bombs. "Butcher Shop's" bombardier tells the story:

"I felt sort of funny when I looked ahead and saw the antiaircraft shells bursting. It gets you mad and you want to hit them. The plane stretched out for a dead-duck bombing run. I began sighting. I aimed at the freight yards, stuck my head against the side of the plane and saw my bombs go down. I saw them go right through the yards and blow up freight cars and everything. 'Bull's-eye, we got 'em dead!' I shouted. I was pretty excited and was yelling so much I forgot everything except that I



"Bombs away!" and doses of TNT spill from Fortress bellies in a precise pattern on enemy target

Fortress crews personalize their planes. "Swoose" (left) won its first renown in the Philippines

Training for action against enemy (below) gunners wear high-altitude equipment, and fire at painted targets on lofty cliffs





Here's a turret-gunner's view of companion Fortresses on Pacific mission

had hit the center of the target. I guess everybody was sticking out their heads to see the bombs go down. We weren't paying any attention to the enemy at all. We bombed between the river and a bunch of houses and didn't destroy one house."

Then on Jan. 27, 1943, three waves of Boeing Flying Fortresses paid the first daylight visit to Germany and dropped calling cards at Wilhelmshaven and Emden, while Consolidated Liberators made simultaneous diversionary sweeps. The Fortress, "Banshee," was credited as the first U. S. plane to bomb Germany.

The saga of the Fortresses is being written day after day in the skies over Italy and Tunisia, Germany and enslaved Europe and the Pacific. "Dry Martini" battled a fleet of Nazi fighters that ripped holes in her with cannon and machine gun shells, killed her pilot and blinded her co-pilot, but came home with other crewmen at the controls. "Thumper" limped home alive with two engines out of action, her nose smashed, an aileron damaged, hydraulic system and instrument panel wrecked and a fire in the cockpit.

No giant bomber can evade a fast fighter, but it can fight

back. The Fortresses are built with the backbone of a skyscraper; they can take it, and give it back.

"Johnny Reb's" bombardier recalls one busy day over the North Sea: "We were in the tail end of a Flying Fortress formation when we were jumped by about 25 Focke-Wulf 190's and Messerschmitt 109's at over 20,000 feet. They set up a decoy out to our right. I was lying in the nose shooting at that when over the intercommunicating system I heard the waist gunner shout: 'Here come three more from above!' I heard a thud in the pilot's cabin and heard the pilot grunt and ask me to come up. The Fortress never wavered from its course although it lagged behind

the formation a little. In the cabin I found the pilot covered with blood, his eyes glazed and his arm half torn off by the cannon shot which had killed the co-pilot. I dragged the body of the co-pilot from his seat. It was a terrific job as I had no oxygen mask. I took his place. The pilot's oxygen mask had been ripped away and he was fighting for breath. He motioned to take the ship down to 5,000 feet. I never

Guards always accompany bombsight, secret of precision bombing



had flown a Fortress before, having been washed out at flying school and come back as a bombardier. But some way we got down. We were nearing England and I saw a flying field. Somehow, between us, we got her down without even a bounce."

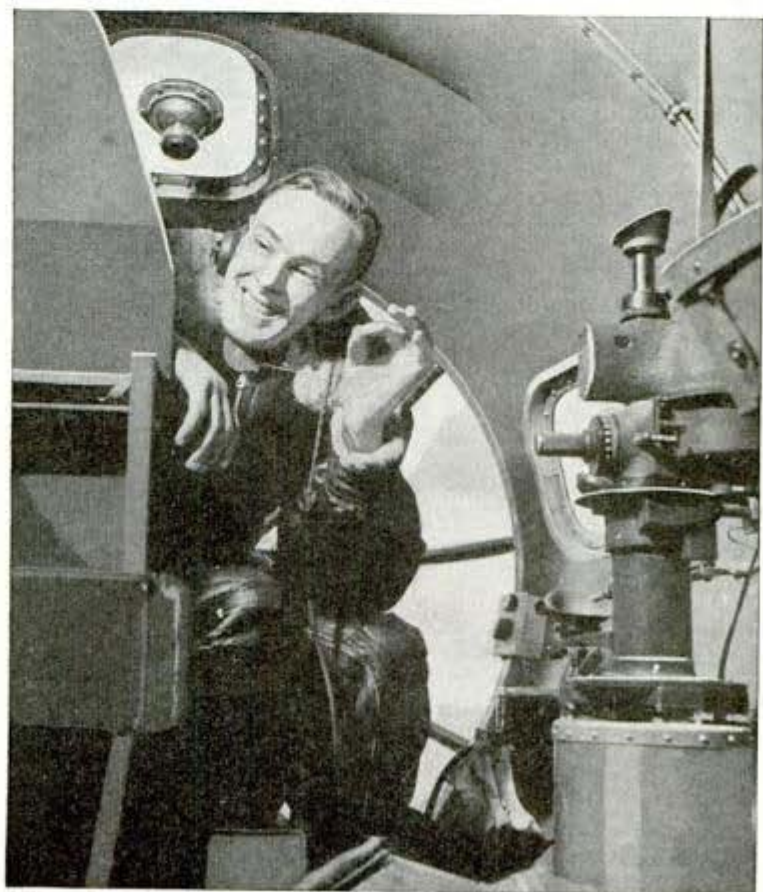
"Alexander the Swoose" was a famous B-17 that lived an enchanted life in the Philippines, Macassar Straits, Java and Australia. She has a sister in England, Miss Swoose. Her pilot, Maj. J. W. Wilson, reports one of her raids: "Just after leaving the target, where we had dumped our bombs precisely on the button, a gunner yelled: 'Here they come, skipper. Give 'em hell.' One FW-190 streaked just over our formation and flashed by before we could get him, but he got in a lucky one on our No. 4 outboard engine, which started to stream smoke and flames. That slowed us down and the Jerries seemed to leave the other squadrons alone and swarm after us. Our boys kept shouting: 'Here's one at 4 o'clock! And another at 5 o'clock.'

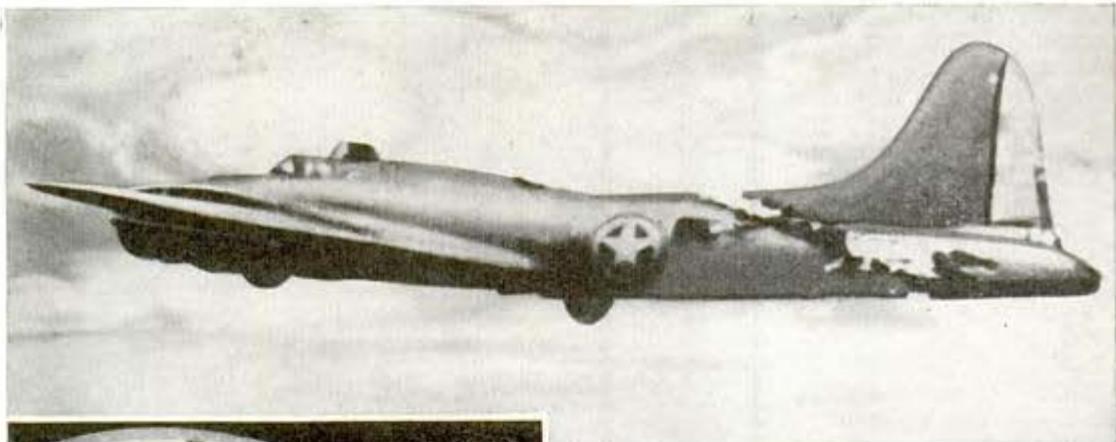
"As they came in—some within 40 yards—the boys made such remarks as 'I could play rummy with that one, he came so near,' and 'Where's that fellow who told us they'd sit out at 1,000 yards?' I smiled at the thought of the sign painted on one of our ships: 'If you can read this you're too damn close.'

"Most of them were Jerry's crack yellow-nosed fighters, like some they had in the Battle of Britain, so we knew we were up against his best. They dived out of the sun; they spotted at once that a beam waistgunner's gun had ceased firing and they were on him. I saw 15 of them lined up



Metal-clad "bundles for the Axis" are stacked in tiers and rows, above. Below, gleeful over a bull's-eye, the bombardier turns to grin at navigator, one of whose instruments, the drift meter, is seen at the right





Built to last—Fortress above still flies after a Messerschmitt struck it, almost slicing fuselage in half. Bombardier, left, takes over for bombing run



overhead at one time. Another pilot said he counted 30. We pumped plenty into them, and saw several go down in flames and others disappear in smoke. The weirdest sight was a dead man's plane that sailed down just across our nose. It must have been flying itself, because we saw right through the cabin and there was no sign of a pilot. He'd evidently been hit and slumped. We gave him some more and he went on down.

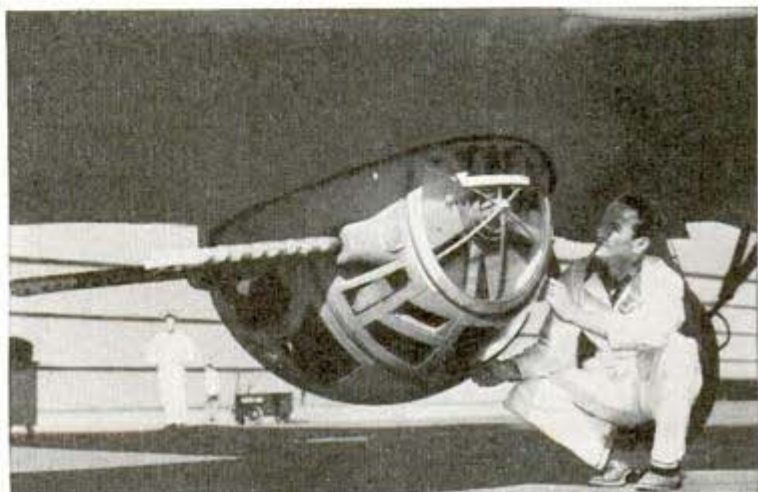
"Vibrations from the increased revolutions of our three good engines were shaking us alarmingly. Besides, a 100-mile-an-hour headwind slowed us up. We were losing height, and when

"Life in a fishbowl" is the destiny of Fortress belly gunners, who swing turret to meet attack

we reached the French coast a few ME109's joined in. We saw our first Spitfire when well over the Channel.

"All five of our squadron got back. Miss Swoose made a lucky landing. One of her undercarriage tires was punctured flat by bullets and we didn't know it. The damaged engine was charred out, and the propeller dropped off. We fought the fire with an extinguisher, but it burned all the way home."

Another immortal B-17, Werewolf, fluttered home from Brest on one engine with only its pilot, Lt. George J. Oxrider, still aboard. The rest had bailed out on his orders only after he promised to follow them out. Then he stuck. A tremendous burst of flak had knocked out No. 4 engine. Number 3 quit over the Channel. Number 1 coughed and died over the English coast when an oil line was severed. Meanwhile the top turret gunner parachuted into the arms of a farmer who thought he was a German and marched him to a police station. Another landed on a mountainside in



his bare feet, the snap of the parachute having thrown off his shoes. The ball turret gunner came down in a flock of sheep. Another was rescued by a young girl who insisted that he ride to a village on her pony, which she led. The radio operator was cornered by a lad who drew a big knife and threatened him until convinced the Yank was not a Nazi. As the bombardier jumped, he shouted to the navigator: "Don't forget our date in town tonight!" They kept it. Lieutenant Oxrider broke his promise to bail out, headed for a likely field but found children playing in it, spied a garden and landed with only slight damage. Werewolf lived to fight again.

One of the most remarkable tributes to American engineering skill and Yankee airmen's courage was the survival of a Fortress that collided with a Messerschmitt 109 over Africa. The Fort's fuselage was ripped in half, from top turret to floor, about 30 feet forward of the tail. Sgt. Sam Sarpolus, the tail gunner, sat there orphaned in the nearly severed tail although the ship threatened to break in two at any moment.

"The Messerschmitt came at us head-on," related Sergeant Sarpolus, "and the bombardier apparently killed the German with a burst from his .50-caliber gun. The ME just scraped the top turret, then its wing cut into the fuselage, scraping off the top for ten feet, then biting downward clear to the floor of the Fortress before snapping off. I saw it falling without a wing. I crawled back and saw a piece of the Messerschmitt's wing was imbedded in the plane. I didn't see anyone bailing out, and I didn't want to be the first so I went back to my post."

With the tail wobbling as if made of rubber, Lt. Kenneth Braggs brought the plane down to a perfect landing. An engineer looked at it and said: "According to our figures, a ship hit like that can't fly."

Next day someone opened the door and the fuselage broke in half.

The Fortresses have been boring holes in typhoons over Munda and hedgehopping over blizzard-bound crags of Kiska. Seventy-five feet over the Jap hangar roofs is the safest height above Kiska. Wingtips nearly brush the walls of the pass that is the B-17's exit from that infested harbor. The boys inside the flying "armored car" joke about mowing the tundra. The Fortresses come back with gaping holes and engines smoking, but they usually come back.

Heroes are made in the cramped quarters of the ball turret beneath the fuselage, where the gunner tastes life in a goldfish bowl. That is the office of Sergt. Maynard

(Continued to page 148)

Rotating Food Dehydrator Works "8-Hour Shift"

71 384



Dehydrator's revolving shelves are heated electrically

Dehydration of food is complete in from eight to nine hours in a cabinet the size of a refrigerator developed by A. J. Stephens, Kansas City manufacturer, for home use. Rotating shelves carry the food, with electric rays supplying heat from one side of the cabinet. One motor turns the rod on which the shelves are hung, and another operates a fan to provide the needed circulation of air. In one test, 16 pounds of spinach, carrots, rhubarb, celery, apples, turnips and beets were reduced to four pounds of bulk by removal of moisture.

250-2862 C. 14 St. Mo.
Kansas City, Mo.

Army Doctors Use Parachutes To Reach Wounded at Front

71 461

British medical units are dropped by parachute to attend the wounded in advance lines of action. In the Tunisian campaign one unit consisting of 10 men, including a surgeon lieutenant, was dropped close to the battlefield to attend 162 wounded men. Prompt medical attention saved the lives of all but one man. The air-borne units carry full dressing station equipment, operating apparatus and instruments, anesthetics, medicines and dressings. Under normal conditions the group can assemble its operating equipment within 10 minutes of landing. The "para-doctors" carry medical supplies and food to last several days.

Enemy Parachute "Bombs" Feed Isolated Troops



Nazi hinged "bomb" holds rations for besieged troops

Nazi troops under siege and cut off from supplies, as were those at Stalingrad, may be supplied with food for a time by air. Though use of parachutes to drop food has long been used by virtually all armies, the Nazis introduced an innovation by packing the food in a container resembling a bomb. This in turn was attached to a parachute, and dropped into the German lines by planes.

Tiny Machine Gun Packs Punch Of 450 Rounds Per Minute

It weighs less than nine pounds and is small enough to be carried in an ordinary brief case—the Army's new M-3 sub-machine gun. The .45 caliber weapon can fire 450 rounds per minute. During one test 49,600 rounds were fired with a single



Firing midget machine gun that fits in brief case

gun and its accuracy appeared to improve, rather than decrease, with use. This sturdy weapon has proved effective in battle and amphibious troops have found that rain and even a dunking in sea water do not hurt the gun. It was developed by the Ordnance Department, Army Service Forces, costs only half as much as the older type Thompson sub-machine gun, and weighs three pounds less.

Polaroid Glasses and Windshield Replace Hood in Blind Flying

Black canvas hoods to cover the cockpit of a plane used in teaching blind flying have been replaced at southern army air fields by polarizing goggles and a polarizing windshield. Formerly the student's cockpit was covered with a hood, and the instructor in the rear cockpit could see only one side of the plane, with his view ahead completely shut off. With the new system, the student is fitted with a pair of green polarizing goggles. The optically ground lenses allow him to see instruments and the cockpit interior plainly. With a



Polarizing glasses and sheet "black out" the cockpit

red polaroid celluloid screen placed over the cockpit cover he can see nothing outside the plane. In the rear cockpit the instructor, who does not wear goggles, can see clearly through the celluloid to avert crashes or bad landings, if the student is in danger of them.

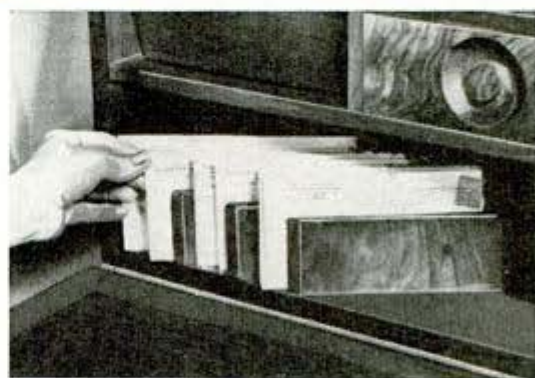
Write to the firms listed in the Where-to-Buy-It index, to learn more about products described in this magazine. Say You Saw It in Popular Mechanics.

*Gen. Lloyd W. Richette
7 Feb Myer, Va.*



The CRAFTSMAN

Mirror-Front WALL DESK

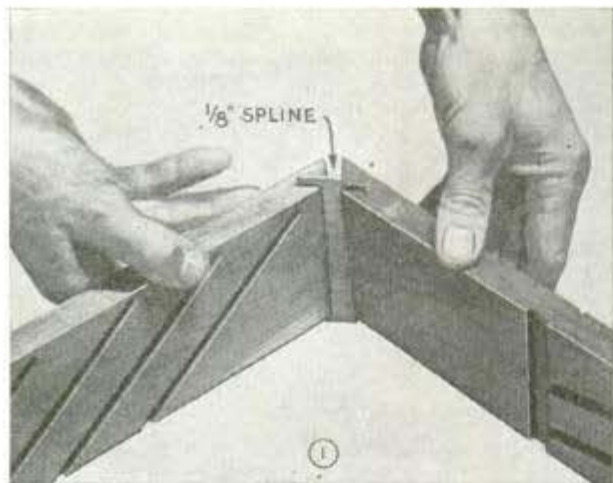


By Benjamin Nielsen

WITH its broken-arch-and-urn design, this mirror-front wall desk is an attractive piece of furniture that is particularly adapted to the limited space in small homes or apartments. Having ample capacity for ordinary family use, the desk can be made from any wood, but preferably hardwood such as walnut or mahogany.

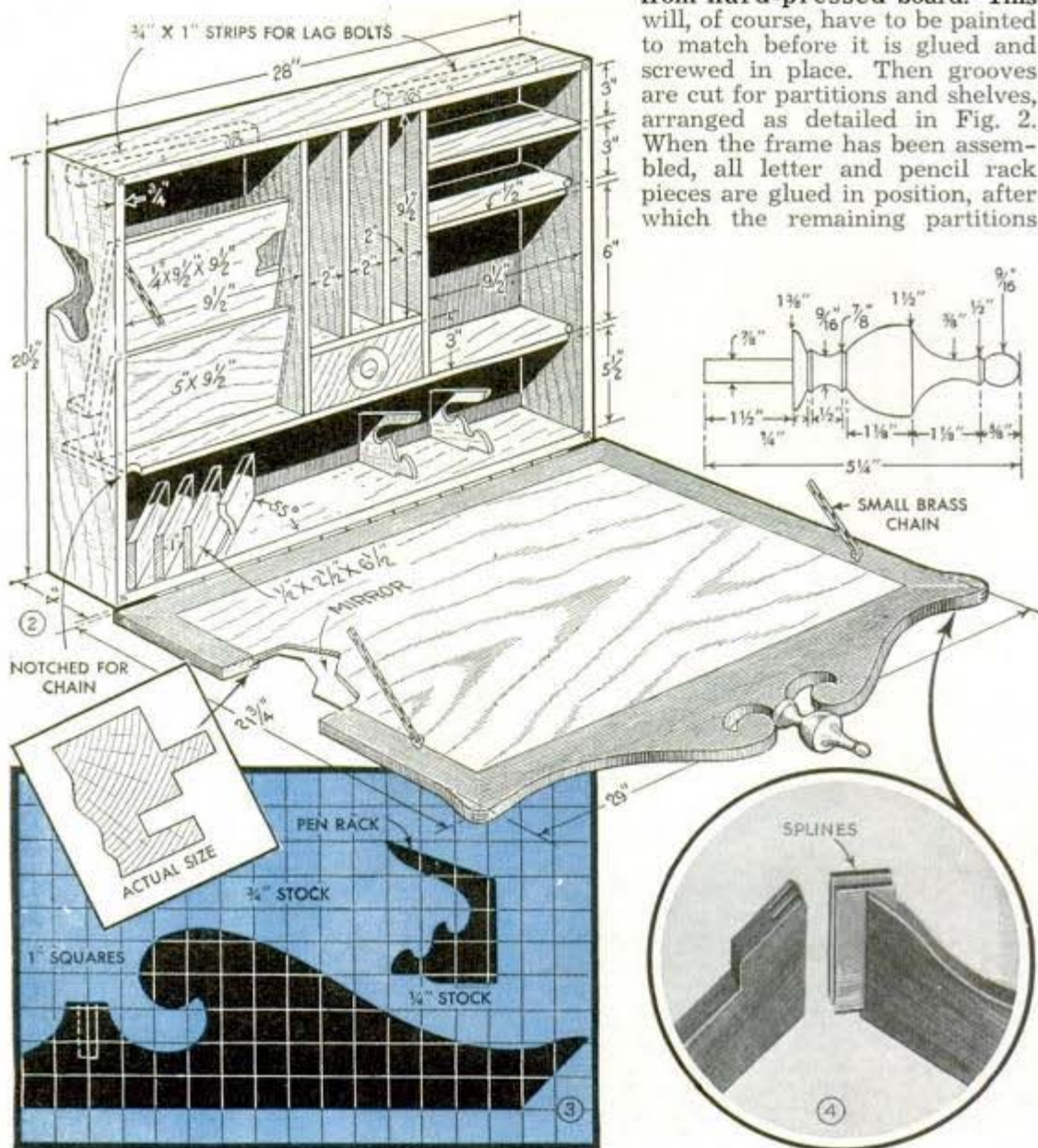
Fig. 1 shows how corners of the body are fitted together with strong splined joints, the door corners being assembled with

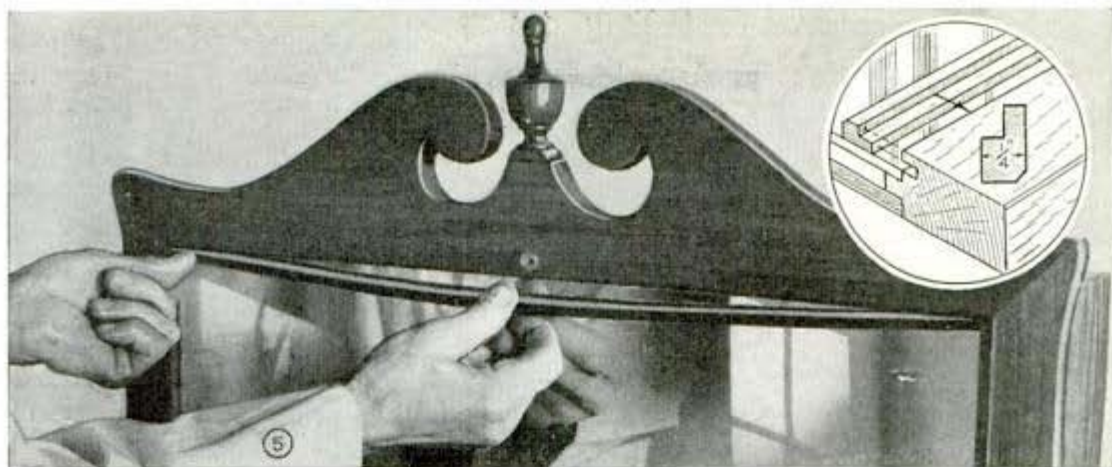
double splines for maximum strength as in Fig. 4. In selecting material for the splines, it's a good idea to choose a wood that is slightly lighter colored than that of the door so that the end grain of the splines will finish very nearly the same color as the surrounding stock, thus making the end grain less noticeable. After completing a full-size pattern of the broken-arch design, Fig. 3, it is transferred to a piece of straight-grained stock and bandsawed to shape. Turning of the urn-shaped finial is next, and this should include a tenon on



the lower end to facilitate mounting in the top frame member. Frame pieces that make up the door are rabbeted to take the mirror and a piece of tempered hard-pressed board which serves as a writing surface. The exact width of the front rabbet depends upon the thickness of the particular mirror used. Also, grooves are cut in the frame pieces to take L-shaped retaining strips which hold the mirror in place. These should be a tight fit so they can be pressed or tapped into the grooves as shown in Fig. 5.

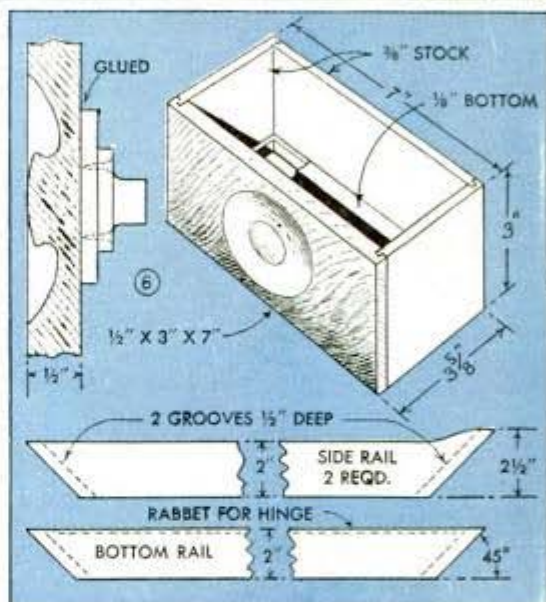
Before gluing up the body frame, both sides and ends are rabbeted to take the back, which can also be cut from hard-pressed board. This will, of course, have to be painted to match before it is glued and screwed in place. Then grooves are cut for partitions and shelves, arranged as detailed in Fig. 2. When the frame has been assembled, all letter and pencil rack pieces are glued in position, after which the remaining partitions





and shelves can be fitted carefully and glued in their respective places.

For the drawer front, Fig. 6, a piece of wood with attractive grain should be selected, cut $\frac{1}{8}$ in. oversize and glued to a piece of waste stock so that it can be mounted on a lathe faceplate. This makes it an easy matter to turn a recess in the drawer front to provide a neat, flush-type pull. After the drawer has been completed, edges of the front are sanded down until a neat fit is obtained without sticking. Before attaching the door and back permanently, all surfaces of the desk should be sanded thoroughly and given two coats of shellac, sanding lightly between coats. A continuous hinge is best for supporting the door, or three or four small butt hinges may be used. In mounting the completed desk on a wall with two lag bolts, it's important to locate the bolts directly over studs.

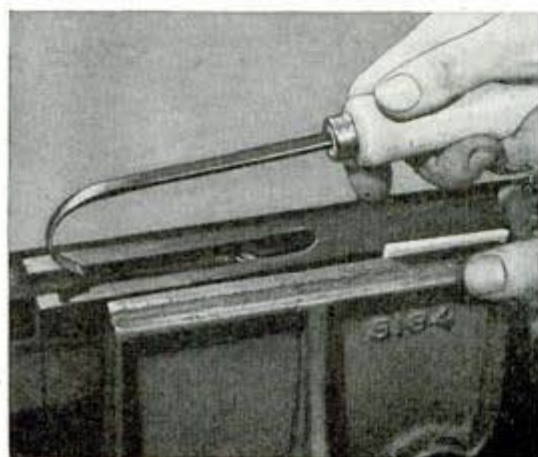


Handy Gouge Cuts on Pull Stroke and Is Easy to Control

Cutting on the pull stroke, this hook-shaped gouge was made especially for working close to the ends of grooves without reversing the work or operator's position. Although the original blade was

formed from a piece of tool steel, an old screwdriver would do as well. The end was heated and forged flat, after which the tip was given a slight cross curve. Then the blade was again heated and bent to form the hook, with the concave surface inward. Hardening consisted of heating the steel to cherry redness and quenching in salt water, followed by reheating to a reddish-brown hue and quenching in water to temper it. Grinding and honing the cutting edge, after fitting the tool with a suitable handle, completed the job.

—Walter E. Burton, Akron, Ohio.



When waxed paper is used to wrap sandwiches, cake, etc., for lunch boxes, or for other purposes where it is desirable to exclude as much air as possible, you can seal the package with a hot knife. Merely heat an old knife or other piece of flat metal and run it over the seams of the paper.

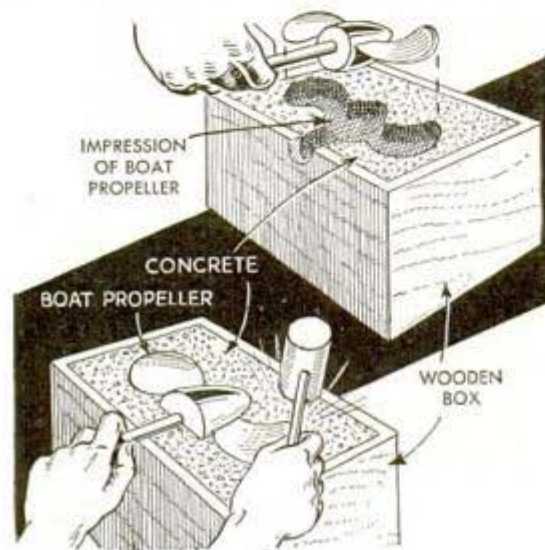
Wood Ticks Removed From Dog With Lighted Cigarette



As the danger of poisonous infection from the bite of a wood tick is due to its being pulled away so that the head of the insect remains in the animal's flesh, one hunter uses the following method of removing ticks to avoid this trouble: The lighted end of a cigarette is touched to the rear portion of the tick's body which causes the insect instantly to remove its head from the small hole that it has made in the dog's skin, thus making the tick easy to remove.

Concrete Mold of Boat Propeller Simplifies Straightening It

If you are unfortunate enough to bend or badly dent the propeller on your boat, the job of straightening it will be greatly simplified if you have a mold of the propeller



W.T.M. Concrete

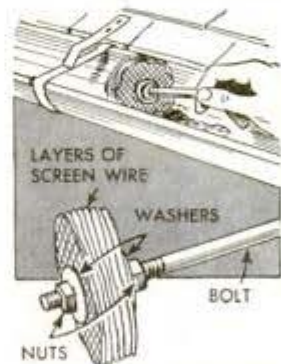
to use as a gauge. Before the propeller has been damaged, take an impression of it in fresh concrete. To do this, fill a box with concrete as indicated and then press the propeller into it. When dry, the impression will be permanent, and will enable you to return the propeller to its original shape with a wooden mallet.

Slip-On Cover for Hot Handles

A cover made by stitching several thicknesses of heavy muslin together so that one end is left open will save you many burned hands when using spoons or cooking utensils over a stove where the handles are likely to become very hot. It takes only a few minutes to make two or three covers of different sizes that will fit your pans and spoons used in cooking.



Brush to Clean Eave Gutters Before Painting Them



The usually difficult job of cleaning eave gutters before painting them can be simplified by using a correctly shaped brush of screen wire. To make the brush, cut several disks and shape them to fit the contour of the gutter. Then

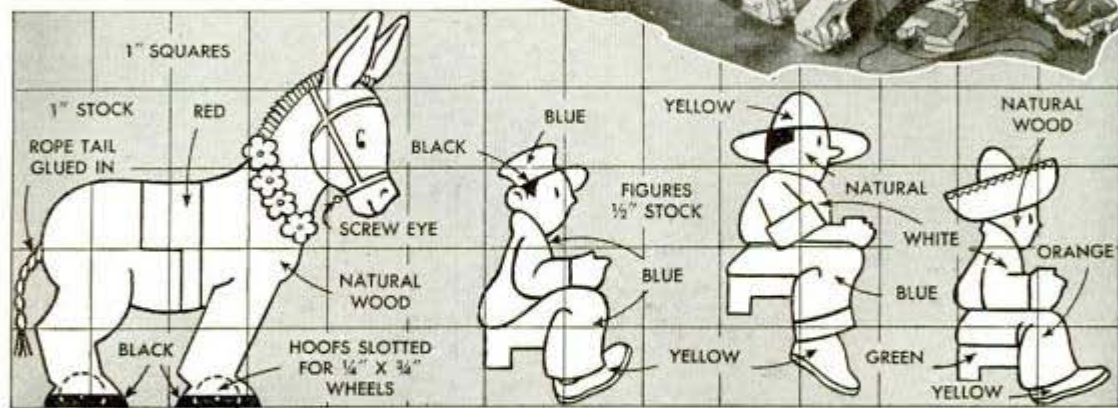
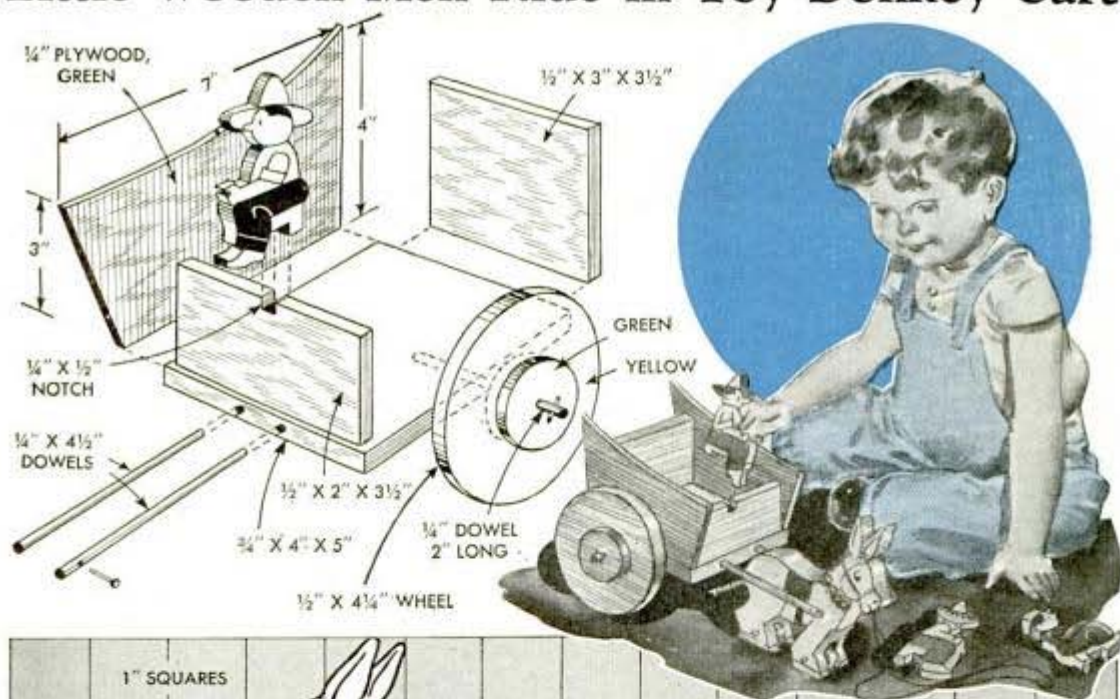
clamp them between a couple of nuts and washers on the threaded end of a long bolt, which serves as a handle.

Warm Air Forced Into Cold Room By Setting Fan on Floor

After attempting without success to force warm air into a cold room by placing a fan near the top of a doorway, I set the fan on the floor, facing it into the warm room. In three minutes, the cold room was very comfortable, as heavy, cold air near the floor proved easier to move in greater volume, which caused warm air near the ceiling to circulate through the top of the door and raise the temperature quickly.

—A. Cooke, Everett, Wash.

Little Wooden Men Ride in Toy Donkey Cart



Small children will have no end of fun with this brightly colored donkey cart with its three interchangeable drivers. If desired, the various parts can be cut in duplicate or triplicate so that two or three toys for gifts can be made almost as quickly as one. After cutting and assembling the body parts of the cart as shown in the upper detail, glue the dowel axles for the wheels into holes drilled horizontally through the edges of the body bottom.

Then jigsaw the donkey and figures of the three drivers, and pivot the donkey between the dowel thills or shafts of the cart with a small nail driven through near the ends of the thills. Put a small screw eye under the donkey's chin for attaching a tow string, set one of the drivers in a notch cut in the upper edge of the cart front and you are ready for a drive. A suggested color scheme is given in the details.

—R. L. Fairall, Los Angeles, Calif.

Loose Hub Caps on Car Wheels Tightened to Stop Rattling

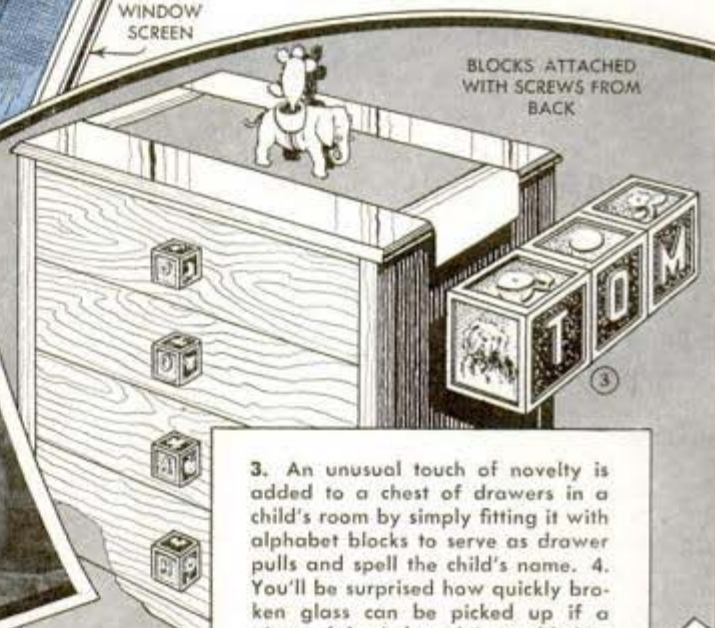
If the retaining flange on the hub cap of a car becomes worn or sprung so that it does not fit tightly and causes a rattle, you can reshape it easily. First, saw or turn a disk from a block of 2-in. hardwood so the edges are tapered slightly. The upper surface of the disk should be just slightly larger in diameter than the flange. Place the hub cap inside up in a box of sand and then set the wood disk over the flange with the narrowest surface down and strike it a few blows with a hammer. This will drive the disk into the flange, spreading it to its original shape. The sand prevents marring or denting the plated side.



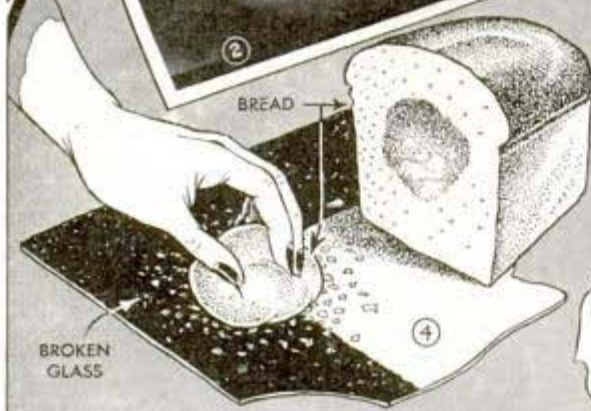
Solving HOME



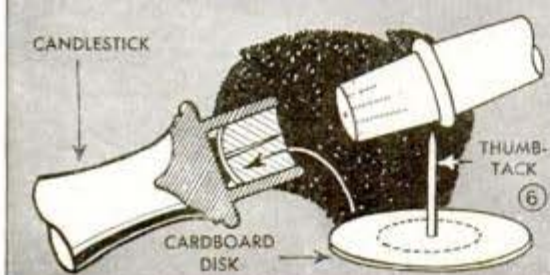
1. By using chalk to outline knitted mittens, sweaters, etc., on a galvanized window screen before laundering, they can be stretched to their original shape accurately and pinned with small nails while drying. 2. To avoid scouring and polishing the inside of an aluminum coffee maker, just drop a few apple peelings in the lower part, fill it with water and simmer for half an hour



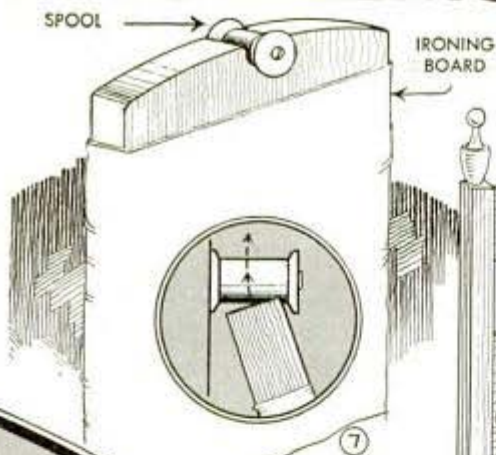
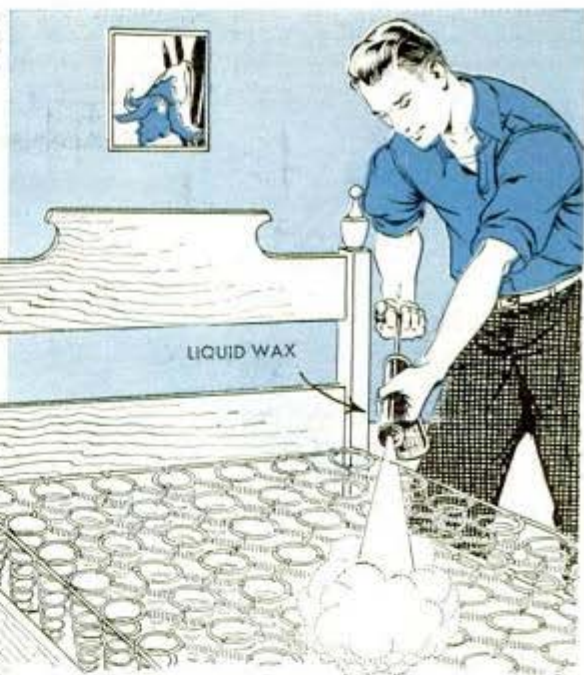
3. An unusual touch of novelty is added to a chest of drawers in a child's room by simply fitting it with alphabet blocks to serve as drawer pulls and spell the child's name. 4. You'll be surprised how quickly broken glass can be picked up if a piece of fresh bread is wadded in a small ball and used as shown



5. Instead of labeling individually many glasses of jelly containing the same flavor, store the jars in a box and place one label on the outside. This not only saves time, but being in a box, the jars will be protected from dust. 6. If you have trouble keeping the candles of your table centerpiece from tipping in their holders, a cardboard disk wedged into the socket to hold a thumbtack will keep them standing vertically



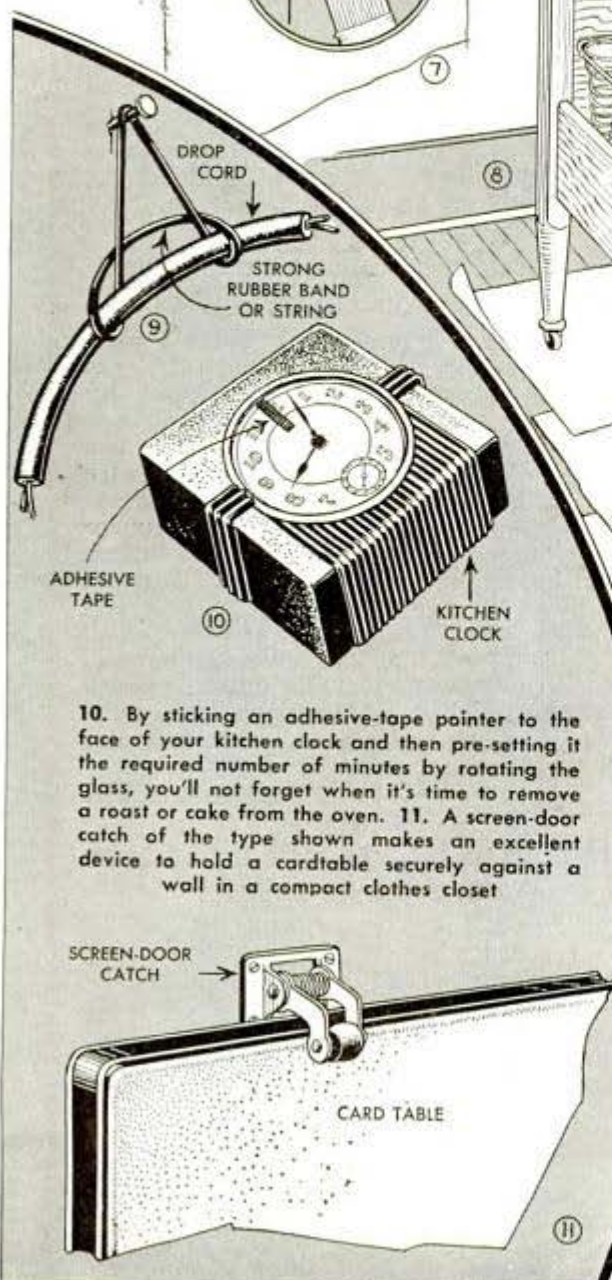
PROBLEMS



7. To hold an ironing board securely against the wall of a crowded storage closet, cut a notch in the uncovered end of the board to engage an empty thread spool mounted on the wall at corresponding height. 8. Although an oil spray is often recommended to cure squeaky bed springs, this causes dust to collect on the springs rapidly and may soil the bedding. However, these objections can be overcome easily by using a thin, liquid wax to accomplish the same purpose. 9. A fruit-jar rubber or strong rubber band looped around a drop cord provides a safe and convenient means of supporting it on a nail

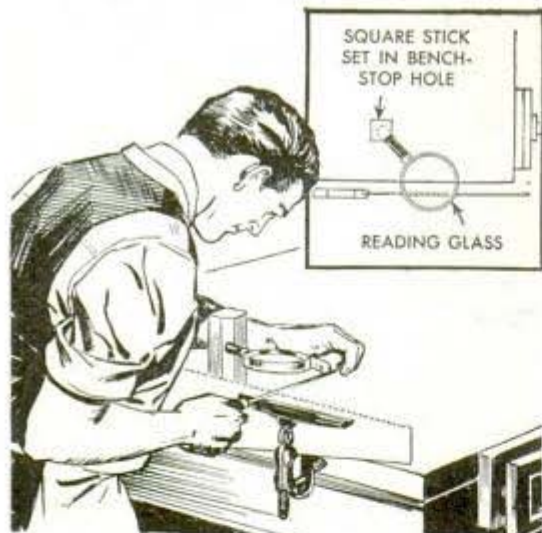


Yarn can be wound into neat balls quickly on a sewing machine, if this press-on spindle is attached centrally to the handwheel as shown above. It consists of a vacuum cup attached to a clothespin, the end of the yarn being held for winding by passing it through the slot of the clothespin



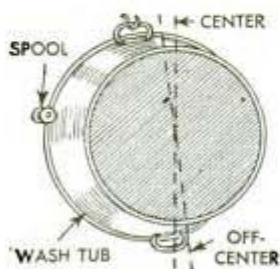
10. By sticking an adhesive-tape pointer to the face of your kitchen clock and then pre-setting it the required number of minutes by rotating the glass, you'll not forget when it's time to remove a roast or cake from the oven. 11. A screen-door catch of the type shown makes an excellent device to hold a cardtable securely against a wall in a compact clothes closet

Square Stick in Bench-Stop Hole Supports Magnifying Glass



While filing a fine-tooth saw, or doing other work requiring the use of a magnifying glass, you can have both hands free by supporting the glass on a stick shaped to a snug, sliding fit in the hole for your bench stop. All you have to do is to drill a hole in the stick for the insertion of the handle of the magnifying glass. The stick can be raised or lowered to adjust the focus.

Rattling of Wash Tub in Wind Prevented by Spool



If you hang your wash tub on the outside wall of a building to dry and air out, it can be prevented from swaying in the wind and causing an annoying rattle by nailing an empty thread spool to the wall at one side of the tub. When doing this, swing the tub slightly to one side and attach the spool. This will assure that the tub rim rests firmly against the spool at all times.

Replacing Oil and Gas Lines On Cars and Motorcycles

When it is necessary to install a new gas or oil line on a car or motorcycle and the original line is not at hand, many owners experience trouble in shaping the tubing, often resorting to the trial-and-error method of bending it into different shapes until the correct form is obtained. This repeated bending of the tubing often causes

it to fracture. To avoid this, use a piece of wire, which can be bent easily, to get the desired length and shape of line, and then bend the tubing to match the wire.

—Ivan J. Stretten, Detroit, Mich.

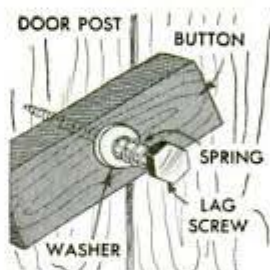
Magazine Pages Torn Straight After Scoring With Clip

Next time you want to remove a number of pages from magazines and a knife or pair of scissors are not at hand, just straighten one side of a wire paper clip and use it as shown. Sharp



edges on the ends of these clips scratch the paper in most magazines just enough so that it can be torn easily without leaving jagged edges.—Don Brooks, Chicago.

Coil Spring Holds Door Button And Prevents It Jarring Loose



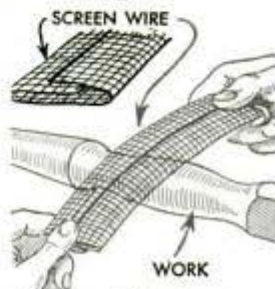
Doors on out-buildings that are held closed by wooden door buttons are often opened by the wind because vibration of the door causes the button to turn. To avoid this, attach the

button in the usual way but put a small coil compression spring under the head of the screw which holds the button in place. This keeps a constant pressure against the button so that slight vibration will not cause it to turn.

—L. Schneider, Clinton, Mo.

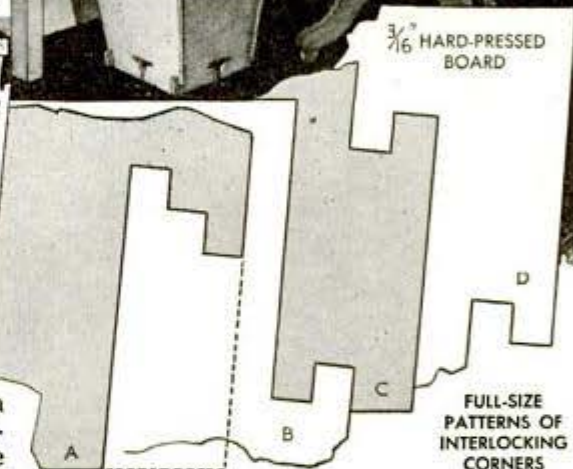
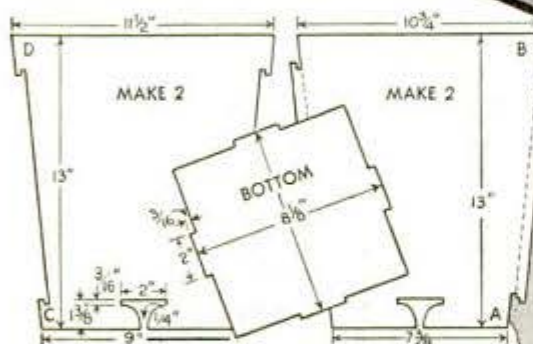
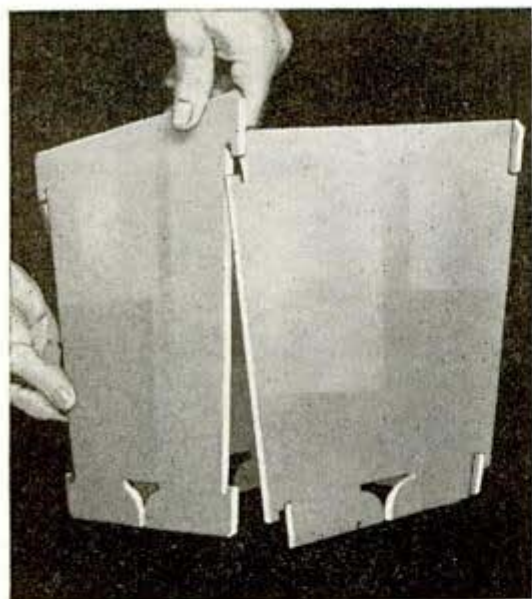
Screen Wire Is Good Substitute For Abrasive Paper

I have found that scrap pieces of screen wire save me a considerable amount of sandpaper in rough-sanding turned work in a lathe. The wire is folded over to provide a strip an inch or so in width and is used in the same manner as sandpaper, which, of course, must be used for the final smoothing.



—G. E. Hendrickson, Argyle, Wis.

Neat Waste Basket Has Self-Locking Joints



Neat design and plain lines, besides a novel method of assembly by means of interlocking corner joints, make this waste basket an attractive piece of furniture as well as an interesting woodworking project. No glue, nails or screws are needed to assemble the basket, and only a hand or power scroll saw is required to make it. Although $\frac{1}{4}$ -in. plywood was used for the original basket, $\frac{3}{16}$ -in. hard-pressed board can be used if plywood is unavailable. The lower left-hand detail gives the shapes and

sizes for the bottom and sides of the basket, and the lower right-hand detail shows full-size patterns for cutting the interlocking corners. In assembling the basket, put the sides together first, but do not press the corners together tightly. Insert the bottom piece from the top, press it into place and then force the corners together firmly.

Correctly Adjusted Burners Keep Gas Bills at Minimum

By keeping the burners of your gas stove, hot-water heater, or other gas equipment adjusted to operate at peak efficiency, you can keep your gas bills at a minimum. If your cooking utensils are blackened by soot, which results when the gas flame has a yellowish color, the burners are either dirty or the fuel mixture of gas and air is incorrectly proportioned. After you have cleaned the burners thoroughly, light the stove and adjust each air valve

separately. When the valve, which is a thin, slotted metal disk, is rotated to admit more air, the flame will rise, have large blue cones in the center and become noisy. The most efficient adjustment is when the flame burns fairly quiet and has small blue cones. Remember too, in cooking, that water gets no hotter than approximately 212 deg. F. regardless of how hard it boils. So to save gas, keep the flame just high enough to boil the water.

Modeling Your FACE



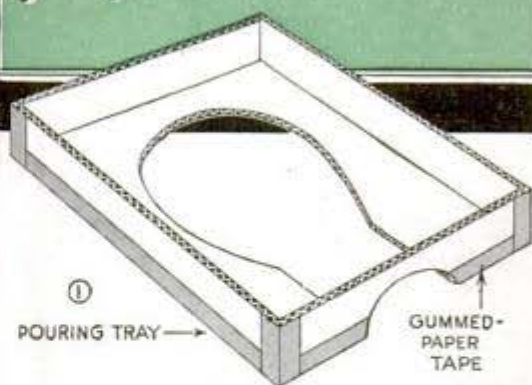
- ② See that hair is tucked in around edge of bathing cap and then cover eyes and eyebrows with small pieces of cigarette paper coated with vaseline



- ③ Insert breathing tubes of paper or rubber in nostrils, packing cotton around the ends, and fasten pouring tray to cap with tabs of cellulose tape



- ④ After coating neck, face and bathing cap with cold cream to keep the mold from adhering, start pouring the plaster around the eyes, nose and mouth



How the facial features of your friends or members of your family can be preserved indefinitely in a plaster-of-paris cast, which can be tinted or left white and used as a wall plaque

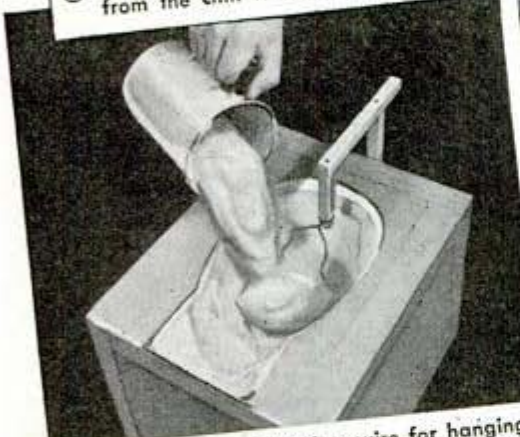
THE first step in making a plaster cast of the face is to form a tray of corrugated cardboard like the one shown in Fig. 1, cutting the opening in it to frame the model's head and neck. This should fit the head rather snugly to retain the liquid plaster, although any error in cutting can be corrected later with fill-in pieces of cardboard held in place with tabs of tape. Now, with a bathing cap of the type shown pulled smoothly over the hair, and the model lying on a suitable table, begin covering the eyebrows and eyelashes with small pieces of cigarette paper coated with vaseline, smoothing them out carefully with the finger tips as shown in Fig. 2. If the model is a man, his face should be closely shaven, and if eyebrows are quite bushy, modeling clay can be applied and molded to the proper shape. A moustache can be treated in the same way. Next, place the tray in position over the head as in Fig. 3 and fasten it to the bathing cap with tabs of tape stuck here and there to the underside of the tray. Finally, breathing tubes of rubber tubing or large-size soda straws are placed in the nostrils and cotton is filled in around the ends to exclude the plaster. The diameter of the tubes should be of a size to prevent distorting the natural shape of the nostrils. Have the model get accustomed to breathing through the tubes with the mouth closed while you coat the face and neck lightly with cold cream.

Everything is now in readiness to pour the mold. Plaster of paris is used to make

in PLASTER



⑤ Allow the plaster mold to set for 15 min., before removing by gently lifting the tray from the chin to free tubes from nostrils



⑥ Provide the mold with a wire for hanging and then fill solid with plaster of paris after first painting the mold with soap



⑦ Let casting set overnight before chipping off mold with wood chisel. Work carefully to avoid cutting into the casting

both the mold and the casting. Prepare the mixture in a pail, adding the plaster a little at a time to cold water while stirring constantly, but slowly, to avoid air bubbles. As the mixture hardens very quickly upon reaching the consistency of thick cream, you will have to work fast in pouring. Cover the area around the nose first, being careful not to dislodge the breathing tubes, and then pour over the eyes. Flow the plaster thinly over all of the face at first to avoid flattening the features, and then gradually build up a thickness of about 1 in., Fig. 4. Just prior to pouring, the model should be instructed to "hold the pose" for 5 or 10 minutes to give the plaster time to set. After a total elapsed time of 15 minutes or so, the tray and mold can be lifted from the face as shown in Fig. 5. Any imperfections or cavities in the mold caused by air bubbles in the plaster should be filled in, after which cardboard sides are added

to the sides of the tray to support the mold in an inverted position for soaping the inside and later filling with plaster. The soaping is done by applying lather from a cake of soap with a soft-hair brush.

Now, with a hanging wire suspended flush in the mold as shown in Fig. 6, the mold is filled with plaster level with the top. Here the plaster can be of a slightly thinner consistency to assure flowing into all crevices of the mold. After allowing the casting to harden overnight, the mold is chipped away as shown in Fig. 7. If you should accidentally cut into the casting with the chisel, the spots, if small, can be made practically unnoticeable by filling with freshly mixed plaster.

Curved Yardstick Does Not Slip While Using It on Blackboard



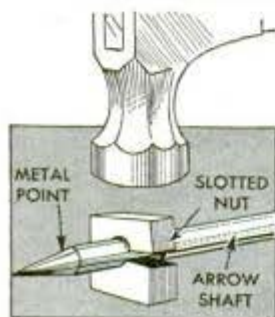
Annoyed by having a yardstick slip when using it as a straightedge to draw geometrical lines on a blackboard, one school instructor warped the stick slightly by holding it in the steam from a teakettle. Forced flat against the board, the bowed stick clamped the ends securely so that slipping was practically eliminated.

Cupboard-Door Hinges Shifted To Increase Their Life

After noticing that the doors on our kitchen cupboards suddenly began to stick when closed, I found that this was caused by the hinges wearing from considerable use. To remedy the trouble without buying new hinges or planing edges of the doors, I simply removed the old hinges and put them on opposite doors. This required only a few minutes as new screw holes were not required, and the shift turned the hinges over so they again supported the doors as good as new ones.

—Ernest M. Grose, Flint, Mich.

Slotted Nut Crimps Metal Point On Wooden Arrow Shaft

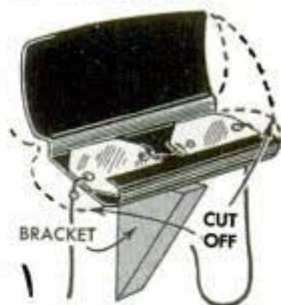


To crimp metal points on wooden arrow shafts, select a steel nut that will fit snugly over the shaft, slot it on one side with a hack saw and then spread the nut so that it will slip over the metal point. By inserting

the arrow shaft as shown and placing the nut on an anvil or other solid surface, the point can be crimped securely onto the shaft by striking the nut a couple of blows with a hammer.

Old Spectacle Case Forms Shelf For Glasses in Workshop

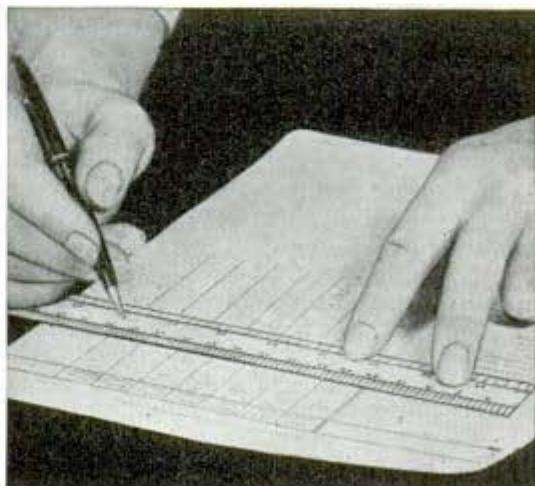
If you have a special pair of glasses to wear while working in the shop, this little shelf provides a safe and convenient place to keep them. It is made by cutting the ends off of an old spectacle case and



attaching the case to a wooden bracket that can be screwed to the wall. When the glasses are not in use, the lid is snapped down to keep out dust and protect the lenses from accidental breakage.

Chart Figures Spaced Uniformly With Typewriter Scale

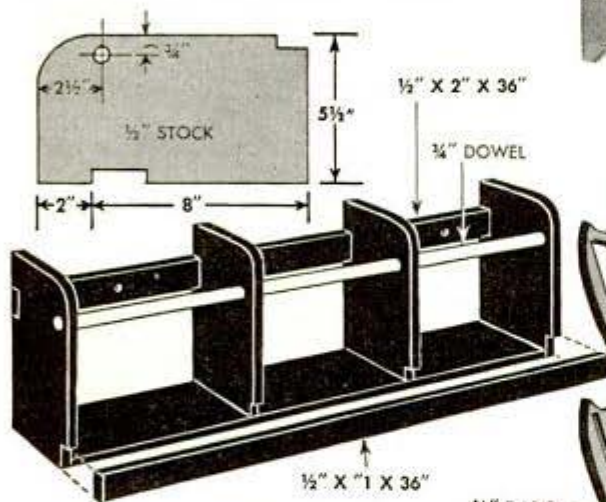
In laying out charts or form letters to be mimeographed, it's handy to have your own scale to measure typewriter line and letter spacings so that a copy of the work can be spaced accurately before typing a



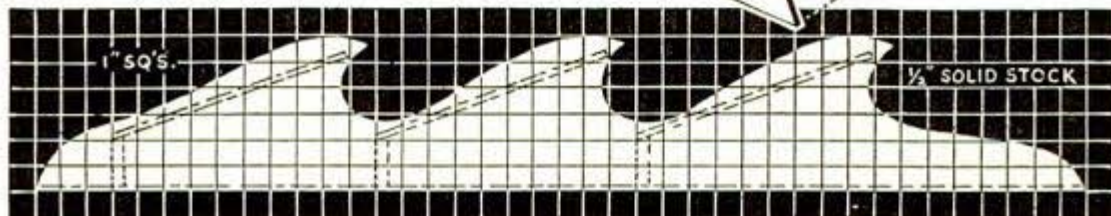
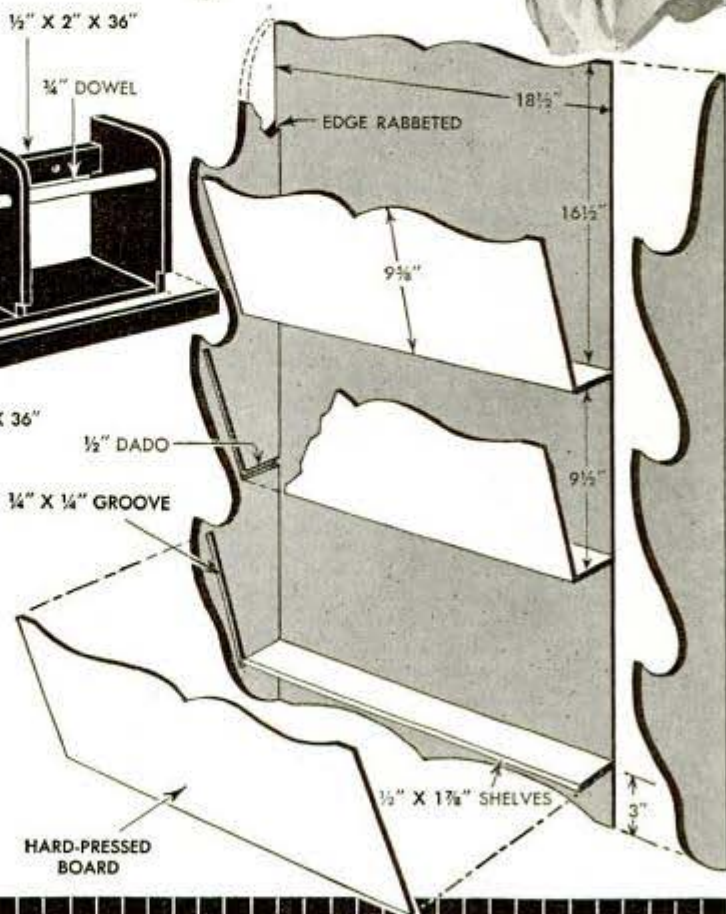
stencil. To make a convenient scale for this purpose on a sheet of white paper, use the apostrophe for letter spacing. And, after turning the sheet, hit the period or underscore key to lay off line spacings. India ink is then used to complete the scale markings after which it is glued onto a celluloid ruler or strip of metal. A coat of colorless nail polish or clear shellac will protect the markings.—Allen Fiske, Chicago.

Designed for MAGAZINES

Sturdily constructed, the attractive rack at the right provides ample room for an assortment of your favorite magazines, which are arranged neatly for quick selection merely by dropping them in the troughs. To get a full-size pattern of the scrolled sides, just mark off a sheet of wrapping paper into 1-in. squares and then transfer the design onto this squared paper freehand. Before cutting the sides, however, these pieces should be grooved for the troughs and rabbeted to take the back. The rack can be either painted or stained. Interesting color combinations are produced by painting the troughs so they contrast sharply with the sides and back



If you like a rack that takes a smaller amount of wall space, the one shown above will solve the problem without the necessity of purchasing expensive materials to make it. To assure a good fit when assembling the various parts, the four uprights, which form the ends and partitions, should be clamped together while boring the dowel holes and notching the edges to take the front retaining strip and rear horizontal member. When the pieces are still unattached, it's also a good idea to sand all surfaces thoroughly, rounding the exposed edges slightly to give a neat, finished appearance



Hollow End of Bamboo Fish Pole Good Place to Store Fishhooks



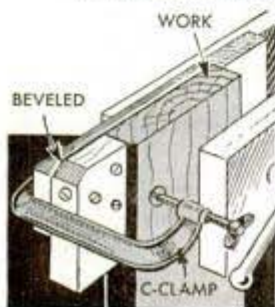
If you use a bamboo fishing pole, the hollow butt end is a safe place in which to carry extra fishhooks. The pole is cut off just above one of the joints, leaving a hollow section to the next joint. Hooks of average sizes can be placed in this hollow portion where they are held by stopping the opening with a cork of suitable size.

Spider Favors for Halloween

These realistic spider favors are good for a round of shudders at any Halloween party. A large black gumdrop forms the body and a baby-size one serves for the head. They are stuck together with a piece of toothpick. The legs are 2½-in. lengths of black pipe cleaners bent to a natural shape and pressed into the sides of the gumdrop body.



Jig Prevents Splitting of Work When Planing End Grain



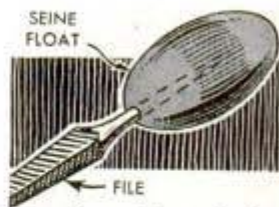
Unless backed with a piece of scrap stock clamped tightly against it, a piece of wood being planed across the end often will split where the plane runs off the edge. To overcome this trouble, I use a

backing jig of the type shown, which consists of a horizontal strip to which is screwed a vertical block. Splitting of this block is prevented by beveling the edge and driving a screw into it near the top. With boards up to 6 in. wide, an ordinary bench vise is sufficient to hold the jig in place, but where wider stock is planed, a large C-clamp will also be needed to hold the jig against the edge of the work.

—W. C. Wilhite, Carlinville, Ill.

Wood Handles for Small Tools From Seine Line Floats

Wooden floats on the upper parts of fish seines to keep them from sinking to the bottom are ideal for use as handles on small tools such as files, chisels, etc.

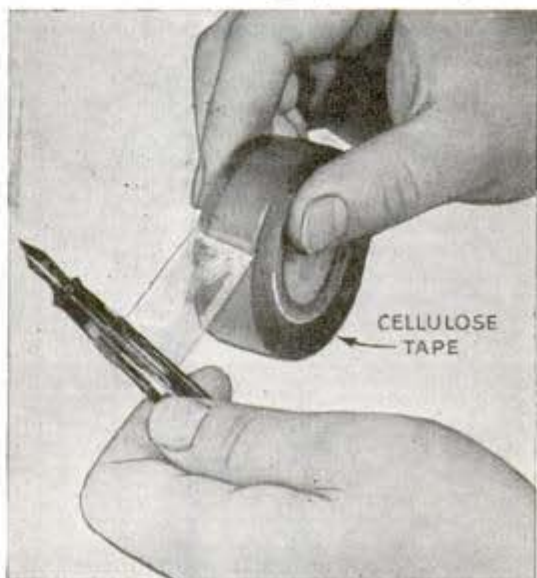


These floats have holes drilled lengthwise through their centers and are easily adapted to use as handles by enlarging the holes to take the tangs of the tools.

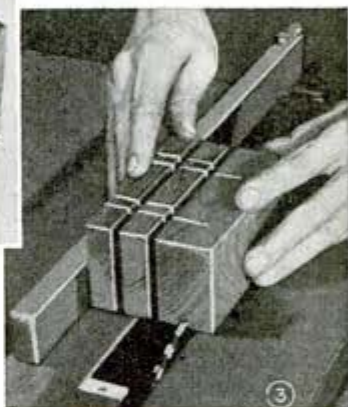
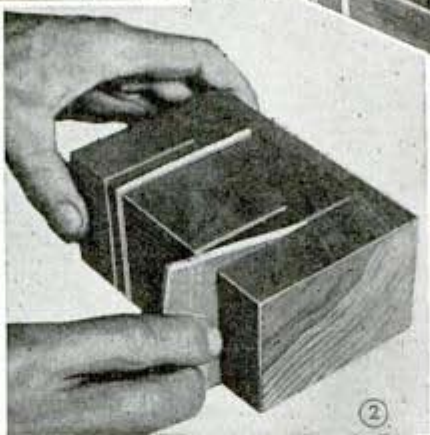
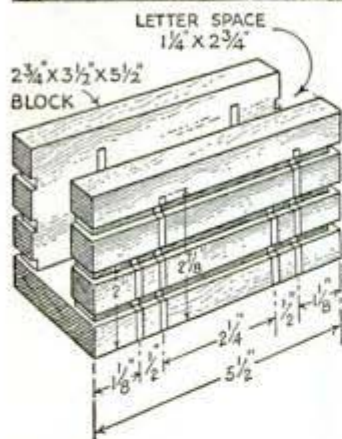
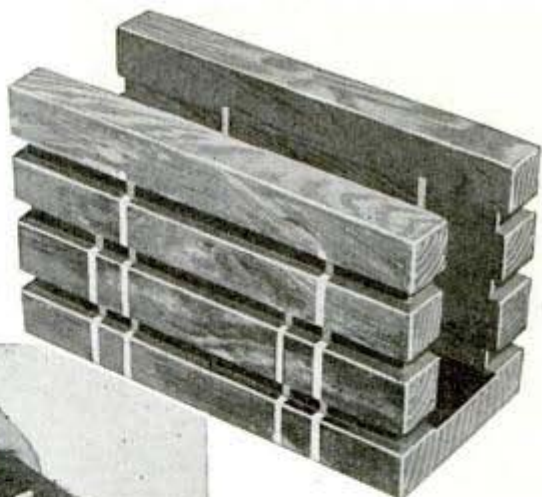
Cellulose Tape Repairs Threads Of Fountain-Pen Barrel

When the threads on a fountain pen are worn to a point where they no longer hold the cap in place securely, I wrap a piece of cellulose tape around the threaded portion of the pen barrel. Usually, this increases the diameter of the threads just enough to make the cap fit tightly again. Also, after the tape has been pressed into the thread grooves by turning the cap on and off several times, it is hardly noticeable.

—Urban J. Doerger, Cincinnati, Ohio.



Inlay Strips in Letter Holder Reinforce Sides



Maple-strip inlays on this attractive walnut letter holder produce a pleasing contrast, and also provide reinforcement for the grooved sides. Construction begins with a block of walnut $2\frac{3}{4}$ by $3\frac{1}{2}$ by $5\frac{1}{2}$ in. All sides and ends are squared carefully, after which saw cuts are made in the block as indicated in Fig. 1. Then, maple strips are glued into these cuts, Fig. 2. After the glue has dried, any edges that project are sanded flush, and the block is grooved along the sides and across the ends as in Fig. 3. Next, the space for letters is bandsawed, and all surfaces sanded. Two coats of shellac, with a thorough rubbing down between coats, complete the holder.

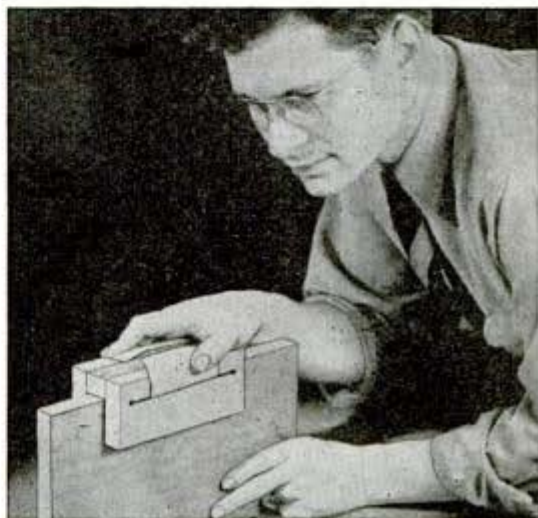
Edges of Work Smoothed Quickly With This Sanding Block

Made from scrap wood, this sanding block for smoothing the edges of flat work is assembled in a few minutes by nailing slotted blocks to a spacer, which is slightly wider than the thickness of the work. To insert a sheet of sandpaper, slip it through the slots in the sides of the blocks, and fold the ends upward so they can be held in place with the hand.

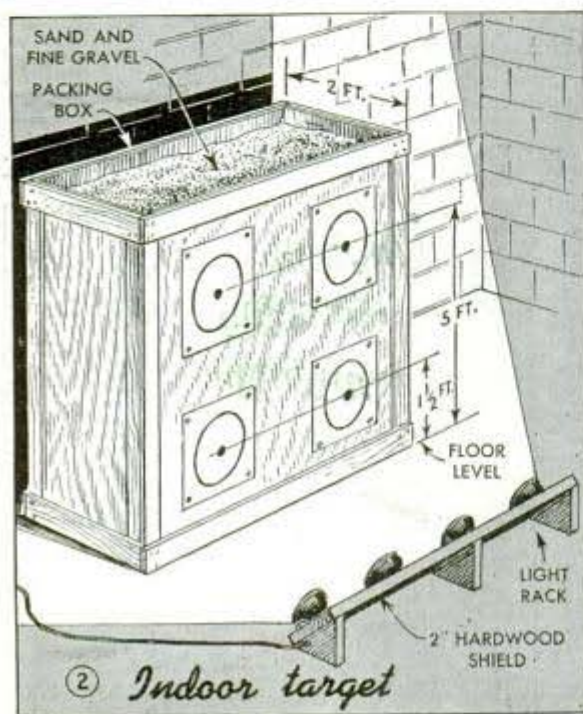
Life of Work Gloves Increased

For garden work, I purchase a pair of men's canvas gloves, apply a heavy coat of paint to the palms and fingers, then let them dry thoroughly. The backs remain soft, but the palms and fingers are waterproofed so the gloves wear longer and offer greater protection.

—Mrs. G. H. Porch, Shamrock, Tex.



How to Use a



By Raymond J. Stan

Public Relations Division,
National Rifle Association

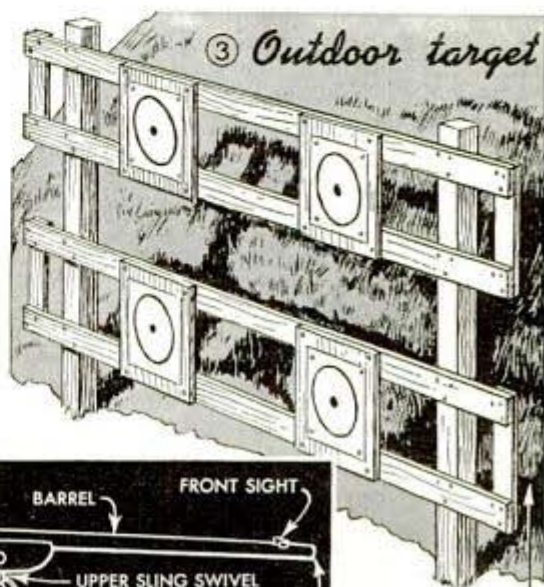
ONLY two percent of the men entering the armed services have any knowledge of how to handle a rifle properly. However, more than ninety percent will be issued a rifle of some sort. Military and government leaders, therefore, are urging men within draft age to prepare for service by learning something about the rifle and its use. When possible, prospective selectees should attend an approved National Rifle Association Small Arms Firing School, but, if that is impracticable, self-indoctrination in shooting terms and in the fundamental principles of marksmanship is next best. The purpose of this article is to provide such information with the help of illustrations from an official National Rifle Association training manual. If possible, get a .22-caliber, bolt-action rifle of the kind shown in the illustrations. These are used by the

TARGET RIFLE



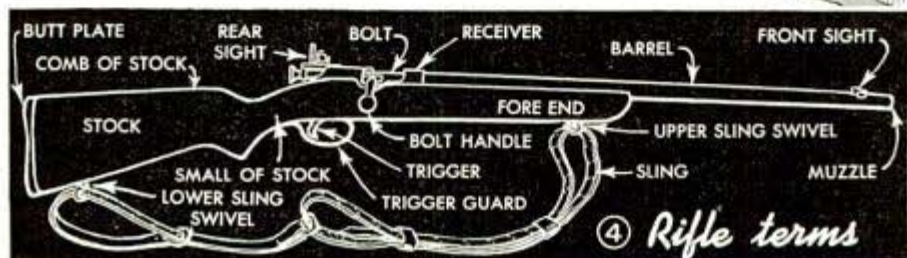
armed services for basic training and are more nearly the military type. If it does not have a sling, put on one. The best type of sights are the post front sight and the rear peep (or aperture) sight. An aperture front or a bead may be used but avoid open rear sights unless nothing else is available. Shoot at paper targets; that's what they will teach you with in the army.

You may practice either indoors or outdoors, but in either case the range should be about 65 ft. long. The distance from the firing point to the target should be 50 ft. You will need a space of 7 or 8 ft. behind the firing point to enable you to stretch out comfortably in the prone position. If you



③ Outdoor target

HILL AT
LEAST 20
FEET HIGH



④ Rifle terms



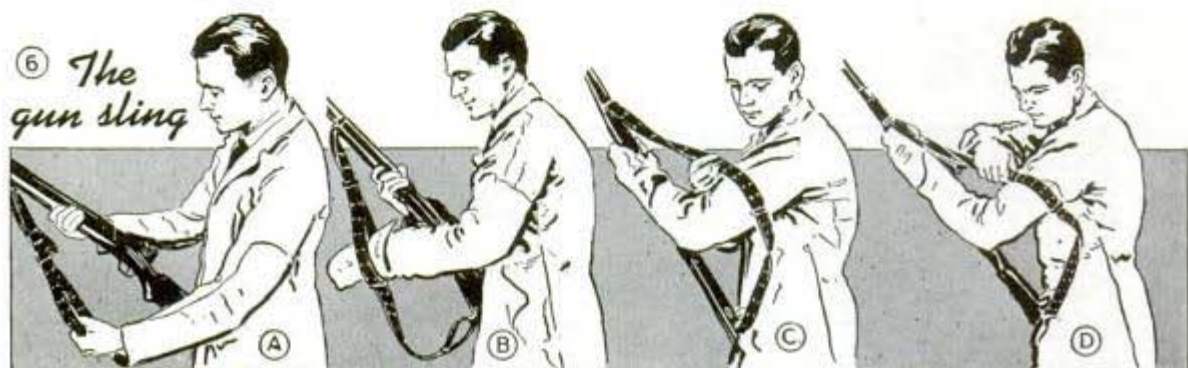
⑤ *Sitting position*

have an artificial backstop this will require a space of 4 or 5 ft. behind the target. Fig. 2 shows a safe backstop for an indoor range. It consists

of a large packing box, 2 ft. wide, filled with sand and fine gravel. Make certain that windows and doorways at the target end of the room are fully protected with $\frac{1}{8}$ -in. soft steel plate or 3-in. hardwood or yellow-pine planking. Doorways between the firing point and the target must be closed and locked from the inside when you are shooting. If you are shooting outdoors, find a hillside with not less than a 45-degree slope and at least 20 ft. high. Then set up a target of the kind shown in Fig. 3, or you can use the indoor target and bullet trap shown in Fig. 2. Clear away all rocks immediately behind the target, and if underbrush is heavy clear a space of 20 to 30 ft. on either side of and a good distance back of the target, as you don't want a child or a dog bouncing out of the brush just as

you pull the trigger. Never fasten a target to a tree; ricochet is dangerous. A gravel pit is a good place to shoot a .22 rifle, but do not shoot in a rock quarry unless you use a big mound of earth free of rocks as a bullet catcher. Wherever you shoot know exactly where your bullets stop and that they are completely stopped. In handling a rifle, remember the following safety rules: 1—Treat any gun as if it were loaded until you are personally certain that it is not loaded. 2—Always keep the bolt (or action) open except when ready to fire. 3—Keep the muzzle pointed in a safe direction. 4—Know your gun and ammunition. 5—Be sure of your backstop. 6—Be sure of your target.

The principal parts of a rifle are shown in Fig. 4. Learn the terms and the function of each part. As guns are fundamentally the same, this knowledge will help you understand the functioning of any gun you may be issued in the service. No matter what your combination of front and rear sights is, the principles of aiming are the same. Fig. 7 shows three types of sights and the correct method of aligning them with the bull's-eye. Look through the rear peep or notch sight and find the front post or aperture sight. Line up both exactly as shown and direct that line of aim upon the bull's-eye. Since hits cannot be ex-

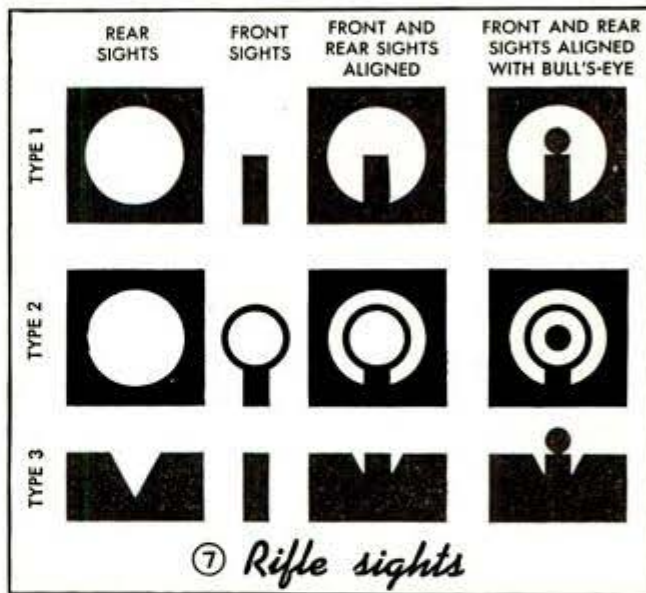


⑥ *The gun sling*



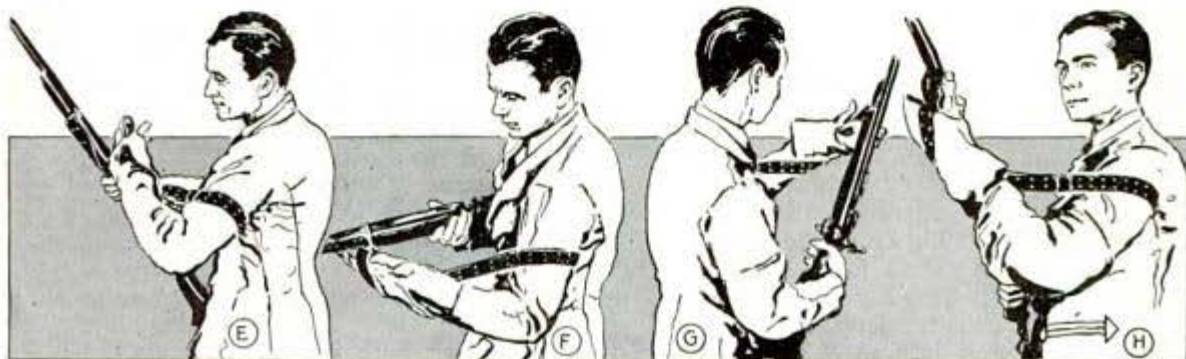
pected unless the aim is correct, this method is highly important. Stick to the bull's-eye target for basic work. Do not be disappointed if your shots are not in the center of the bull's-eye, even with perfect aim, as it may be necessary to make some adjustments in the sights as will be explained in this article. Never try to correct poor hits by aiming higher, lower or to either side but stick to the correct sight method as illustrated, making the proper adjustments on the sights if necessary.

Good shooting positions are a matter of mechanics. The idea is to hold the rifle barrel pointed toward the target during the time necessary to fire a cartridge and to allow the bullet to travel the length of the barrel and emerge from the muzzle. In a cannon this is done by mounting the barrel and action in a recoil mechanism on a rigid gun carriage. In rifle shooting you become the recoil mechanism and gun carriage. You have flexible muscles to absorb the recoil, and long, straight bones of your body to provide the rigid support. Basic principles underlying all good shooting positions are first to let the bones carry the weight as



much as possible without muscular effort, and second, to allow the flexible muscles to absorb the recoil.

In order to get almost complete bone support to carry the weight without muscular effort, a gun sling is used in most positions to tie together the rigid bones with a rigid brace. Fig. 6 shows eight steps to get into the sling correctly. After loosening the sling from the parade position (sling tight





⑧ *Low kneeling position*

against stock) you draw the loop down to about the trigger guard and refasten the hook a few holes from the end of the strap. Then you push the loops (keepers) up toward the upper swivel to form a big loop in the sling to take your arm, which must be put through the loop properly or the sling will twist and cut your wrist instead of providing the desired comfortable support. To do this, you rest the butt of the rifle on your right hip or thigh, holding it with the right hand so that the sling is toward your left; then hook the thumb of your left hand into the loop, turning your wrist toward the left so you can look

through the loop. Push the left hand and arm through the loop past the elbow until the loop comes over—not on—the biceps muscle of the upper arm. You can locate the exact position by feeling the arm above the biceps, which is the proper place for the loop to bear. The loop is tightened by sliding the keepers against the arm. After this you swing the left hand out toward the left, then back over the top of the sling to grasp the fore end of the rifle. The sling should be flat and comfortable across the back of the wrist, giving a snug support.

There are four standard shooting positions—prone, which is the most accurate and which offers maximum concealment and protection from enemy fire; sitting, which is slightly less steady but higher, offering a better view of a target not clearly visible from a prone position; kneeling, even less steady but higher and speedy to assume; and standing, which is the most difficult of all from the standpoint of accuracy but which affords quick fire and best visibility. Always assume the steadiest position possible within the limits of available time and type of terrain.

The prone position is shown in Fig. 1. The long bones of both arms are utilized to support the upper portion of the body in a comfortable position. The left arm forms a sturdy V with the gun sling completing a rigid truss support similar to those used to support heavy bridges. From the front view you can see that the left arm is vertical beneath the rifle with the right arm forming approximately a 45-degree buttress support for the upper body. No muscular effort is required in this position. The sling, tying the bones together into a rigid support, does the work. Make sure the sling is tight enough to give that support. Note that the body is at an angle of about 30 degrees from the line of fire, that the legs are spread wide apart for stability and comfort and that the entire body is relaxed.

In the sitting position, Fig. 5, note the similarity in the position of the shoulders, head and arms, to the prone position. The same fundamentals apply, the only difference being that the elbows are supported by the knees rather than by the ground. Both the left elbow and knee must be directly beneath the rifle to get solid bone support. Plant both heels solidly on the

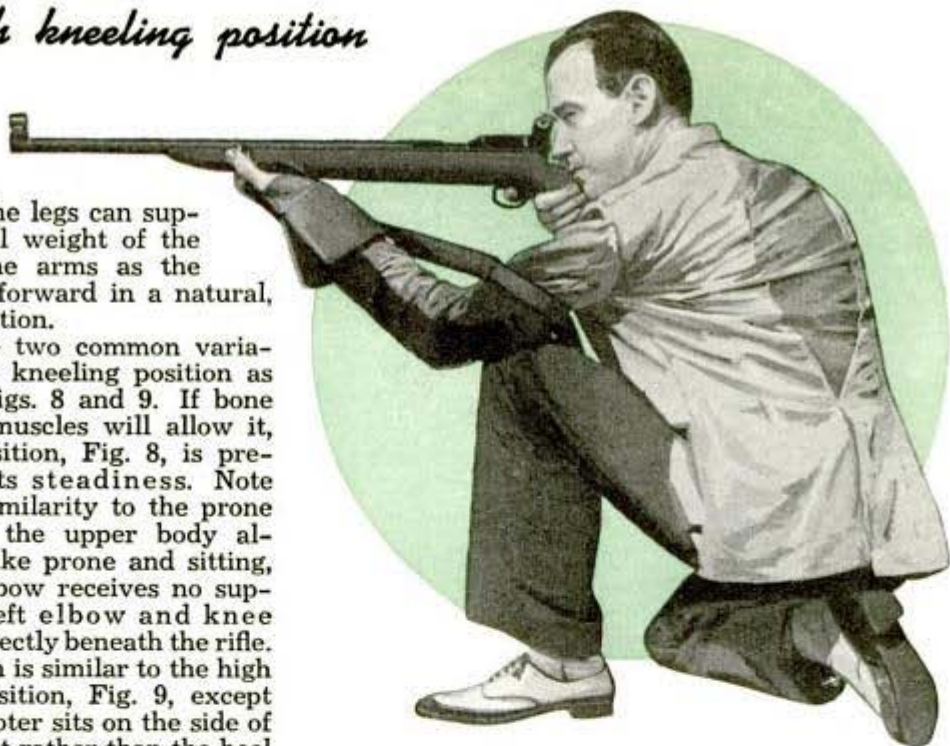
⑨ *High kneeling position*

ground so the legs can support the full weight of the rifle and the arms as the body leans forward in a natural, relaxed position.

There are two common variations of the kneeling position as shown in Figs. 8 and 9. If bone joints and muscles will allow it, the low position, Fig. 8, is preferred for its steadiness. Note again the similarity to the prone position in the upper body although, unlike prone and sitting, the right elbow receives no support. The left elbow and knee again are directly beneath the rifle. This position is similar to the high kneeling position, Fig. 9, except that the shooter sits on the side of the right foot rather than the heel and that the left foot is somewhat extended. In the low position most of the weight of the body is supported by the right foot, while in the high position it is distributed more equally between the right foot and left leg.

The sling is not in use in the illustration of the standing position, Fig. 10, and in this position neither arm receives any support. Thus more muscular support is required. But, by complete relaxation of the body, a comfortable stance, and with the left arm and elbow still vertical beneath the rifle, and the right elbow at shoulder height, a fairly steady position can be reached. Do not be worried if the muzzle sways considerably. Continued training will reduce that sway to a point where all shots will be well within the scoring rings. Although the sling can be used in this position, either as used in the other positions or as what is called the "hasty" sling, stick to this fundamental method at first. Remember, in any position, remain relaxed and let the long bones and sling do the work of holding the rifle as much as possible. The gun should lie across the heel of the left hand and the fingers should not grip the stock.

Assuming you have learned something of positions and know what to look for through your sights, you are almost ready to start shooting. But there are still a few seemingly minor but actually all-important points. Breathing is the first. While tightly tied up in the sling even a normal breath will cause a rising and falling of the chest which is transmitted to the gun. To



control this seesawing of the muzzle you must control breathing during the moments of aiming and squeezing the trigger and while the bullet is passing through the barrel. Simply take a breath or two just a little deeper than usual while settling your cheek firmly against the comb of the stock in preparation for aiming. Let out a little of this air and hold the rest by closing your throat. Stay relaxed and hold this breath easily until the shot is well on its way to the target. This complete relaxation, plus a comfortable position, also will eliminate any tendency of the pulse beat to be transmitted to the gun.

The U. S. Army training manual says, "the difference between good shots and poor shots is measured in their ability to squeeze the trigger properly." Do everything else correctly, you still can spoil the whole thing by the way you release the trigger. There is only one correct way to "squeeze" the trigger—to increase the pressure so smoothly and steadily that you do not know exactly when the rifle will fire. With the right hand gripping the small of the stock firmly (but not tightly) exert a steady, controlled pressure on the trigger, moving no hand muscles except those necessary to crook the forefinger. The mechanical reason for the squeeze is this: With the rifle held steadily in any position, the sudden movement necessary to "jerk" the trigger will move the sights out of line and cause a miss. Smooth, steady pressure enables the shot to be fired and the bullet to clear the muzzle without any motion



pointing as the bullet left the muzzle.

In your shooting you may have found your shots to be grouping consistently at a point not in the center of the bull's-eye. If the sight picture, position, breathing, pulse and the other important factors were right, it is probable that an adjustment of the sights of your rifle is necessary. Note, however, that shots above, below and to either side of the bull's-eye indicate bad shooting habits, not bad sight adjustment. Sight adjustments can be made accurately only from a group of shots in relatively the same position on the target.

To make a simple sight correction, determine the approximate center of a group of at least three shots which are in relatively the same position. If, for instance, the center of the shot group is low and to the right of the bull's-eye it is obvious that the sights will have to be adjusted so the shots will strike higher and to the left. Move the rear

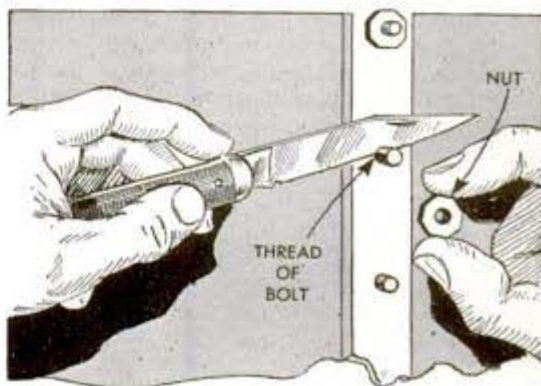
sight in the direction you want to move your hits. Thus, in the example above, you adjust the rear sight to move it toward the left and raise it until your shots are striking in the center of the bull's-eye.

Practicing these fundamental principles underlying every type of shooting—military, competitive or hunting—following the illustrations carefully, may not make you an expert rifleman, but will result in improved marksmanship, which will make your shooting more enjoyable and it certainly will help you later in the service.

that could cause a poor shot. Apply that pressure and continue to apply it while the sight picture is perfect. As the gun moves slightly and you see that the sight picture is not quite right, hold the pressure you have but do not apply any more. Then as the gun moves back apply that same smooth pressure. Continue to hold and squeeze, hold and squeeze, until the gun is fired. And follow through—after the gun fires continue to hold the trigger back, concentrating on watching through the sights to see exactly where the rifle was

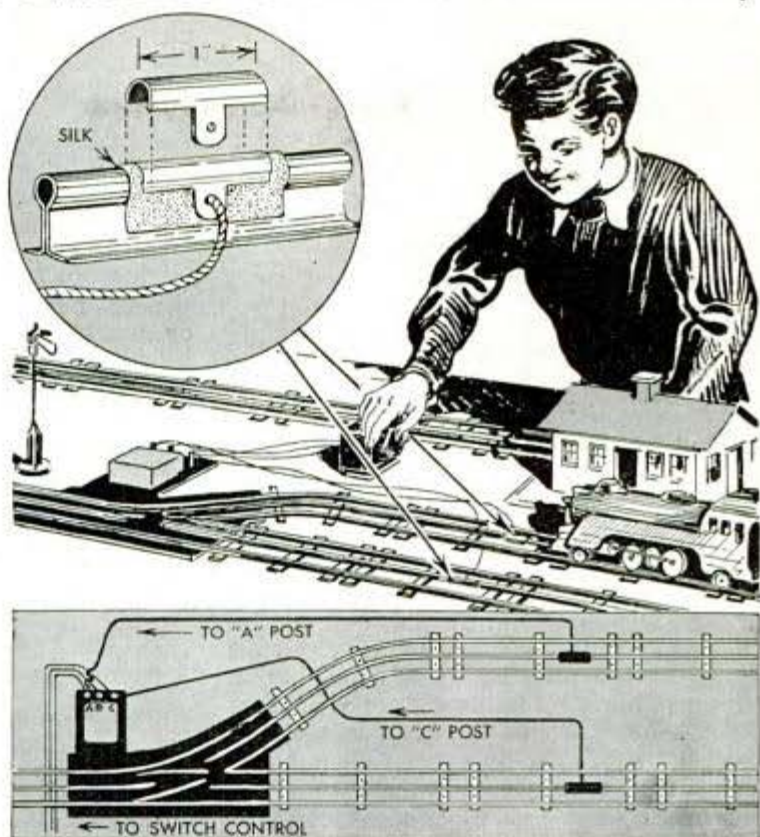
Knife Aids in Holding Small Bolt While Starting the Nut

Whenever you are doing some repair or assembly work singlehanded, and it is necessary to start a nut on a small bolt, which cannot be reached by your fingers to keep it from pushing out of the work as the nut is started, try the following: Pull the head of the bolt up against the back of the work snugly and then hold the blade of your pocketknife against the work and the threads of the bolt as indicated. In this way, you can prevent the bolt from pushing out while turning on the nut. When the latter reaches the knife blade remove the blade and place it in front of the nut while you turn up the latter tightly.



Electric Train Switches Closed Automatically

Whether manually or electrically operated, switches for toy electric trains require an operator's attention to be sure that they are always in correct position to receive an approaching train. However, in the case of electrically operated switches, this constant vigilance can be avoided by fitting the track with metal clips and connecting them to the switch-operating mechanism as shown. When an engine passes over one of the clips, momentary contact is made to close the switch automatically. The clips are thin brass, tin or copper strips, bent to fit over the center rail from which they are insulated by pieces of silk. The clips should be located a train's length from the switch so proper contact is made in plenty of time.



Mousetrap Supplies "Firepower" for Simple Toy Cannon

In assembling this toy cannon, which uses shells cut from wooden dowels, you won't have to worry about fitting a trigger and spring mechanism, as firepower is provided by an ordinary mousetrap. After screwing the trap to a solid wood base, a

suitable barrel is turned, bored and mounted so that the trap jaw strikes the center of it when sprung. Note that the barrel support is grooved to the same contour as the barrel and that it also is fitted with a metal or leather strap to aid in clamping the barrel in place after glue has been applied. Where sides of the barrel are thick enough, small tacks can be driven through the clamp to help anchor it securely. Loading is accomplished quickly by setting the trap and inserting a shell, leaving the end of it project slightly as shown. Then the trigger is pressed to spring the trap and "fire" the cannon.

—Thomas M. Stradley, Jeffersonville, Ind.



Increasing Berry-Bush Yield

As fruiting canes of raspberry, blackberry and dewberry bushes die after they produce a crop, it's best to remove them soon after the berries are picked. Besides providing more room for young canes in the coming season, this also permits additional light to reach the bushes. And, in case disease or insects are present, removing the dead canes greatly reduces the possibility of new ones being infected.

Large Magnet Holds Stamp Pad On Shipping Clerk's Desk



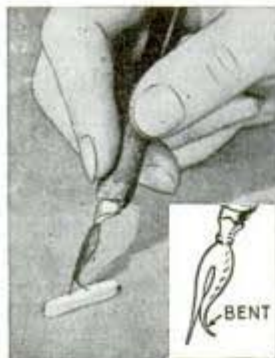
When using a rubber stamp on packages in the shipping room, the ink pad can be held securely in place on the desk, and yet be removed easily, by using a magnet as shown. This is set into a couple of notches cut into the edge of the desk so that the ends are flush with the desk surface. When the pad is placed on top of the magnet in this position it will not be moved about by pressing the stamp against it for reinking.

Linoleum Blocks Carved Easily When Heated Over Register

Before starting to cut or carve a linoleum block for printing, after the design has been transferred to the surface of the block, hold it over a register or small flame several minutes, being careful not to let the flame touch the linoleum. You will find that the material will be easier to cut when slightly warm as this has a softening effect on it.

—Reginald W. Swinyard, Oswego, N. Y.

Tiny Model Parts Handled Easily With Bent-Pen Tool

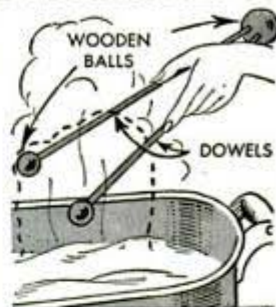


Bent as indicated, an old pen-point serves as an excellent tool for picking up and releasing tiny wooden parts in assembling small airplane and ship models. The straight point is used to spear and hold the pieces, while releasing is

accomplished quickly by tipping the holder back to rock on the bent point. Note that the amount of bend in the point can be changed to suit various sizes of model parts.

Safe Laundry Tongs Assembled By Gluing Dowels in Balls

A handy pair of tongs with which to lift hot clothes from a wash boiler or tub and feed them into a wringer can be assembled in a few minutes by drilling three wooden balls to take short dowels as shown.



Note that the two holes for dowels in one of the balls are drilled at a slight angle to give the tongs a spring action. It's a good idea to use resin-type waterproof glue.

Wrist Watch Is Carried Safely In Spectacle Case



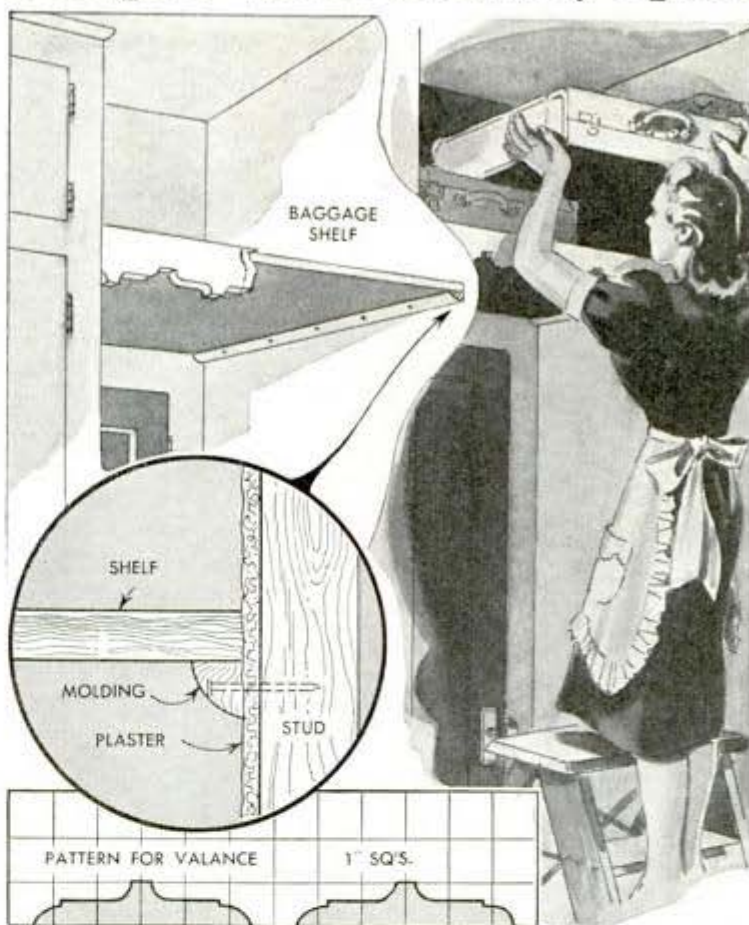
To protect your wrist watch from being damaged when stored in a drawer or traveling bag, place it in a spectacle case with the strap ends extending over the edges. Closing the cover holds the watch and protects it from heavier articles, which might crush the crystal and scratch the face.

WRITE FOR POPULAR MECHANICS!

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

Baggage Shelf Occupies Waste Hallway Space

Space above doors in small homes or apartments where the side of a closet or wardrobe forms a short hallway, provides an ideal location for an extra shelf to store luggage cases and other miscellaneous boxes. To support such a shelf, all you need to do is nail strips of quarter-round molding to the wall and wardrobe side as indicated. When driving nails into plastered walls to anchor the strips securely, have the nails enter the studs back of the plaster wherever possible. These can usually be located by tapping the wall lightly with a hammer and noting the difference in sound. To add a finishing touch, a scrolled valance board, cut from either hard-pressed board or plywood, is tacked to the front edge. A full-size pattern for it is drawn by marking off a sheet of wrapping paper in 1-in. squares and sketching the design on it.



Hot Salt Substituted for Liquid in Leaky Hot-Water Bottle



If you find that a hot-water bottle leaks and materials are not readily available to patch it, just fill the bottle with hot table salt, which will retain heat even longer than water. The salt can be heated in a frying pan and poured into the bottle quickly with the aid of a small funnel.

Funnel Vented With Glass Tube To Speed Flow of Liquids

To vent a funnel and prevent swirling of liquids so that they would flow with greater speed, one laboratory worker bent a glass tube so it could be hooked over the rim of the funnel as shown.

This permits air to escape from the bottle and also provides a baffle that stops the swirling motion of liquids.



Don't

—overload the brush by dipping it completely up to the ferrule. Surplus paint will accumulate at the heel and soon work up over the ferrule and handle. Dip the brush only about one-third the length of the bristles



—jab or force a wide brush into corners, narrow openings or other places hard to get at. Edge bristles will start to curl and spoil the shape of the brush. Always use a small brush or an old one to reach such places

—paint narrow surfaces by holding the brush edgewise. This causes the bristles to "finger" and the brush to wear off at the corners, resulting in a streaky job

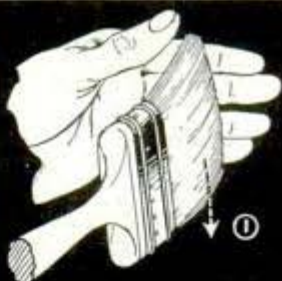


—rub the brush hard against the work. Grip it lightly and ply it with a steady, even stroke, painting with about one-half the length of the bristles. Using the whole brush only tends to wear down the bristles at the sides

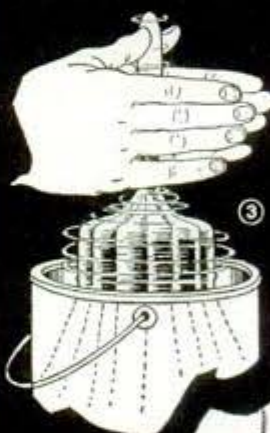
—straddle pipes and similar round work when painting with a wide brush, as this wears the bristles down at the center. Apply the paint by stroking crosswise and then lightly lengthwise



—place a brush in water to keep it soft and pliable. Water causes the bristles to swell and finger, and to become flabby, as the pigment seals in the moisture and keeps the brush from drying out satisfactorily. Also, never stand a brush on end



The ABC of



Before using a new brush



PAINTBRUSH CARE

PAINTBRUSHES are used occasionally in most homes, and because of this wide distribution in inexperienced hands, brushes often are so misused and incorrectly cared for that they last for only one paint job. A good brush that is used and cared for properly will last for several years. A few of the most common abuses of brushes are illustrated on the opposite page.

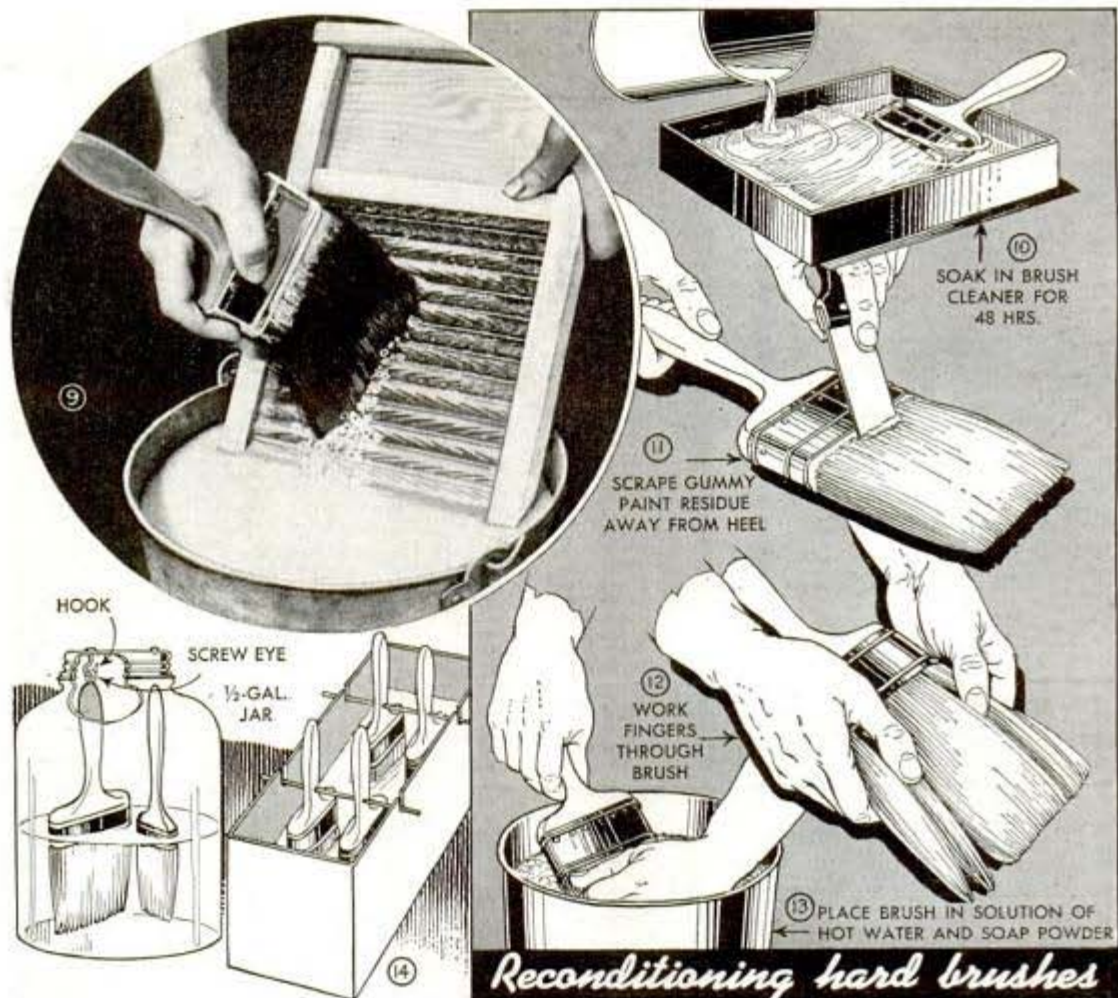
When a new brush is purchased it should be broken in before using it. Figs. 1 to 4 inclusive show how this is done. First, hold the fingers of one hand extended as in Fig. 1 and flip the bristles sharply across them a few times. This causes any loose hairs to work forward and extend so they can be pulled out. As this operation is likely to tangle the bristles, they should be combed. Next, the brush is suspended in linseed oil for at least 12 hours. If this is not done, the paint pigment will adhere tightly to the dry bristles and make the brush hard to clean. Fig. 14 shows two handy containers in which brushes can be suspended in oil. One is a large glass jar having hooks in the lid to engage screw eyes in the ends of the brush handles. The other container is an open one in which the brushes are suspended from pieces of wire run through their handles. When ready to use the brush, remove all the oil from the bristles. One way of doing this is to use a wood strip as in Fig. 2. Start at the ferrule of the brush



and press the strip heavily across the bristles while moving it toward the tip of the brush. Centrifugal force will remove most of the remaining oil if you twirl the brush between the palms of your hands as in Fig. 3. It may now be necessary to again comb out the bristles as in Fig. 4.

Although often done, it is not good practice to press a brush across the edge of a paint can or pot to remove excess paint each time the brush is dipped. This bends the bristles at the corners of the brush and also results in an accumulation of congealed paint under the can rim that often drops back into the paint and has to be removed. A better way is to wipe the brush across a wire arranged as shown in Fig. 8.

Clean brushes are essential to good painting. A clean brush is more pliable,

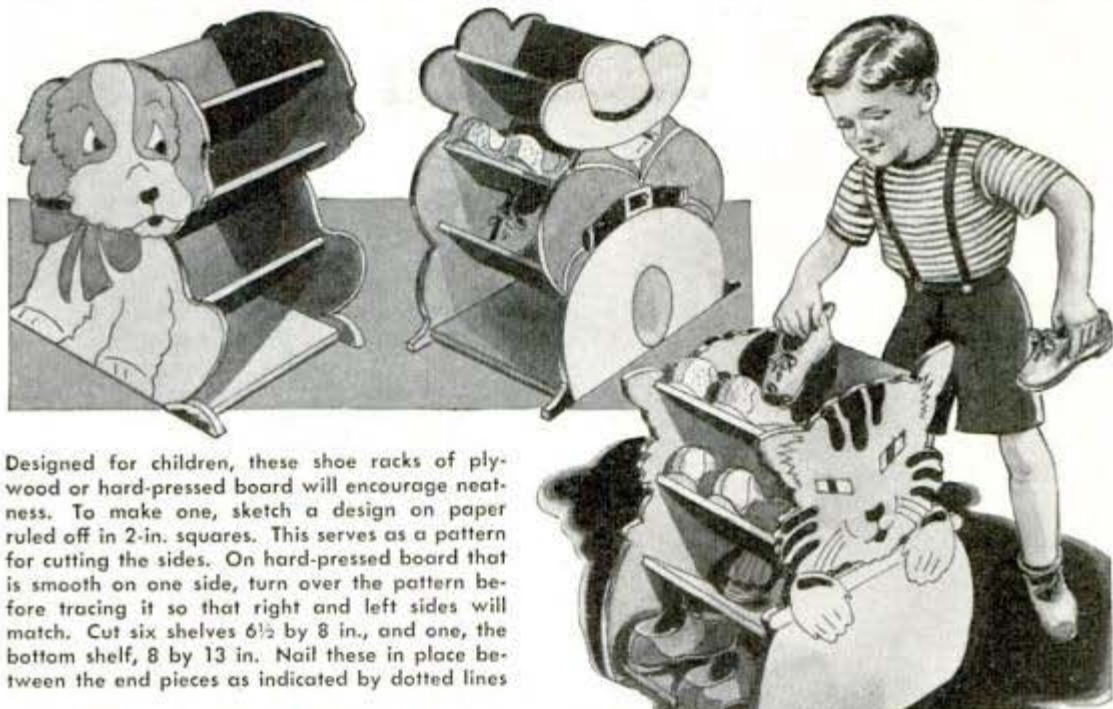


will work more easily and efficiently and will last much longer than one that is not kept clean. Therefore, always clean a brush in a suitable solvent before laying it away. The solvent recommended for the kind of paint in which the brush was used is the best for cleaning it. Use plenty of solvent and see that it is worked well up into the bristles, Fig. 7. A table fork or comb is handy for loosening gummy paint residue as in Fig. 5. If paint accumulates in the heel close to the binding, the bristles eventually will flare and ruin the shape of the brush. The back side of a knife can be used to good advantage for scraping away paint at the heel of a brush as in Fig. 6. When a brush is to be stored indefinitely, it should be cleaned thoroughly, first by washing it in liquid cleaner and then in soap and water. As soon as it is dry, the bristles are immersed in linseed oil and wrapped in paper. It's a good idea to remove the paper occasionally and apply a fresh coating of oil.

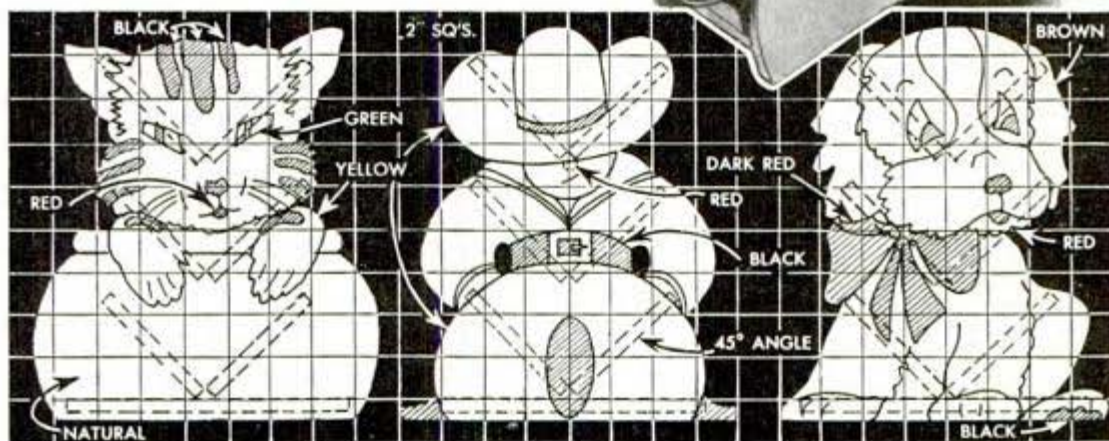
An old brush, which has been discarded because the bristles are full of hardened

paint, often can be reconditioned by removing the dry paint. First, soak it in turpentine or liquid brush cleaner, Fig. 10, until the bristles have softened, working the bristles with the fingers from time to time as indicated in Fig. 12. A scraper like the one in Fig. 11 will be handy for removing the gummy paint residue that may accumulate at the heel. Next, place the brush in a pail containing hot water, 1 gal. and soap powder, 1/4 lb., and work out the cleaner as in Fig. 13. Now comes the actual washing, which is done on a washboard. Sprinkle soap powder on the board, dip the brush in hot water and rub it over the board as you would when washing clothes. See Fig. 9. After the brush has been cleaned, rinse it in clear water to remove all traces of soap, comb out the bristles and wrap the brush in paper to dry, after which it is dipped in linseed oil, rewrapped and put away until needed. In replacing the brush each time in its paper wrapper, be sure that the bristles lie flat and straight; otherwise, the brush may assume a shape difficult to paint with.

Three Novel Shoe Racks Children Will Enjoy



Designed for children, these shoe racks of plywood or hard-pressed board will encourage neatness. To make one, sketch a design on paper ruled off in 2-in. squares. This serves as a pattern for cutting the sides. On hard-pressed board that is smooth on one side, turn over the pattern before tracing it so that right and left sides will match. Cut six shelves $6\frac{1}{2}$ by 8 in., and one, the bottom shelf, 8 by 13 in. Nail these in place between the end pieces as indicated by dotted lines



How to Repair Doorbell Chimes

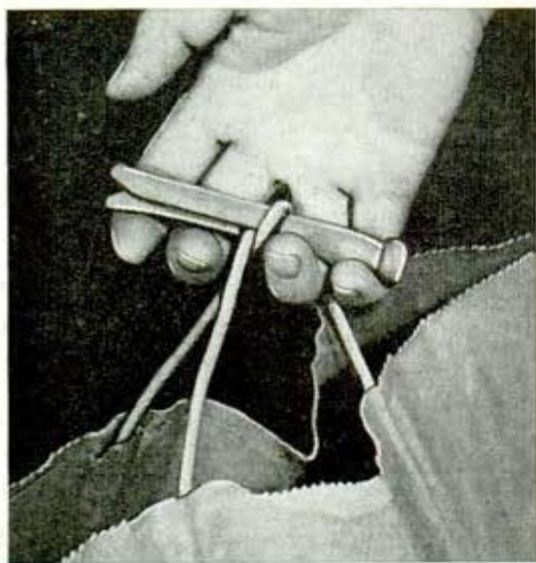
When servicing two-tone doorbell chimes that do not operate properly, I have found that trouble usually can be corrected easily as follows: Where the first tube struck is much louder than the second, this is remedied by covering the tube's striking surface with from one to three layers of friction tape, which softens, but does not flatten the tone. If the chime rattles or gives off a buzzing sound while the button is pressed, wrap the end of the spring next to the coil with several layers of tape, leaving about 2 in. of tape free. Then replace the spring and stick the free tape to the coil while holding the spring firmly against it. In case the tone of a tube is flat or muffled, just remove the plunger and file the striking

end until smooth and slightly rounded. When one or both tubes do not sound at all, this is often due to corrosion on the plunger. To clean the plunger, remove it and polish lightly with a strip of fine abrasive paper. Also, it's a good idea to polish the guide by pulling a thin strip of abrasive paper through it several times, folding the paper lengthwise before inserting it to assure contacting the entire surface.

—Wm. R. Lewis, San Francisco, Calif.

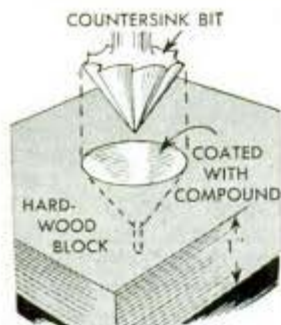
☐ If your dog refuses to eat dehydrated food, cook a small quantity of liver or heart by boiling. Then grind this meat and stir it into the dehydrated food, moistening the mixture with the hot broth in which the liver or heart was cooked. Add the broth at intervals until all the food is softened.

Clothespin Provides Handy Grip For Carrying Shopping Bag



Carrying a shopping bag full of heavy groceries is often hard on fingers, even if the walk home is only a few blocks. However, you'll be surprised at the ease with which such a bag can be carried if an ordinary clothespin is slipped through the cord handles to provide a comfortable grip. When the bag has been emptied, it's a good idea to drop the clothespin into it before putting the bag away, so it can be found easily when the bag is used again.

Countersink Bit Honed Easily



Although considered by most craftsmen to be a difficult job, sharpening countersink bits can be done very easily by the method shown. Select a hardwood block about 3 in. square and 1 in. or more thick. Drill a hole $\frac{1}{16}$ or $\frac{3}{32}$ in. in diameter in the center of the block and countersink it with the tool to be ground to the full depth of the bit head. Then, when it is necessary to sharpen the countersink bit, merely apply a little valve grinding compound or emery flour mixed with oil to the flared interior of the countersunk hole. Chuck the bit in a brace or hand drill, insert the bit head into the abrasive-charged hole and turn the bit counter clockwise, rotating it several times and applying just a little pressure.

—W. C. Wilhite, Carlinville, Ill.

Make Your Own Baby Carriage

Inability to purchase a suitable baby carriage is no reason for the new arrival in your home to do without one, as any dad can make the carriage shown on the opposite page with ordinary tools. Similar in design to the popular English pram, the carriage has hickory springs and an adjustable top, not folding, that can be tilted forward or backward. The hickory chassis requires some steam-bending of the handles and springs, which can be done in a length of pipe or downspout by partially plugging one end and supplying steam from a teakettle in the other. After steaming, the members are clamped in wooden forms on a flat surface until thoroughly dry. Leather straps are riveted to the upper ends of the springs and screwed to the underside of the body. Axles are hardwood, preferably a close-grained wood, and have tenons or spindles turned on the ends. A shallow groove in the top side of each tenon retains paste graphite, which lubricates the wheels.

Framing of the body is of scrollsawed pine, covered with a thin durable material such as veneer, hard-pressed board, or even linoleum with the smooth side out so that it can be painted. A pillow or cushion is supported on slats nailed across the body frame for a false bottom. A neat top is made of thin hickory bows riveted to a yoke or pivot block and covered with silk or other suitable material. Wheels are jigsawed or turned on a lathe, each one consisting of a wood disk, which has a small disk glued on to simulate a hub, and two wood rings to form a rim for the tire. One ring is doweled on permanently and the other is screwed on so that it can be removed when it is necessary to renew a tire. This is made of leather or other suitable material. The wheels are held on the axles with screws and washers as indicated.

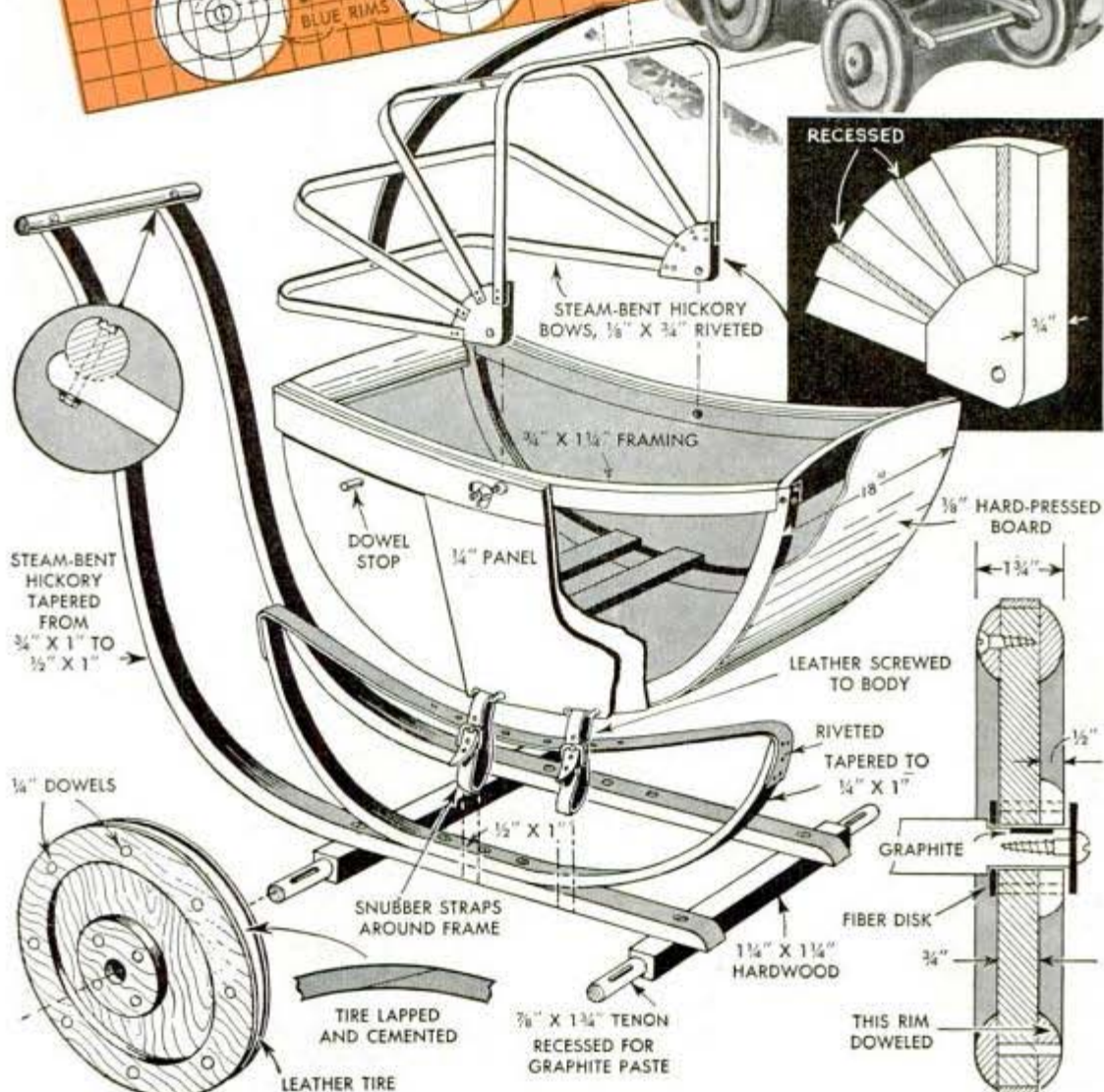
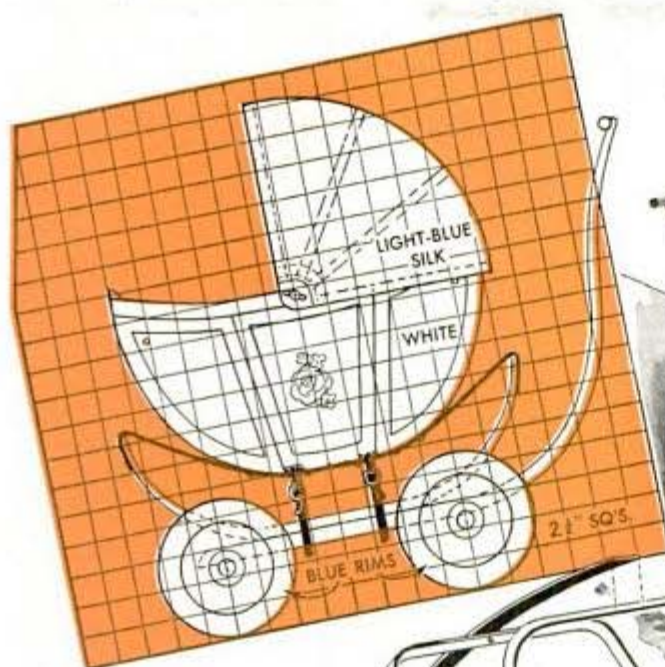
Shoe Polish Is Applied Quickly With Old Powder Puff

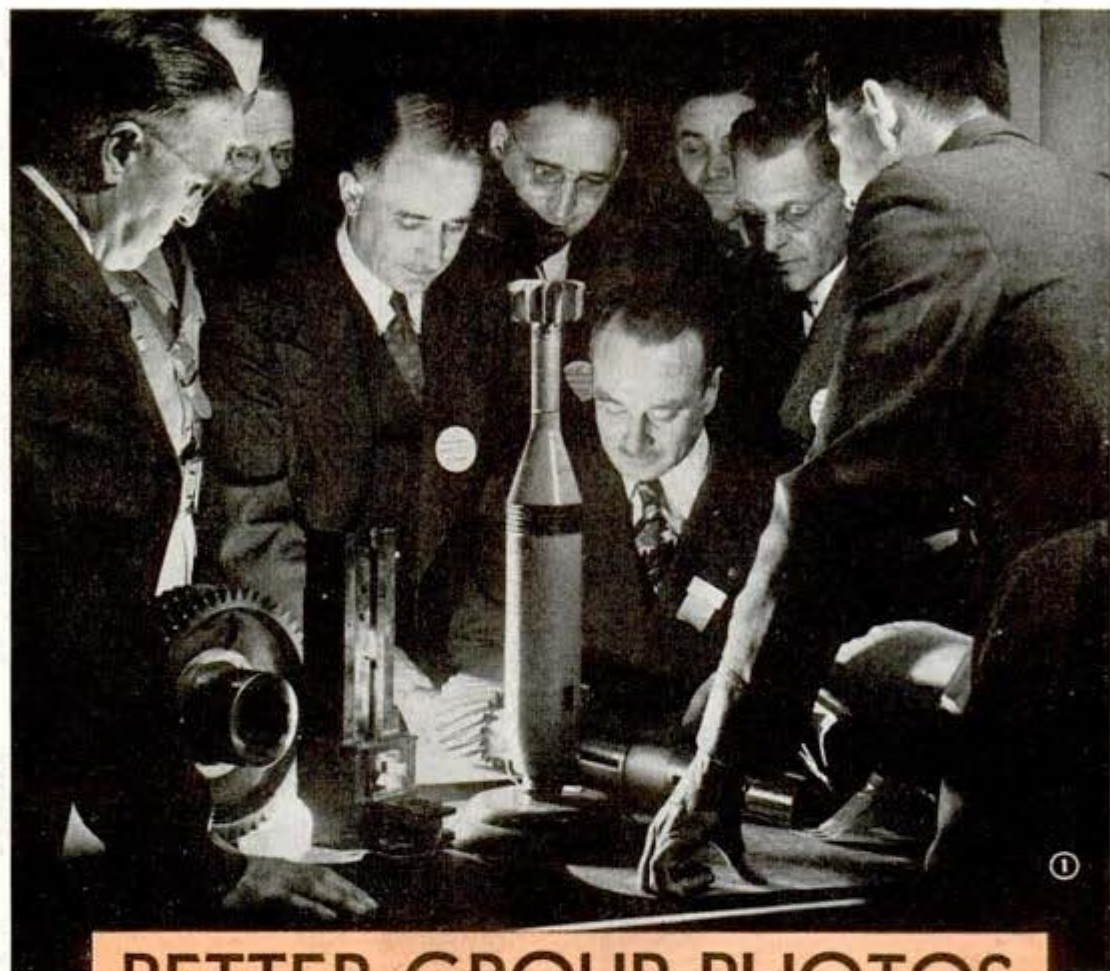


Instead of discarding an old powder puff after it becomes soiled or worn, just wash it thoroughly and keep it in your shoe-polishing kit, as these puffs make excellent applicators for wax-type polish. The small ones are especially handy as they can be stored in polish cans where they are out of the way and won't dry out.

100 W.P.

All-wood BABY CARRIAGE





BETTER GROUP PHOTOS

By FRED G. KORTH

WHEN making photos of groups, the placing of the subjects is of utmost importance, the idea being to avoid undue emphasis on the individuals in order to subordinate them to stress group activity or common interest. Also, the camera angle and the lighting must be considered with care. Sometimes the speed at which you have to work may tend to hamper you considerably, especially if the sitters show little or no interest in photography, and are just hoping to be released soon. Although it is comparatively easy for the photographer to keep the attention of one person by means of conversation while he is busy arranging the camera and the lights for a portrait, this is generally not so easy if there are a number of persons to be included in the photo, as there is usually a good deal of distraction. Rules of composition apply to all pictures. Paintings and color photos may violate them with more

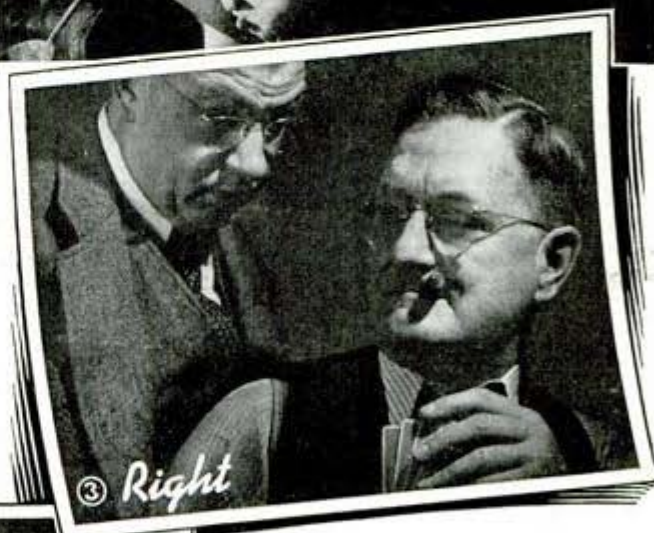
immunity than black-and-white pictures in which everything depends on lines and tone masses. Two persons of equal importance are difficult to group pleasingly but three or more persons enable a photographer to arrange a good composition more easily.

Figs. 1 and 2 are examples of large groups that were hastily yet easily photographed. In both instances a central theme of interest was provided. Fig. 1 shows a number of representatives of army and industry discussing the manufacture of weapons. In the picture, therefore, the emphasis was placed on a few items set on the table, upon which the attention of the group was focused. For the main light in taking this shot, a flashbulb without a reflector was placed in the center of interest, although, of course, the light itself was hidden from camera view. Then, all that was needed to lighten up the shadows and to outline the



heads was a secondary flashbulb held high and to the right of the camera. The fact that several faces were hidden helped to stress the theme.

Almost identical is the treatment of Fig. 2. Here individuals were grouped around a fireplace inside of which the main light was placed without a reflector as the use of the latter would shade part of the fireplace. There was no fire but only ashes. A secondary light held a few feet above the camera



helped to lighten up the shadows. A fireplace is always a good point of interest for a group picture. A smaller group than the one shown can be placed around a fireplace with less crowding.

There are many times when a photographer cannot escape making conventional group pictures, where everybody wants to be looking toward the camera. In such cases there is still opportunity to avoid stiffness to a great degree by introducing something toward which attention of the



can be divided into individual pictures is not a good group picture but merely two or three pictures combined into one. Such a faulty photo is shown in Fig. 4. Here obviously, two men are eating lunch on the job and both are separated so that the picture could be cut in two, providing two photos. Another objection is that the two men are looking in different directions for no good reason, which further tends to disunite them. This faulty photo should be compared with Fig. 3, which shows good composition and has a unity of interest. The outlines of both men prevent the

picture from being cut into separate units. They are inseparably connected by position and mutual interest although both look in different directions.

Fig. 6 shows a good arrangement of two persons, obviously engaged in conversation of mutual interest. In this pose there was a slight attempt to dramatize. For lighting, use was made of a spot light which was located in the right-hand background so that the light could be directed on the girl's hair. Another light in a reflector was placed in front and slightly below the camera position. Notice the diagonal arrangement of the photo, the idea of which can be followed in many cases as it is an easy road



group may be directed. When taking pictures of groups, you should remember to avoid lining the persons up against a wall either indoors or outdoors, as backgrounds tend to complicate further a picture already complicated because of the number of persons involved. Therefore, it is best to exclude bright and sharp backgrounds unless they actually help to emphasize a story. Fig. 5 shows a family seated comfortably at home. Although the four persons are looking in the general direction of the camera, they are not looking directly at it and at the same time, they have a book and other items of interest to avoid a posing attitude. The impression is that the photographer, finding them occupied at home, just asked them to look up to take the picture.

Any picture of two or more persons that



to forceful composition. Another approach to the problem of arranging two persons is shown in Fig. 9. Here, a bride is featured looking at a present, and the groom is only there to support the wedding idea. His face is kept in the background and out of the light as much as possible. This is another trick for groups, as two persons under equal light usually are very difficult to unite into one pleasing picture. However, in Fig. 8 both persons had to be featured with equal emphasis but the picture has unity and action. Flying hair and a playsuit cannot be posed convincingly without ac-



tion. A very low camera angle helped to emphasize the subjects. The two are looking the same direction and walking in step.

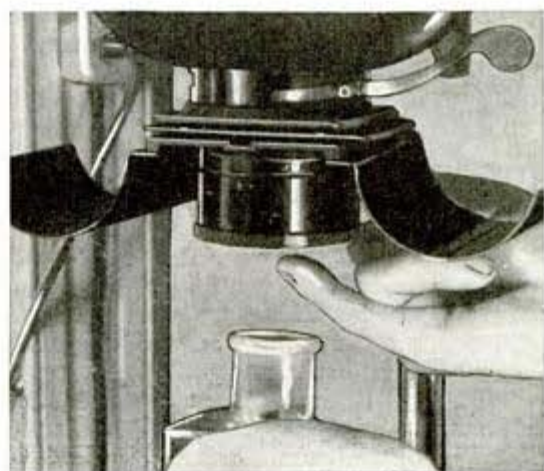
The theme of Fig. 7 is not "two boys" but "building a model plane." Notice how the wing of the airplane forms the most obvious compositional line, in this case also a diagonal. The placing of the heads is of secondary importance. Both boys are looking at the plane, which leads the observer's eyes to it also. However, with only two heads, no ring around the center of interest is possible as was the case in Fig. 1.

Glycerin Drop on Enlarger Lens Gives Soft-Focus Effect

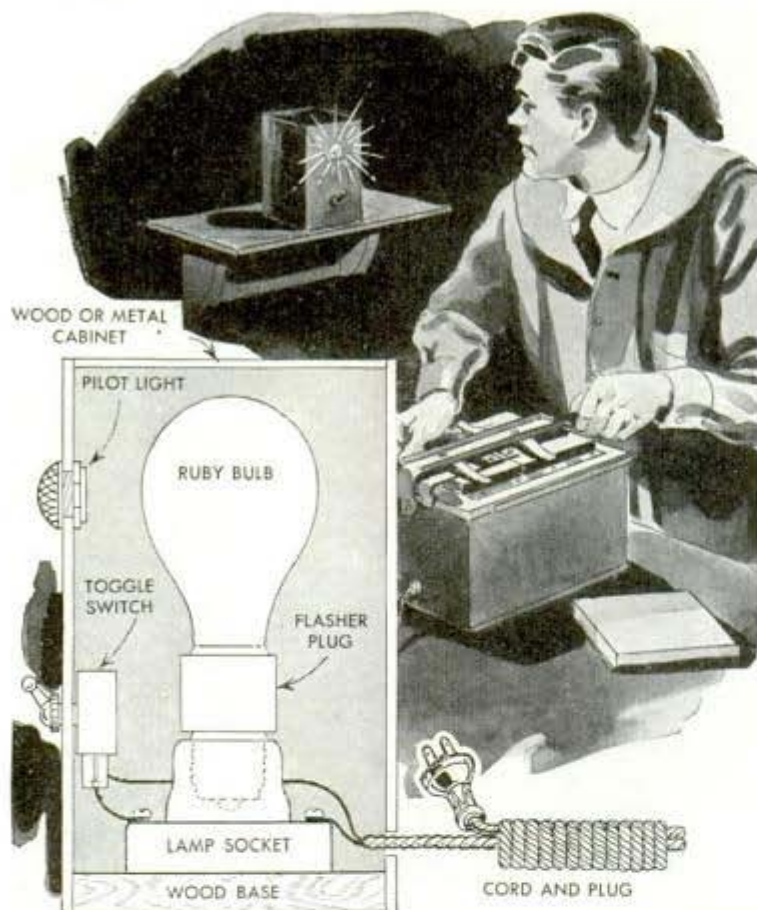
Enlargements can be given a pleasing soft-focus effect by placing a drop of glycerin in the center of the enlarging lens. Apply the glycerin with a fingertip, being careful not to use too much. It can be wiped off the lens easily with a piece of lens tissue or a soft cloth.

—Wm. Swallow, Brooklyn, N. Y.

☞ To keep finger marks off a negative while you are retouching it, cut a hole in an envelope and place the negative inside so that just the part being retouched appears in the hole. The envelope must be fairly large, so the film can be moved about easily to bring different parts opposite the hole for retouching.



Inexpensive Darkroom Timer Flashes Seconds



Providing a visible red flash and an audible click each second, this inexpensive and easily built timer is a valuable addition to the darkroom. Heart of the timer is a flasher plug, obtainable at most five-and-ten-cent stores. The flasher must be of the adjustable type and must be set accurately with the small adjusting screw to flash once each second. While the only parts actually necessary are the flasher and a bulb and socket, the entire setup may be mounted in a small cabinet to provide a neater appearance. Dimensions of the cabinet will depend on the size of the parts. When the timer is to be used, it must be turned on for about a minute and allowed to "warm up" before the flasher starts operating. The cabinet should be placed so it can be seen from both the printer and the enlarger.

Time Exposure With Bulb Release

Night shots, tabletop photos, etc., requiring long exposures, present a problem to those whose camera shutters will make a "bulb" exposure, but cannot be set for "time." One way to overcome the difficulty is to use a paper clip on the cable release, as shown. The section of the clip that presses on the release button is roughened with a file to make sure it will not slip off easily. The clip



can be placed on the release after the plunger is pushed down, with the shutter set on "bulb," and left until the exposure time is up. It then can be released by a flick of the finger.

—John K. Karlovic, Chicago.

Paper Cup Serves as a Funnel

Cone-shaped paper drinking cups provide handy funnels for use in the darkroom and they are inexpensive enough to be discarded after using. The pointed end is cut off with a pair of scissors, the amount removed depending on the size of the bottle in which the funnel is to be used.

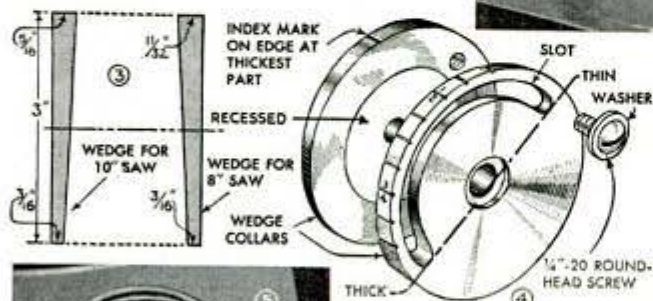




SHOP NOTES

Adjustable WEDGE COLLARS for GROOVING

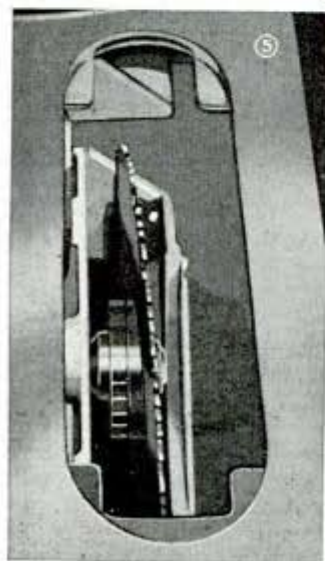
THE old trick of using a wedge behind a circular-saw blade to make it cut a groove much wider than its thickness is developed to maximum efficiency with the set of wedge collars shown in Fig. 1. Two wedge-shaped collars are required, both being tapered on one side only, and of identical shape as far as the amount of taper is concerned. If your saw has a 10-

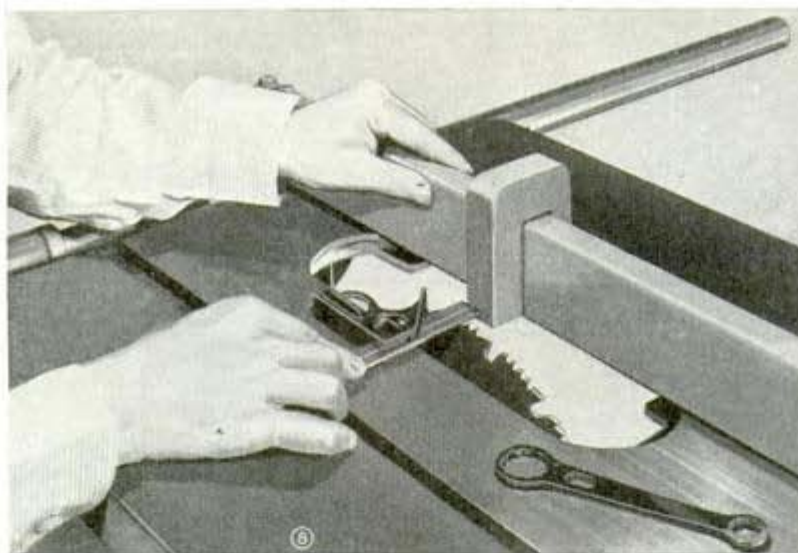


Any circular saw becomes a dado head of $\frac{1}{8}$ to $\frac{7}{8}$ inch capacity with a set of these simple wedge collars

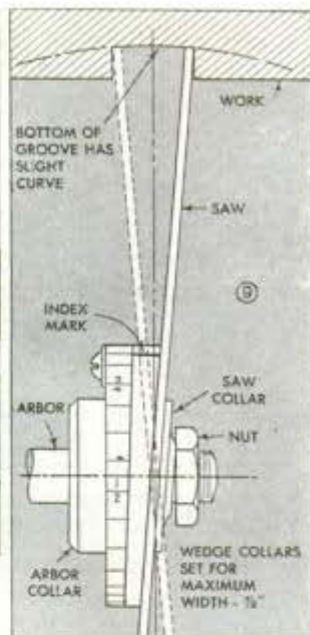
in. blade, the difference between the thinnest and thickest part of the wedge should be $\frac{1}{8}$ in. in a 3-in. disk. Two of these collars give a total wedge of $\frac{1}{4}$ in., which is the amount needed to stagger a 10-in. blade for a $\frac{7}{8}$ -in. groove. If your saw has an 8-in. blade, the taper should be increased slightly, as shown in Fig. 3. The two wedge collars are best turned from aluminum, but if this is not available other metal, plastic or even hardwood can be used. First, the collars are turned to diameter and maximum thickness. Then, setting one edge out from the chuck jaws with a spacer, as shown in Fig. 6, the collar can be faced to the required wedge shape.

One of the collars is slotted half-way around, as can be seen in Fig. 4. The method of doing this will depend on the collar material and





Graduation marks are determined by rotating the saw by hand and measuring the amount of wobble. Diagram at right shows action of collars set to cut maximum groove width of $\frac{7}{8}$ in.



tools available. The original was cut by first drilling a series of holes as in Fig. 7, and then routing the remaining metal with a small metal-cutting router bit. The slot takes a round-head machine screw, and the other collar is tapped to suit. Holes for the saw mandrel should be $\frac{1}{2}$ in. oversize to permit free tilting of the collars.

The scale marks on the edge of the slotted collar are scored with a file. Correct location of the marks is a matter of "fit-and-try." Fig. 8 shows the set-up. The saw need not be run, as the amount of wobble can be measured quite accurately by turning the saw by hand. Adjust the collars as required until you get a definite fractional width of groove. Then rotate the collars about $\frac{1}{16}$ in. and test for a $\frac{1}{16}$ -in. groove. After the unit of rotation has been determined, the remaining marks can be found quickly as the graduations are equidistant from each other throughout the whole range. Fig. 9 is a diagram of the collars set for maximum width of groove, $\frac{7}{8}$ in. being the maximum that can be cut with this type of device, both because the curve at the bottom of the groove becomes excessive, and because the arbor hole in the saw blade will not permit tilting the blade any greater distance. This last item—the amount the blade can be tilted when free on the saw arbor—should be checked, and no attempt should be made to force it beyond its natural maximum, which, in most cases, is between $\frac{3}{4}$ and $\frac{7}{8}$ in., Fig. 5.

The grade of work done with this device is excellent. The whole depth of groove is cut in one pass over the saw at normal ripping feed. Provided the saw blade is sharp, the groove is very clean, with perfectly

square sides, but with a very slight crown at the bottom which is invisible to the eye on grooves $\frac{1}{2}$ in. wide and under. An insert to accommodate the full range of wobble should be made and fitted in the saw-table opening. The insert should be plywood. Some types of work, such as cross grooving, as shown in Fig. 2, can be done without a table insert, but for most work the insert is required in order to support the work. Because the weight of the metal in the collars is slightly off balance, there is a small amount of vibration when the collars are set for wide grooves. This is not excessive and can be partially corrected if desired by drilling holes in the thick portion of the plain collar.

Catalogue Pages Marked by Wax For Quick Location



Where certain pages of a directory or catalogue are referred to frequently, these can be marked for easy location by applying several drops of wax on the corner of each page which must be located most often. To do this quickly, light a candle and hold it above the selected pages until enough wax has melted and dropped to mark them. The book will then open almost automatically at these places.

Sign Painting on Trucks Is Easy With Stencils



Lettering of names, telephone numbers and other business data on cars and trucks can be done neatly by anyone if a stencil is used. Such data not only has advertising value, but it also is required by law. To make a stencil for this purpose, draw the letters on paper and then cut them out. You can use either regular stencil paper, a good quality of bristol board, or even heavy kraft wrapping paper. Before cutting the letters, but after they have been drawn, the paper is coated with linseed oil and then is wiped and dried. A coat of varnish or shellac can be substituted for the oil if desired. The stencil is cut over a piece of glass or hard-pressed board, using a pocket knife having a thin, pointed blade, which must be razor sharp. Notice in the lower photo that parts of some letters must be tied to the stencil by leaving strips of paper. The letter O is a good example. Before stenciling the surface it should be washed with gasoline to remove all wax and polish. Then the stencil is placed over the surface and fastened down with strips of tape. Auto enamel is the best material for the lettering. For the first coat, pour off the liquid on top and use the thick pigment in the bottom of the can. On the second coat mix the enamel thoroughly before using it. Enamel undercoater is ideal where white or very light tints are desired as it hides dark surfaces with one coat. For the second coat, use either varnish or auto enamel. If neither of these materials is available, oil colors



thinned with turpentine for the first coat followed by a varnish coat will give good results. Oil paint such as that used on houses is not suitable as it will run under the edges of the stencil. Apply the paint with a stencil brush, using a stippling motion, never a wiping motion as this will cause the paint to work under the edges of the stencil and give the lettering a messy appearance. If a stenciling brush is not at hand, a short bristled sash brush will do. Even a flat brush with short bristles will produce a fairly good job. In any case, be sure that the stencil is held firmly against the surface as the paint is applied. When finished with the stencil, wash off the paint with turpentine and dry it. Then wrap it between two pieces of wood or heavy cardboard to preserve it for future use.

☛A label paste for bottles can be made by soaking strong glue in strong vinegar, boiling and then adding flour; this adhesive will not decompose.

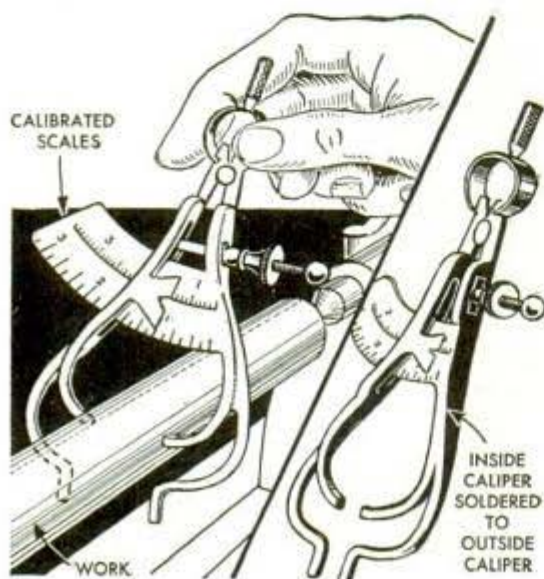
Handling of Packages Simplified By V-Strips on Counter



Wrapping and labeling of heavy packages while resting on a counter was simplified in one shipping room by tacking a number of V-shaped wooden strips to the counter top as indicated. Raising the package above the counter, the strips permit insertion of the fingers under the package to turn it over and move it about as desired. Also, such an arrangement permits the insertion of cord under a package.

Combination Calipers Save Time

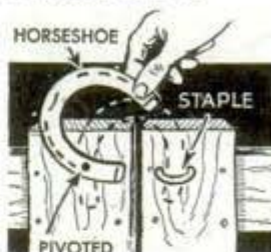
Woodworkers and others who use calipers where measurements are not too critical will find this combination pair a time saver, especially where inside and outside calipers are required on the same job. The combination consists of the jaws



of an inside caliper soldered to those of an outside caliper as indicated. A calibrated scale consisting of a piece of thin metal permits known settings of the calipers. The scale is soldered to one leg of the calipers and a pointer is soldered to the other leg.

Pivoted Horseshoe Makes Latch For Double Farm Gate

Difficulty of locking or latching a double gate so that it will not swing or give easily in the center may be overcome by employing a discarded horseshoe for a latch.



The shoe is bolted onto one section of the gate so that it may be swung over to engage a large staple in the opposite section.

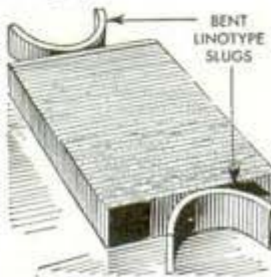
File Welded on Soldering Iron Closes Metal-Roofing Seams



The difficulty of closing and holding the seams of metal roofing while soldering them, led one workman to use a piece of broken file as a heel on his soldering iron to press against a seam while soldering. The tang end of the file is broken off as indicated, and then welded to the handle of the soldering iron. The device not only closes the seam ahead of the iron but it also permits the iron to be rocked on the seam to hold it closed while the solder cools.

"Book Ends" to Hold Loose Type On Imposing Stone

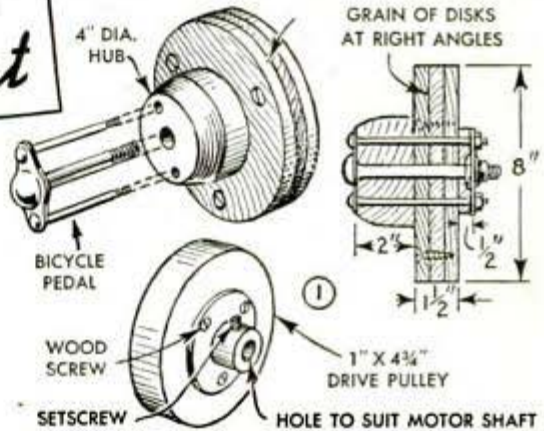
To avoid having small type forms fall apart on the imposing stone, one printer uses old linotype slugs to support them. The slugs are curved and used like book ends.



When filing steel in a metal-turning lathe, use a mixture of water, 6 parts, and emulsifying oil, 1 part, to get a smooth finish and keep the file from clogging.

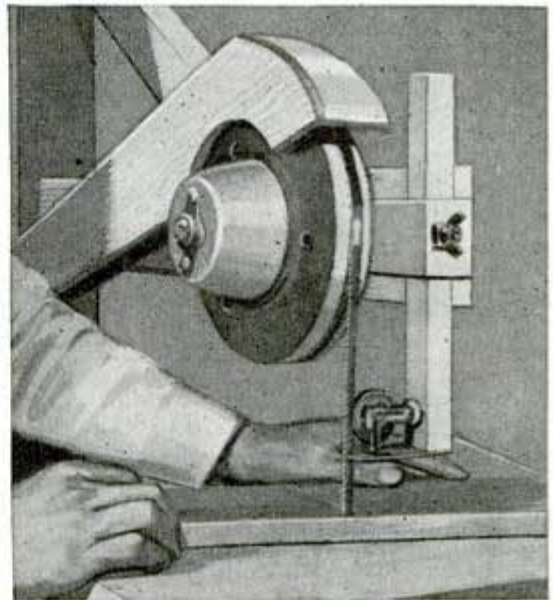


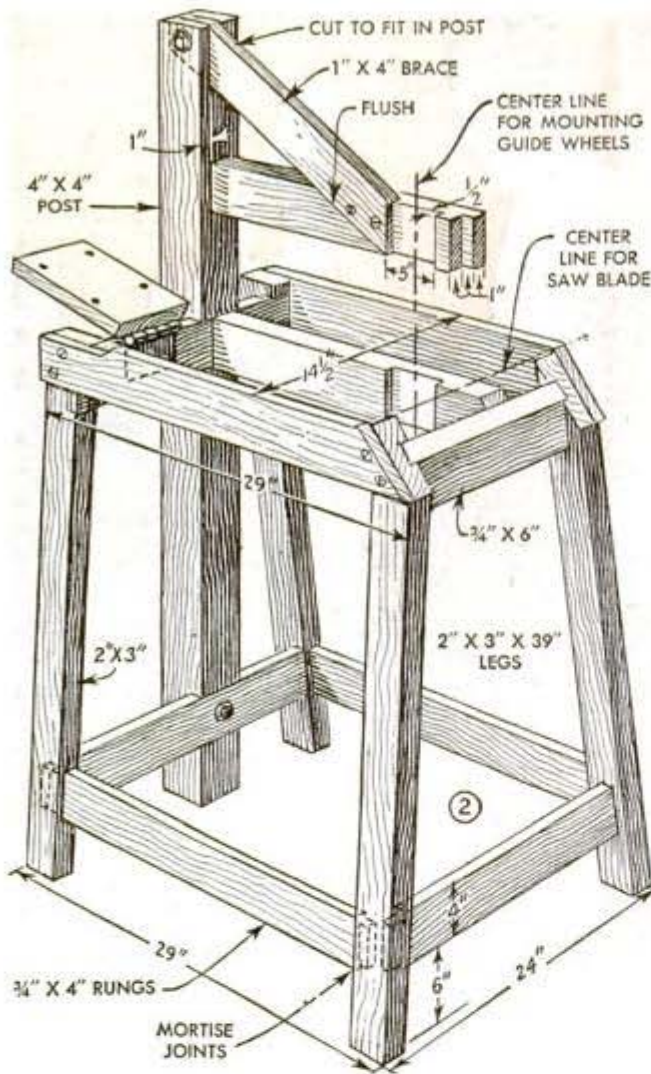
Three-wheel
BAND SAW
has 22-in. throat



WITH its deep throat and sturdy wooden frame, this three-wheel band saw handles 4-in. stock with ease and is capable of cutting to the center of a 44-in. disk. Excluding the motor and 80-in. blade, there are no new metal fittings needed, as the blade guide is improvised from a screw-type pulley, and wheel bearings are provided by old bicycle pedals.

After cutting the main frame pieces according to dimensions given in Fig. 2, and assembling them with glue and screws, mark center lines for the two guide wheels. Then, fit drilled-and-tapped plates of steel flush in the upper arm and the center frame member to take bicycle-pedal bearings, which are used for mounting the wheels. As shown in Fig. 1, the guide wheels consist of three $\frac{1}{2}$ -in. wood disks, glued and screwed together with the grain running at right angles to prevent warping. They are trued on a lathe, crowned slightly, and sanded so that vibration is reduced to a minimum, after which 4-in. dia. hubs are

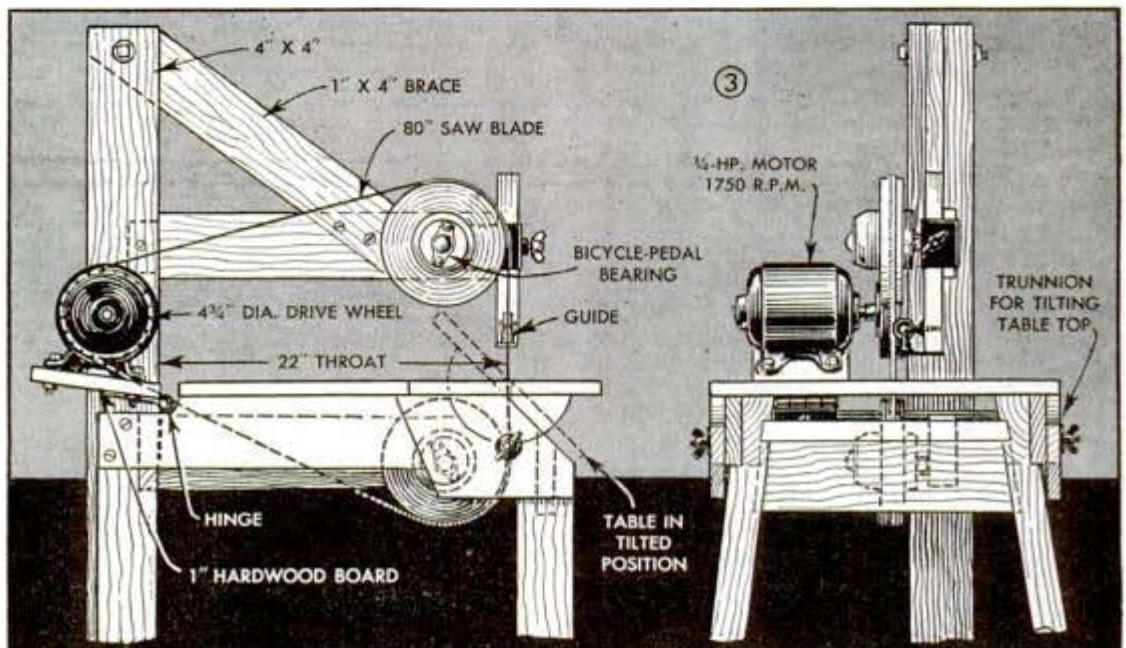


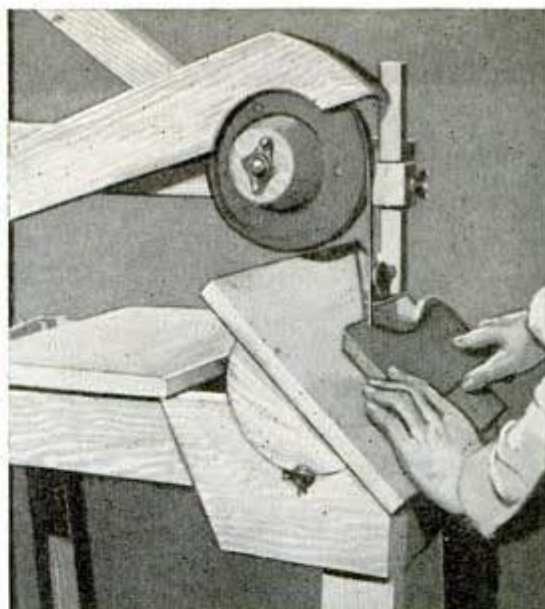
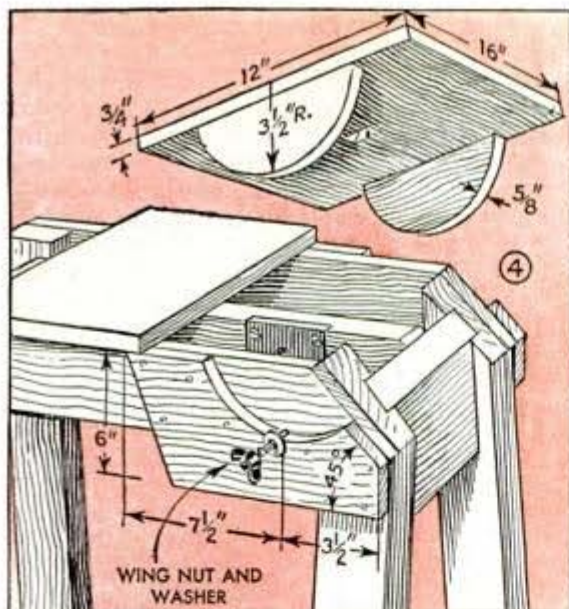


turned, bored and then glued to the outer surfaces of the wheels. These provide spacers to facilitate tightening the bicycle-pedal bearings securely. The drive pulley is turned from a single piece of 1-in. hardwood and fitted with a metal hub, improvised from an old autopump pulley or made especially for the purpose. The hub can be attached with either wood screws or small bolts.

Next comes the motor base, which is hinged at the rear of the frame and aligned with the front guide wheels before anchoring the motor securely as shown in Fig. 3. To allow for additional adjustment of the motor, which keeps constant tension on the blade, it's a good idea to cut slots in the base so that the motor can be shifted sideways quickly, if necessary, to get perfect blade trackage.

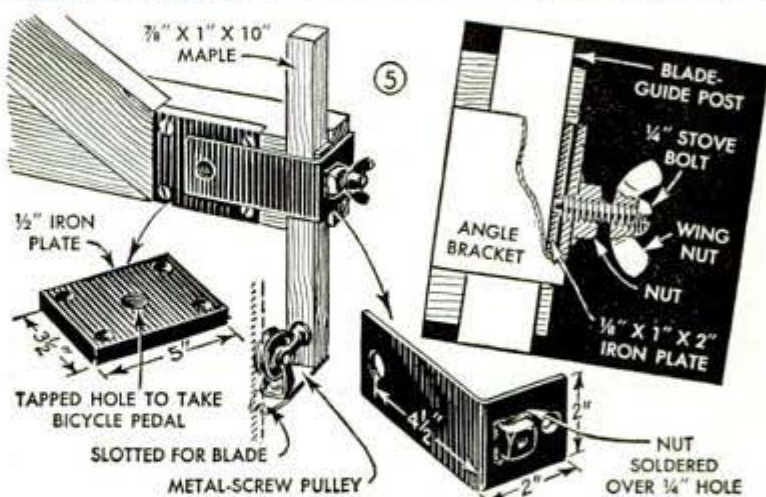
Fig. 4 shows the table trunnion assembly, which permits tilting the table to 45 degrees and adjusting it for any angle cuts within this range. Note that the table supports are made by sawing a 5½-in. wooden disk in half and that filler pieces are needed on each side of the frame, the top edges of these being cut to the same contour as the half-round table supports. The important thing here is to position these pieces so that when the table is tilted, the blade will remain in the center of the table opening. By placing a blade on the wheels,





you can determine the correct location easily. Wing nuts and large washers on the trunnion bolts make the table assembly easy to loosen or tighten in any position. If desired, the trunnion also can be indexed for rapid setting.

For the adjustable blade-guide post, Fig. 5, a piece of good maple and a screw-type pulley will be required. After screwing the pulley in place near the lower end of the guide post and fitting the post with a slotted metal plate to take the blade, the vertical adjusting clamp is attached. This consists mainly of an angle bracket made by bending a piece of flat iron and fitting it with a setscrew as indicated. The bracket is drilled to slip over the wheel shaft, and also is anchored at the end of the frame arm with a long, flat-head wood



screw. Instead of tapping the bracket for an improvised adjusting screw, a nut is soldered over the hole for it as shown. Installation of a suitable wheel-and-blade guard completes the saw, and it's advisable not to start the machine until this guard is in place as it offers protection against accidents in case a blade is broken.

Safe Method of Finding Leaks in Car's Exhaust System

If you notice carbon monoxide gas escaping from the exhaust system into your car, it's best to check the system quickly to avoid danger of serious accidents. To do this safely, just select a cork that will fit snugly into the tail pipe, but do not drive it in place. Next, pour about one tablespoonful of clean motor oil into each spark-plug hole, and start the engine. Let it run a few minutes just above idling speed, and watch where the burning-oil smoke is escaping. If leaks appear at a con-

nection, it may be possible to correct the trouble by merely tightening the connection. However, where cracks are found in the exhaust pipe or muffler, it will be necessary either to repair the openings carefully or replace the damaged parts.

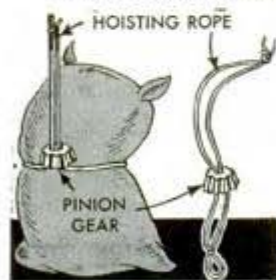
☐ Dirt smudges, pencil marks, etc., can be removed easily from tracing cloth with a cotton swab soaked in benzine. The swab can be rubbed freely over inked lines or water colors without dissolving them.

Heavy Castered Sidewalk Sign Is Easy to Move About



Having a large sign on the sidewalk in front of his store, one merchant made it easy to move the sign morning and night by fitting it with casters as shown. The casters are inserted in holes drilled into the ends of the base so that they do not contact the walk when the sign is resting in a vertical position. To bring the casters into use, the sign is merely tipped over on one side and moved wheelbarrow fashion.

Slip-Proof Loop on Hoisting Rope Made by Using Pinion Gear



Farmers who are obliged to hoist sacks of grain to an upper floor in a building for emptying or for storage, will find this slip-proof loop in the hoisting rope a time and labor saving

method of attaching and releasing the sacks. A large permanent loop is tied in the rope end, after which a small pinion gear is slipped over it and a knot tied in the lower end of the loop to keep it from sliding off. In use, the loop is opened and closed to receive a sack by sliding the gear up or down, after which the gear bears tightly against the sack to keep the loop closed under the weight of the load.

Grafting Wax Dipped in Paraffin Will Not Stick to Fingers

To simplify the task of handling grafting wax by preventing it from sticking to the

fingers, especially on warm days, I dip each stick of wax into melted paraffin before using it. The container to hold the paraffin should be large enough to submerge the stick at least half of its length at one time so that an entire stick is coated by two immersions. I have found a large, glass tumbler handy for this purpose and by placing it in a pan of warm water, the paraffin is kept in liquid form. Besides keeping the workman's hands clean, even on warm days, the paraffin keeps the wax free from dirt.—Chas. S. Marshall, Baptistown, N. J.

Oiling Twist Drills and Auger Bits

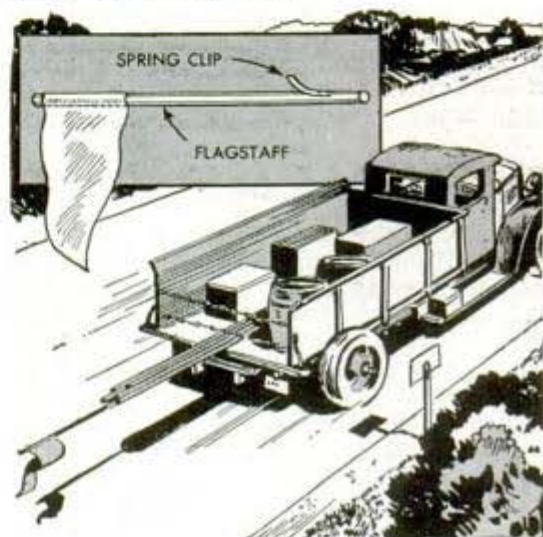
Especially handy for applying a thin coat of oil to twist drills and auger bits, this simple oiler is nothing more than a rolled strip of carpet inserted in a small tin can.



After pouring a little oil in the latter, the entire strip of carpet soon becomes soaked. In use, all you need to do is wipe the tool as shown to contact all surfaces, as the carpet edges follow fluted portions of drills when they are turned.

Spring-Clip on Warning-Flag Staff For Fastening It to Load of Pipe

In order to attach a warning flag to the rear of a load of long pipe in his truck, one plumber nailed a length of clock-spring to the longer end of the staff. In this way, the flag could be inserted into the end of a projecting piece of pipe and held securely regardless of the size of the pipe opening, yet permitting the staff to be pulled out easily when necessary.



Sturdy Sawhorse Has Folding Extension Legs

Carpenters, painters and others who find it necessary to use sawhorses of various heights for low construction work, painting, etc., can make one pair take the place of two by fitting them with extension legs. As these legs fold flat when not in use, they do not require extra space in storage or when transporting them from one job to another. After cutting the extra legs from 2 by 4-in. stock, heavy butt hinges are used to attach them. Then, horizontal braces are mortised and screwed in place near the bottom of the legs as indicated. Iron hooks fastened at each end hold the extension legs rigid when in use, while small hooks and eyes lock them securely in a folded position. Horizontal braces also are added to the regular sawhorse legs to provide additional rigidity.—J. L. Vanderheyden, Toledo, Iowa.

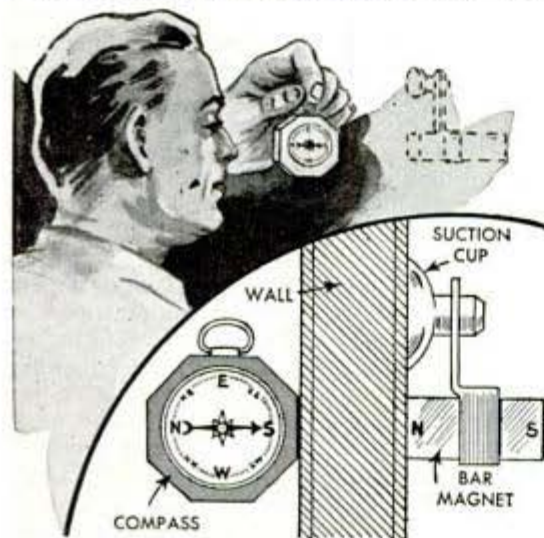


Positions on Opposite Sides of Wall Located Accurately

On several occasions where it was necessary to locate identical positions on opposite sides of a wall, I completed the job quickly by using a small bar magnet and pocket compass. As one side of the wall

was covered with smooth material, this was done without the aid of a helper by slipping the magnet in a metal holder, attached to a suction cup. With such an arrangement, the magnet could be supported in any position desired while shifting the compass to find and mark the position on the other side of the wall.

—E. E. Lofgren, Springfield, Mass.

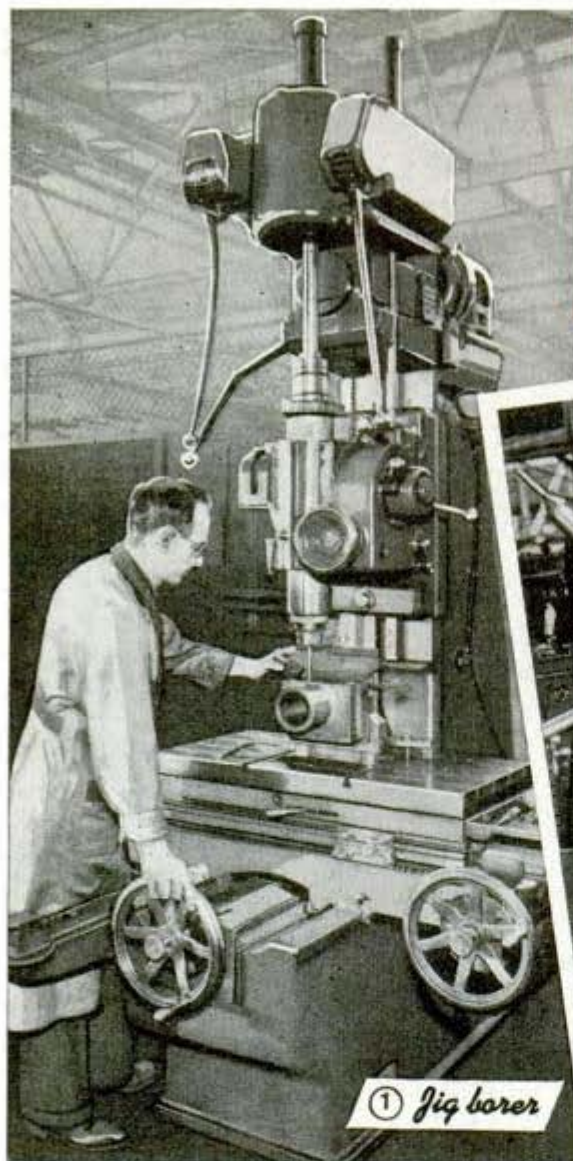


Clothespin Holds Abrasive Cloth To Cut Down Bolt Threads

Instead of reducing the diameter of bolt threads with a strip of abrasive cloth held in the fingers so that bolts can be driven into reamed holes, I use a spring-type clothespin to apply even pressure on the cloth and prevent sore fingers. This is done by fitting strips of abrasive cloth in the clothespin jaws, after which the improvised tool is clipped over the threads and rotated. As the abrasive wears, the pin is released to bring a new cutting surface into position.—R. Langwasser, Seattle, Wash.

BORING MACHINES

by H. J. Chamberland

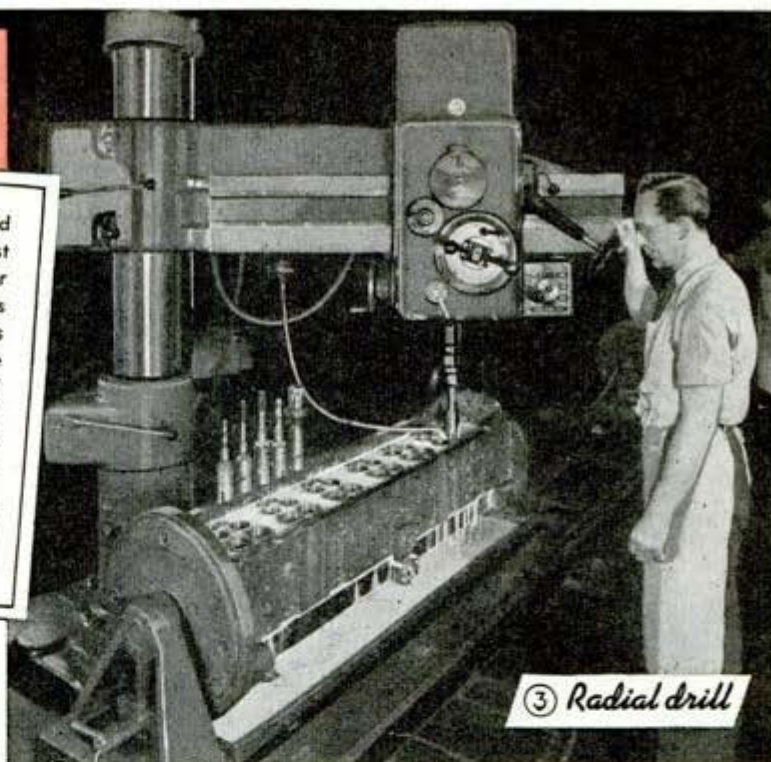


ANY engine-lathe or drill-press operator who already has a substantial amount of experience is well qualified to operate any one of the modern types of boring machines. In machine-shop practice, a hole often is called a bore and vice versa, but it is less confusing if a hole such as is produced with a twist drill is called a hole, while one such as is produced with a boring tool is called a bore. A cored hole in a casting can be finished by boring without the aid of a drill, but to start a hole in solid stock requires a center drill and then a drill, whether or not the hole is to be enlarged later by boring. There are four basic types of boring machines, as follows: A tool-room jig-boring machine such as shown in Fig. 1; a vertical type boring machine as in Fig. 2; a radial drilling machine, Fig. 3, which is commonly called a radial drill, and a horizontal type boring machine,

Fig. 4. The last three are quantity production machines.

Tool-room jig-boring machine: This machine is also known as a jig borer and it is used chiefly in tool rooms to space and bore holes quickly and accurately in the making of drilling jigs and piercing punch-and-die assemblies. Frequently a vertical milling machine is used for this kind of work but the jig borer is better adapted and much more foolproof for the purpose. Owing to the time-saving arrangement and handy attachments on a jig borer, an operator can do just as good work after 30 hrs. of experience as he can do on a vertical milling machine after 300 hrs. of experience, on the type of work mentioned. The procedure is to start with a properly located hole, drilled the usual way but about $\frac{1}{16}$ in. smaller than the finished bore. Then the machine spindle is adjusted to be concen-

Includes easy-to-understand information every machinist should have regarding four types of boring machines shown on these pages. Gives purposes for which these machines are designed and used; the procedure in drilling first and boring later; various setups and sequence of typical machining operations; time-saving use of universal tables with radial drills, etc.

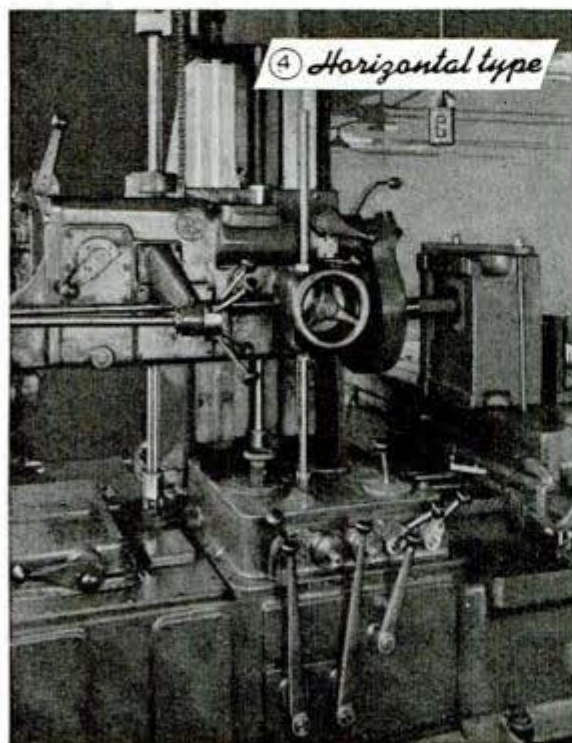


③ Radial drill

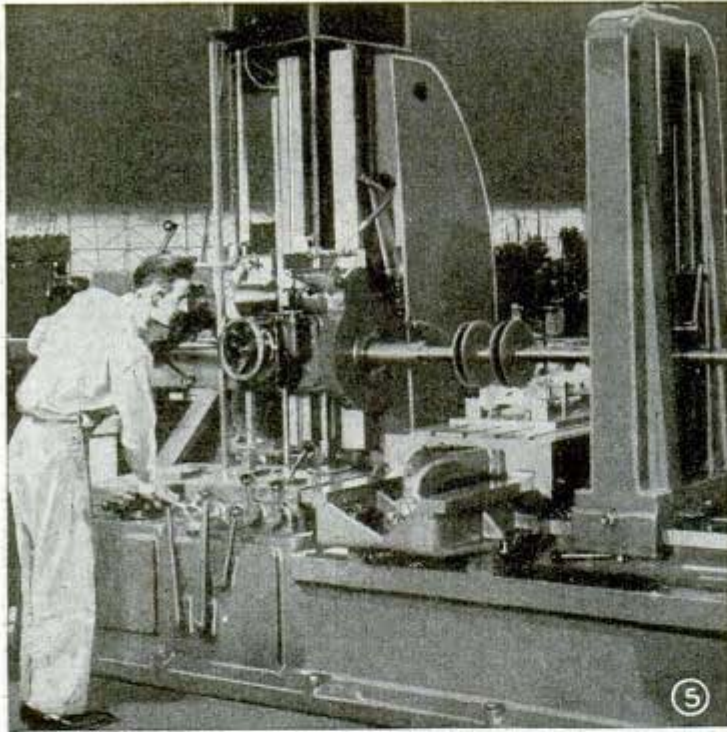
tric with the hole, after which a boring attachment such as shown in Fig. 6 is substituted for the drill chuck. The boring attachment is nothing more than a precision single-point boring bar that can be adjusted eccentrically in steps of .0005 in., with a wrench as shown. After finish-boring the starting hole, the distance to the next hole is located by means of graduations on both the traverse and crossfeed handwheels. The

second hole is drilled undersize just like the first, and if the distance is plus or minus requirements it is corrected by means of a vernier system on some machines, or dial indicators on others as shown in Fig. 7. Then the second hole is bored to size and the operation is repeated as required. The distance between two holes is accurately determined by placing plug gages in the holes, measuring the exterior distance from plug to plug with micrometers and then subtracting this amount from one-half of the two plug diameters.

Vertical boring machine: This type of boring machine, shown in Fig. 2, is often and justly termed a vertical turret lathe. In examining it, you will notice that the general idea of a conventional turret lathe is quite apparent. Although the construction of a vertical boring machine differs in many respects from that of the regular turret lathe, they both have the same ease of operation. For instance, the base and column of a vertical boring machine are integral. Some spindles are as large as 64 in. in diameter with built-in three-jaw universal or four-jaw independent chucks. However, although tooled similarly to the conventional type of turret lathe, the vertical boring machine is much more a multi-operation unit. It is intended to machine parts or castings that are too large to be practically and safely revolved on a horizontal axis. Therefore,



④ Horizontal type



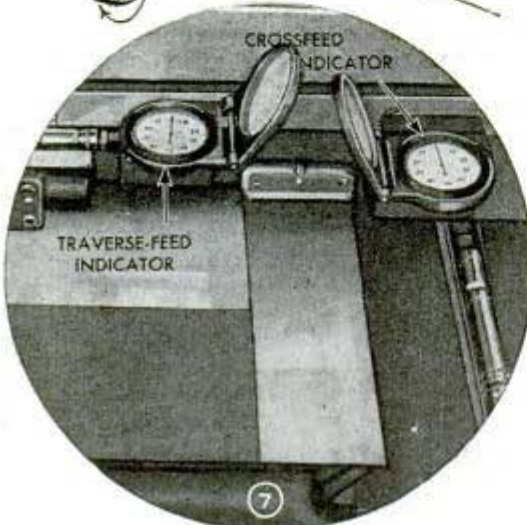
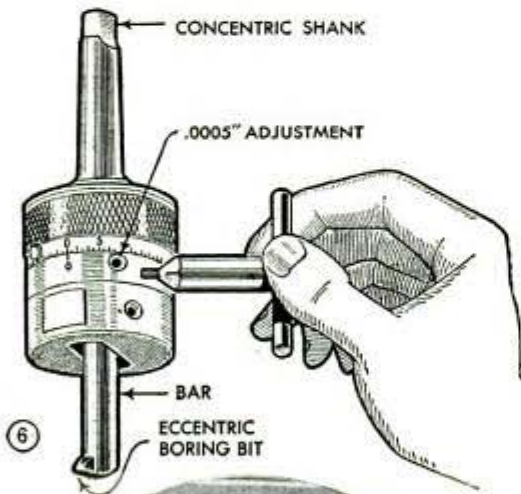
spindle wear of vertical boring machines is reduced to a minimum due to the elimination of overhang. The turret on the column of a vertical boring machine is called the main or regular head, and a second tool-holding part is known as the side head. The latter replaces the rear tool block of a regular turret lathe. A tool in the main head bores the work while another tool in the side head faces a lower surface simultaneously.

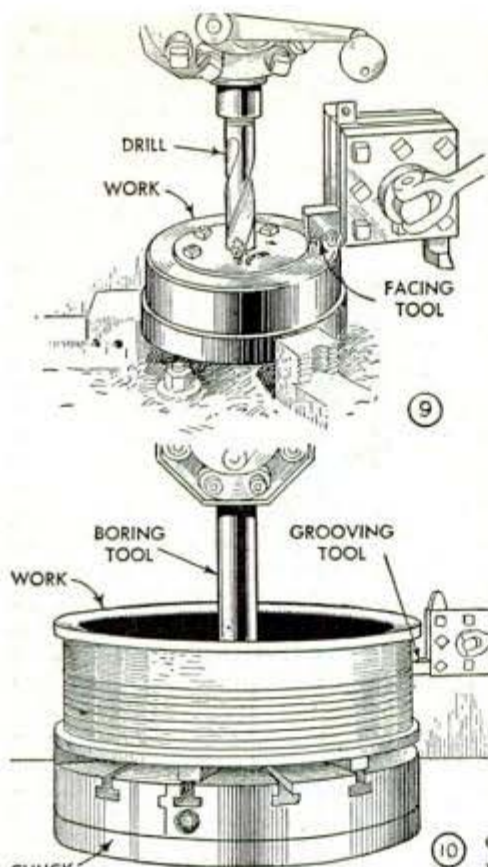
Multiple-operation set-up possibilities for this type of boring machine are many. In Fig. 9, a part is being drilled previous to boring and the side-head tool faces at the same time; another tool bit in the side head has previously taken a turning cut. In Fig. 10, the hole in the part is being bored to size while the out-

side circumference is being grooved with a tool in the side head. In Fig. 11, the machine executes an external tapering operation with the side-head tool with the aid of a master former, which is located in the main head. The guide bar follows the taper of the master former and thus the tool bit reproduces the taper on the work. Fig. 12 shows a somewhat similar set-up, but in this case an internal cut is made, which duplicates the shape of the master former.

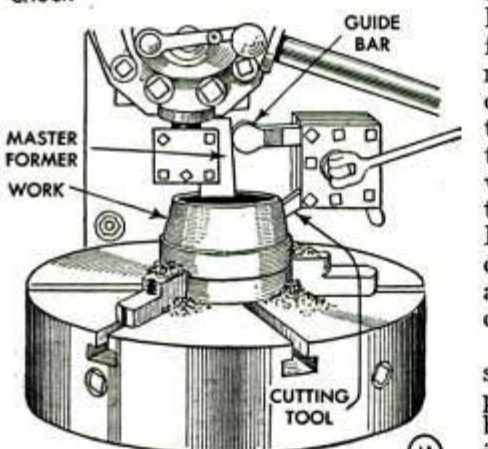
Fig. 15 also shows a number of interesting boring-machine setups, arrows pointing in the direction of the cuts. In detail A, tool 1 finishes while tools 2 and 3 are making rough cuts all at once. In detail B, single-point boring tool 1 is making a rough cut while side tool 2 finishes the surface previously roughed in detail A. In detail C, the double-point boring bar 1 semi-finishes the bore while side tool 2 turns a diameter and separately faces the flange both on the side and underneath as shown by arrows. In detail D, the bore is being finished, and in detail E, the work has been reversed to face the opposite side.

Horizontal boring machine: While some vertical boring machines are made especially large for special use, horizontal boring machines excel in this respect. The smaller models have single columns as shown in Fig. 4 and the larger models have an extra upright support. These boring machines are intended for heavy castings, their range only being limited by the height of columns and the length of the bed. The horizontal boring machine is not consid-

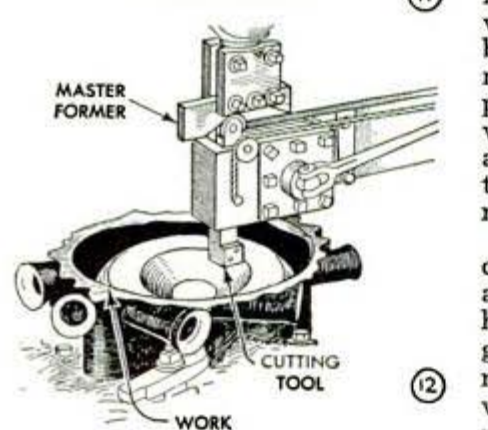




9



10



11

12



8

ered a multi-operation machine as it executes various operations in sequence. Boring bars are the leading tools used. For large jobs these may be from 12 to 15 ft. long, and a large casting often remains on the table four or five days before it is completely machined. The boring head is fitted to the main column and therefore takes care of vertical adjustments. The work is bolted to the table, which in turn operates crosswise. One can learn to operate a horizontal boring machine more quickly than one of the vertical type, due to much less complicated tooling requirements. In either case, a good lathe, milling-machine or drill-press hand can soon master boring-machine details.

The improvised column or upright with all large size horizontal boring machines is merely to support, guide and guarantee alignment for the long bars used when boring long or wide castings. Horizontal boring machines are similar to those of the vertical type in that they perform facing, counter-boring and spotting operations. Also, the horizontal machines are better adapted to machine odd-shaped parts such as shown in Fig. 14, because when such work is strapped to an angle plate and rotated in a vertical machine, it is more likely to cause chattering and uneven surfaces than when the work is mounted in a horizontal boring machine.

As shown in Fig. 5, a horizontal boring machine can be used for milling when no milling machine available is large enough to handle certain types of heavy work. The cutters are mounted on a long gang arbor as a substitute for the boring bar. The machine has all necessary movements for milling, with increased capacity for size. Horizontal boring-machine tables are not intended to rotate, but aux-

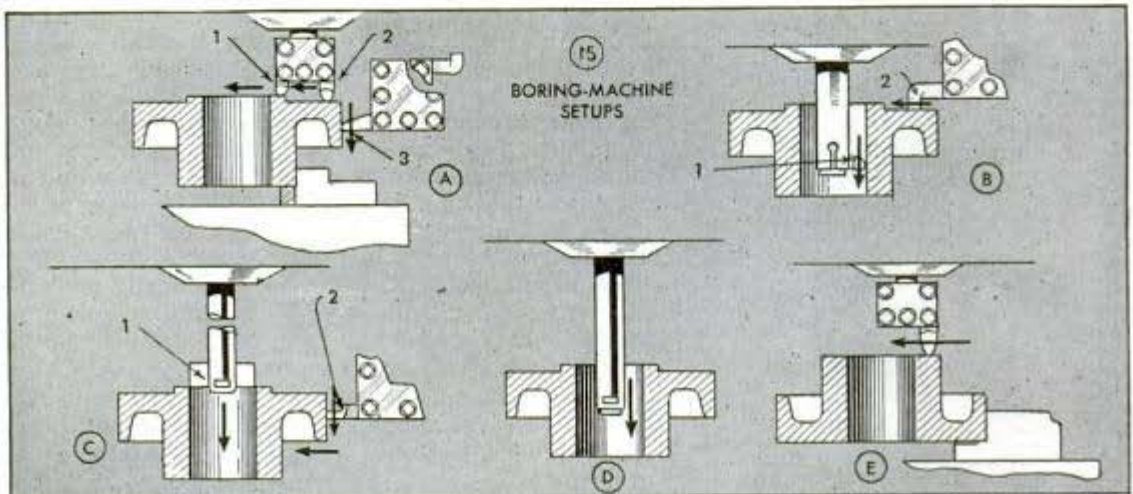
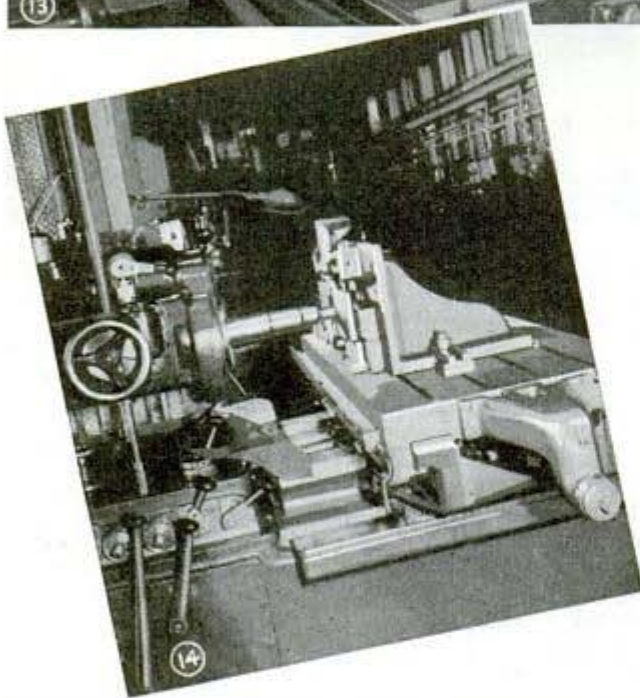


iliary tables give them this extra versatility, as shown in Fig. 13. Movement for the rotating member is derived from the traverse feed shaft by gear box and universal-joint mechanism. The work is actually being turned with the spindle locked.

Radial Drilling Machine:

Better known as a "radial drill," a radial drilling machine is somewhat like a big brother to the drill press, but it is essentially a boring machine because of its versatility and ability to use various types of boring tools in addition to drills. As shown in Figs. 16 and 18, the heavy column of a radial drill carries a long arm that can be swung around through an

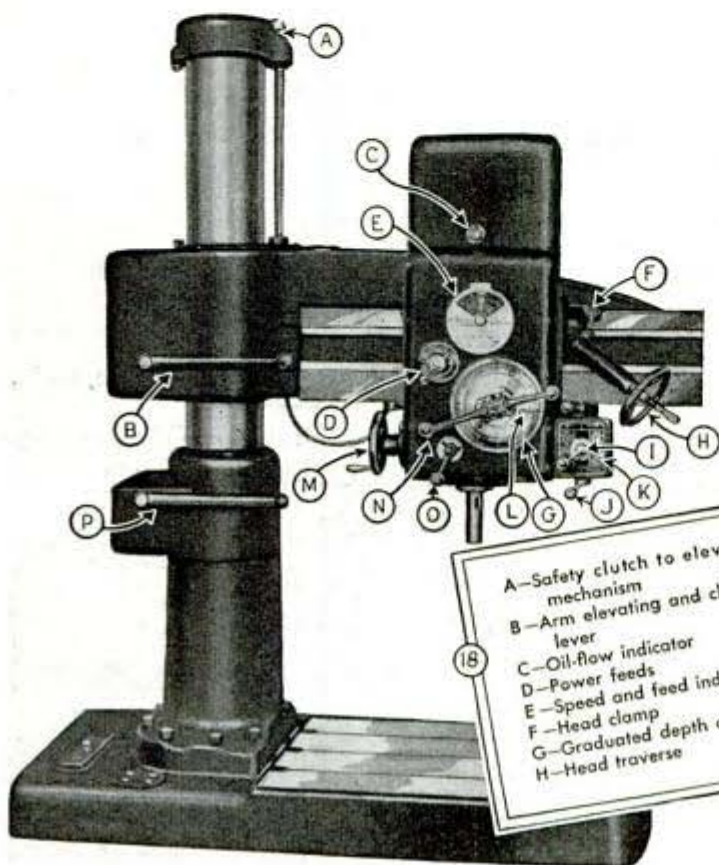
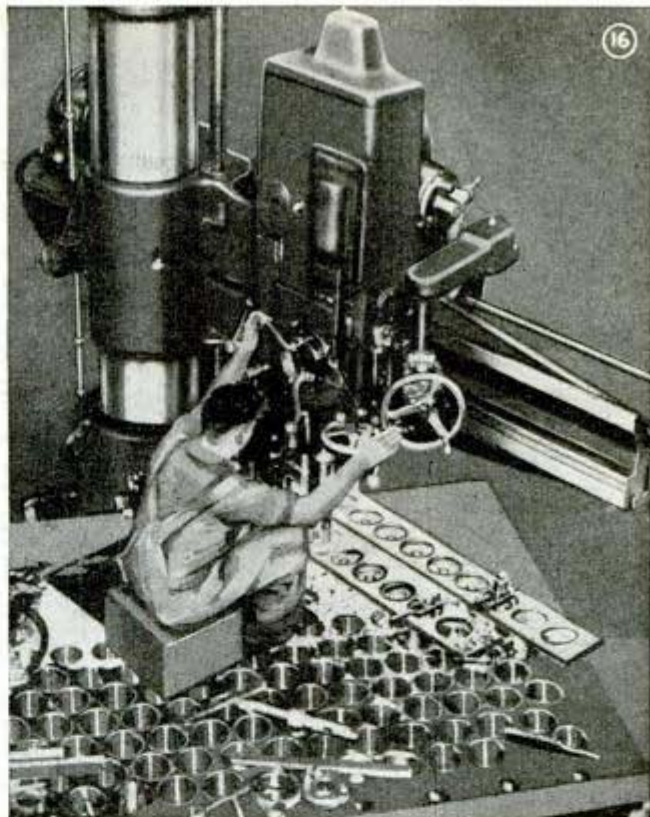
entire circle if necessary. This arm has a vertical adjustment and is fitted with a drilling head which has both traverse and vertical adjustments. These combined movements permit positioning the work securely so that drilling can be done by directing the drill from hole to hole, rather than moving the work as is the case with a regular drill press. The primary feature of a radial drill is the area that the spindle can cover. Fig. 16 shows a typical application. In this case, more than two-hundred 5-in. holes were bored in armor plate. End holes of 2-in. diameter were drilled as a primary step, and the other holes located from these with a template. Using a single-point piloted boring bar, the holes were enlarged to 3 1/4 in. after which they were brought to a precise 5-in. diameter with a blade-



style boring bar. In this exceptional case, however, the space to be covered was beyond the radial and traverse capacity of the machine, and therefore the plate had to be relocated to suit the particular work at hand.

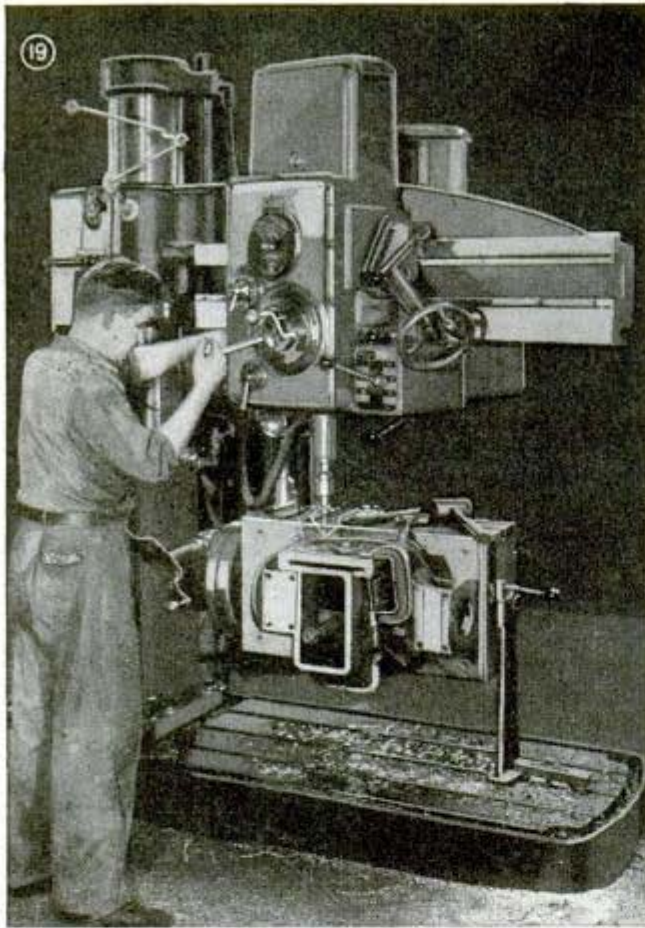
Universal tables, as the one shown in Fig. 19, add greatly to the versatility of a radial drill. This one is known as a swivel type, and it is adjustable to any angle, and may be rotated completely around. In many plants, work is speeded considerably by having a man lay out the work on a table on one side of the machine while another does the machining on a second table on the other side. The machine arm is turned to the next table for each machining operation and the men shift working location from one table to the other.

As shown in Fig. 8, regular twist drills as large as 3 in. are used frequently to drill solid stock in boring machines, except jig-boring machines. Single-point boring bars are never used in a radial drill and the blade-style bars must be piloted. Radial drills and vertical boring machines are not in-



- A—Safety clutch to elevate mechanism
- B—Arm elevating and clamp lever
- C—Oil-flow indicator
- D—Power feeds
- E—Speed and feed indicator
- F—Head clamp
- G—Graduated depth dial
- H—Head traverse
- I—Speed change lever
- J—Start-stop-reverse lever
- K—Speed plate
- L—Depth dial lock
- M—Hand feed lever
- N—Feed engaging and quick-return levers
- O—Power-feed trip
- P—Column-clamp lever





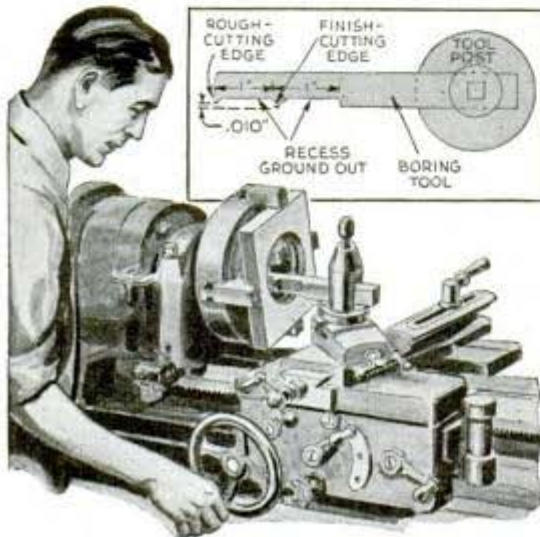
tended to bore deep holes; this work is done on horizontal boring machines. Core drills are often used with all types of boring machines to partly process cored holes in castings. A core drill has four flutes, cuts faster and more accurately than a regular drill. Cored holes must be chamfered before using a core drill to guide the tool concentrically. Core drills are made to 3 in. in diameter and modern designs comprise two parts known as the drill and the holder. Since the points do all the cutting, the holder (shank end) is made of carbon tool steel and the drill (cutting end) is of high-speed steel or the edges are tipped with carbide. Shown in Fig. 17 are two typical examples of special boring tools to finish large holes. In all instances such as these, a twist drill or drill and boring tool must produce the starting or clearance holes. Lip clearances and point angles for drills, back rakes, nose radii, side-cutting edge angles and rakes for tool bits are the same for a boring machine as they are for an engine lathe, turret lathe or drill press. This also applies to the various speeds and feeds as well as lubricants.

Double-Edged Boring Tool Makes Rough and Finish Cuts

This twin-edged boring tool has been a timesaver in our shop when boring short precision holes, as it makes the rough cut and finish cut in one operation. I have bored as many as 500 steel plates to a tolerance of .0005 in. without having to reset

or adjust the tool. The detail shows the general shape of the tool and gives the most important dimensions. When shaping the tool be sure that the two cutting edges are spaced apart a distance equal to a trifle more than the thickness of the work. This is necessary so that the rough cut will be completed before the finish cut is started, otherwise the tool may chatter.

—John D. Aldstadt, Akron, Ohio.



Large-Capacity Soap Dispensers From Oilstove Founts

With extra employees using liquid soap, one shop owner found that the regular dispensers were too small. To solve this problem, gallon-size founts from old oilstoves were substituted for the regular dispensers.





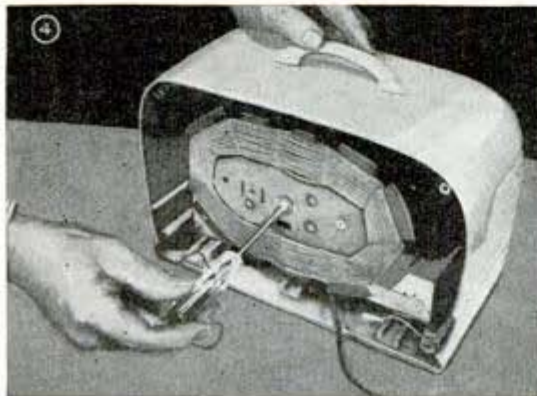
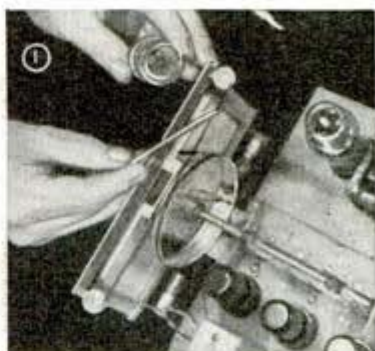
Radio

SERVICE HINTS FOR HOME RECEIVERS

SLIPPING cord-driven dials are a common source of trouble in many receivers. This annoying defect shows up when your favorite station will no longer tune in at the usual dial setting, and turns up at some remote point. A simple remedy is to make up a small quantity of "belt dope," which consists of a saturated solution of powdered rosin in alcohol, and apply it to the full length of the cord with a small brush or cotton-tipped applicator as shown in photo No. 1. Readjust the dial to the proper frequency reading, and permit the cord to dry before doing any further tuning. Two or three such applications a year will prevent slipping in most cases.

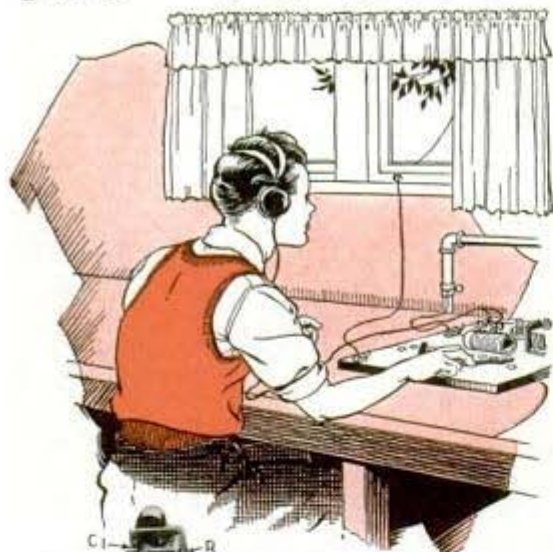
Photo 2 shows a pocket-type neon tester; these handy and inexpensive trouble shooters will check any voltage between 110 and 550 volts, either a.c. or d.c. It will indicate open circuits, shorts, polarity, blown fuses and defective cables. Set owners in localities remote from radio servicemen should have a bottle of cement of the type specially prepared for radio and speaker work. Such cement is necessary for repairing rattling or torn speaker cones, cementing voice coils, spiders, etc. It is also useful for cementing loose tube bases and grid caps to tops of glass tubes. It is applied with a small brush as illustrated in sketch Fig. 3.

If your small utility receiver is equipped with a loop antenna mounted in a manner similar to the one shown in photo 4, and it becomes necessary to remove the tubes for testing, don't try to reach around the loop and pull out the tubes. Examine the loop supporting bracket and remove the screw that holds the loop in position and lay the loop back carefully without disturbing the connecting wires, as indicated in photo No. 5. If the assembly is ultra compact it may be necessary to remove the control knobs and chassis mounting bolts and take the set out of the cabinet. More small sets are damaged by carelessness in removing tubes than in any other manner.



The "TOOTHBRUSH" TWINS

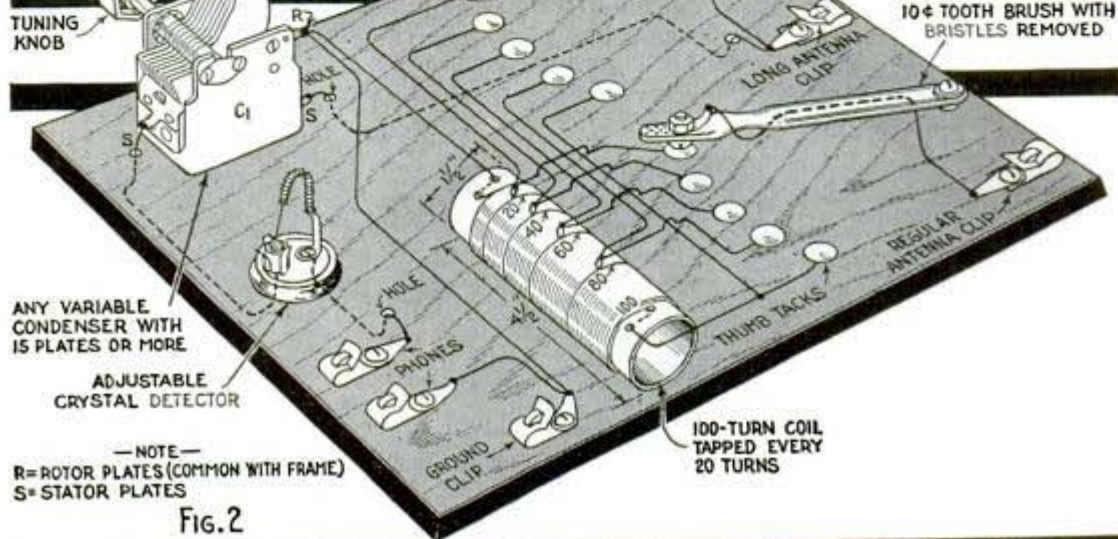
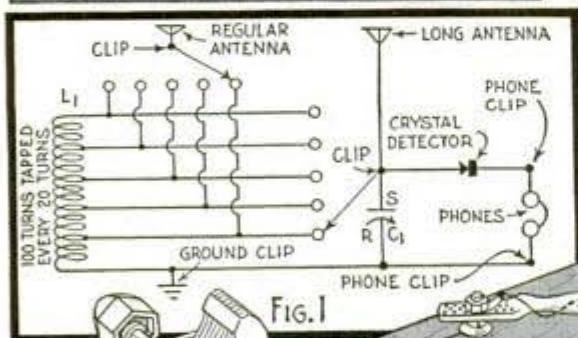
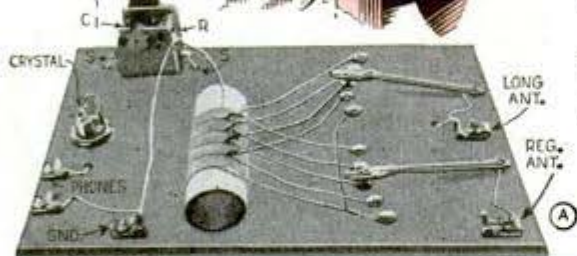
By Stanley A. Johnson



IT WOULD be difficult to imagine two simpler radio receivers that could match the performance of these student units. If you have a good pair of headphones, a quick look at the junk box and a visit to the "dime" store will produce the necessary parts.

The two sets are about equal in sensitivity and both will give excellent results on local broadcasting stations. However, the tube set has the advantage of being somewhat more selective and eliminates critical crystal detector adjustment. On the other hand the crystal set needs no tube, socket or flashlight cell. Otherwise, receivers A and B are identical in construction details.

A 10 by 13½-in. breadboard is used for the base. The coil is wound on a cardboard tube obtained from a toilet roll, and consists of 100 turns of No. 26 d.c.c. wire. No. 24, 28 or 30 wire will do just as well, and any covering will answer the purpose. Such wire can be salvaged from old radio coils. Wind the coil in a clockwise direction; stop at the 20th turn and twist the wire into a small loop which is to be scraped free of insulation and used as a tap. There will be 4 of these taps, as will be noted in the simplified wiring diagrams Figs. 2 and 4; schematic circuit diagrams appear in Figs. 1 and 3. Mount the coil form and Fahnestock clips with short wood screws. To lay out the toothbrush switches, mark off the thumb tack positions with a compass, then bare the



Radio Project for Beginners

A SELECTIVE CRYSTAL SET AND AN ULTRA-SIMPLE ONE-TUBER FOR RADIO STUDENTS

ends of the wire leads which go to them, and wrap the bare wire around the tacks. Pull the bristles out of the small 10 cent toothbrushes with a pair of pliers, and drill the handles for short machine screws at one end and wood screws at the other. Washers are placed under the wood screws so that the switch arms will swing freely; the round heads of the machine screws contact the thumb tacks. Circuit connections are made to soldering lugs under the hex nuts.

Drill and countersink a hole for a machine screw which is inserted through the baseboard from the underside to mount the variable condenser. Any condenser with 15 or more plates may be used, or, one section of a 2-gang condenser will do.

Use a good long and high outdoor antenna, and run the ground to a clamp on a cold water pipe. Exceptionally long antennas will give better results when connected to the "long antenna" post. To tune either set, move the switch arms to the No. 3 thumb tack, rotate the variable condenser until a station is picked up, then try re-adjusting the tap switch at the rear of the baseboard to see if the signal can be made stronger. If no station is heard at the first adjustment, try another combination of switch positions. To turn off set B, disconnect positive battery lead or insert switch indicated in Fig. 4.

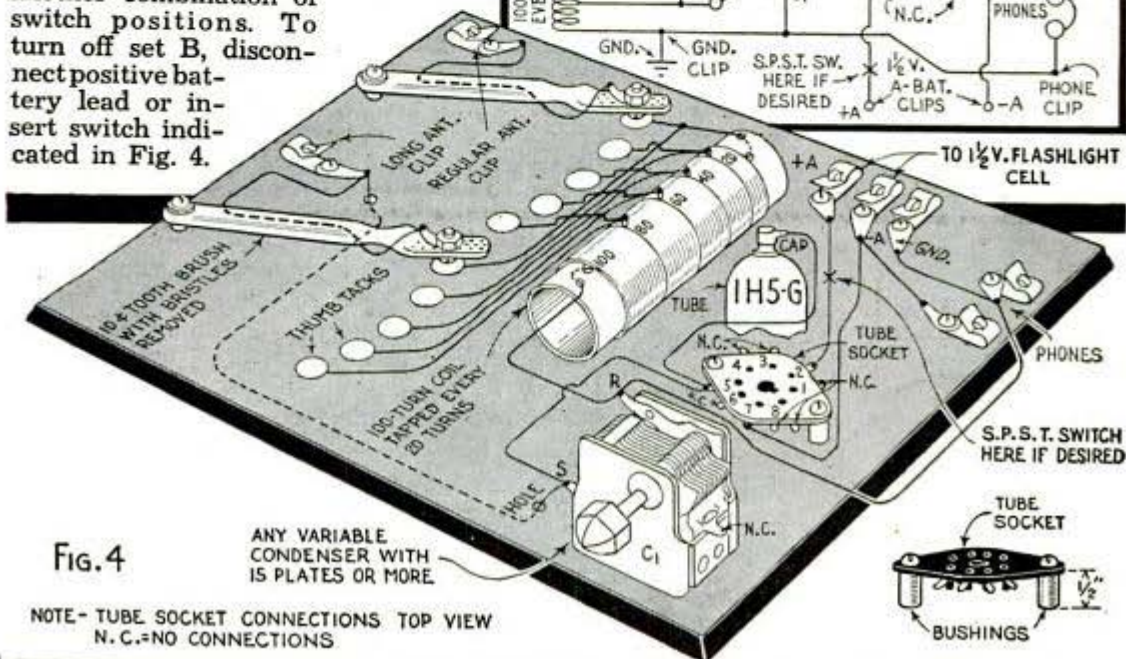
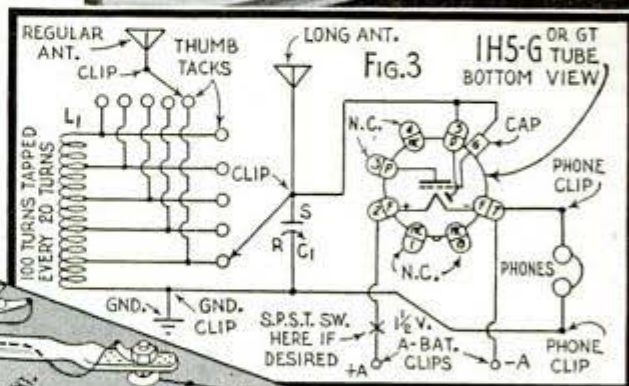
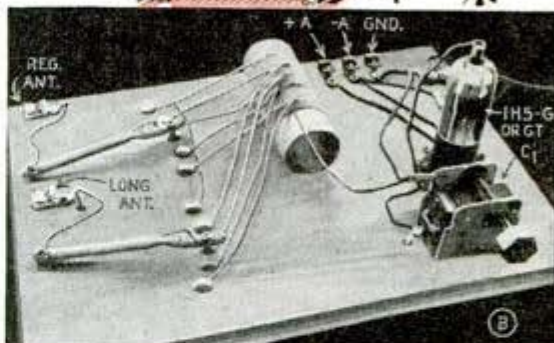


FIG. 4

ANY VARIABLE CONDENSER WITH 15 PLATES OR MORE

NOTE- TUBE SOCKET CONNECTIONS TOP VIEW
N. C.=NO CONNECTIONS

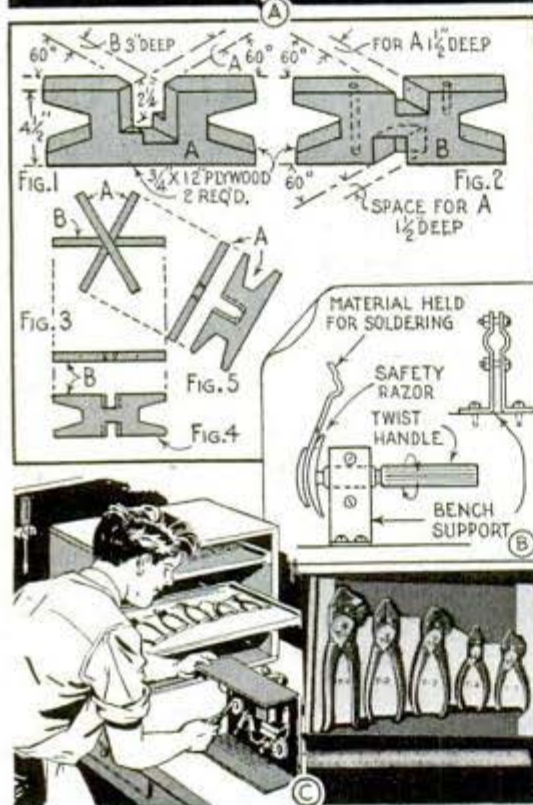
Practical RADIO SUGGESTIONS



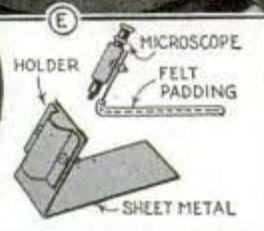
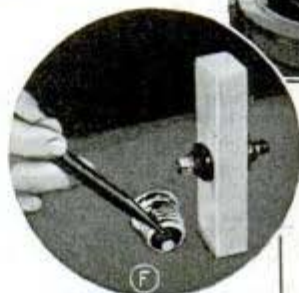
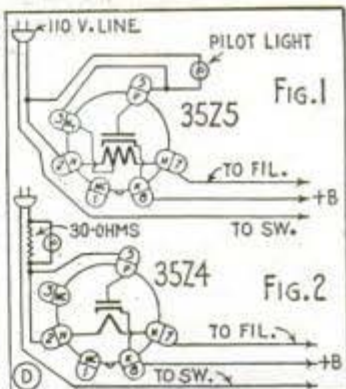
(A) Public address and film-sound extension speaker cables are difficult to replace and will last longer if coiled on a large diameter reel, than if hung on a nail or small diameter peg. The reel shown in photo A, and detailed in Figs. 1 to 5, serves as a practical electrical cable reel, and also provides an interesting sawing problem for students. It is made from 3 pieces of wood, sawed carefully to fit together and form a six-sided reel. Dowel rod handles can be withdrawn to permit laying flat. (B) Old safety razor of the "hoe" type, with screw-in handle, mounted on radio workbench by means of a simple bracket, acts as vise to hold small parts for soldering or assembly



(C) Tool trays help radio students and experimenters to identify and keep track of valuable tools. These pliers were outlined on a board which was then cut on a bandsaw to provide the proper shaped retaining blocks which were glued to the trays and numbered to correspond with identifying numbers on the tools



(D) You can substitute a type 3524 tube for a 3525. If a pilot light was used as in diagram Fig. 1, insert a 30-ohm 1-watt resistor in series with the a.c. line and connect the pilot light across it as shown in Fig. 2. (E) Microscope holder for viewing home recorded record grooves by reflected light. (F) Lead-in insulator made from composition ends of burned-out glass enclosed fuses, and a machine screw. To dismantle fuse break shell and remove rivet



Life smiles on the
man with

Pipe Appeal



BLONDE or brunette—
they prefer the man who smokes a pipe!
But don't let 'em down! Follow through—
with true PIPE APPEAL! Put Prince Albert
in the bowl. FRAGRANCE to keep 'em
smiling—on a date—at home—in the office
—anywhere. GOOD TASTE to keep you
smiling—rich taste, yet *mild* and *mellow*,
easy on your tongue. P. A. is no-bite treated,
crimp cut—the world's largest seller. Keep
'em smiling with Prince Albert Tobacco—
PIPE APPEAL for all!

BUY WAR BONDS AND STAMPS

PRINCE ALBERT

THE NATIONAL JOY SMOKE

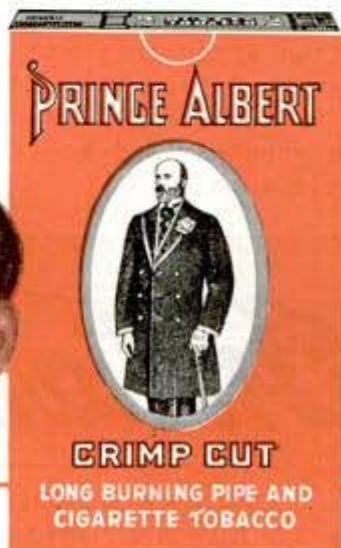
50

pipefuls of fragrant
tobacco in every
handy pocket pack-
age of Prince
Albert

70

fine roll-your-own
cigarettes in every
handy pocket pack-
age of Prince
Albert

IT'S THE NO-BITE
SMOKE —
THE RICH TASTE
COMES THROUGH
MILDLY!



America's No. 1 War Crop

(Continued from page 43)

its original form, or as cloth, or in plastic parts, the Quartermaster Corps reports.

The army uses 11,000 different cotton items. Cotton clothing has been found warmest for Arctic wear and coolest for the tropics. Ski troops are clothed in tightly woven, wind-resistant cotton fabric. Their reversible outfits are white on one side, for snowy backgrounds, and green on the other, for forest fighting.

Tropical clothing of cotton is designed for comfort, light weight, and resistance to heat, rain and perspiration. For jungle combat there is an all-cotton one-piece uniform with built-in suspenders to hold up pocketfuls of grenades. Every item worn by such a jungle soldier is cotton, from plastic helmet liner to mosquito gloves and rotproof shoes, haversack, gun sling and water bag.

Warplane crews wear electrically heated cotton suits, containing coils wired to electric batteries, eliminating the need for heavy, cumbersome clothing at high altitudes. Testing such wired-up clothing, one scientist slept outdoors at 30 below zero, covered only with a cotton sheet warmed with wire coils. All-cotton parachutes are used to deliver supplies by air, and personnel parachutes have cotton cords and harnesses.

Rubberized cotton appears in blimps and balloons for war patrol and weather observation, hoses, belting, tubing and rubberized garments. In all, it takes 250 pounds of cotton per soldier to equip the army.

And now, if you still haven't figured out the guessing game that opens this article, here are the answers:

"You wear me (from hat lining to shoe laces); eat me (as vegetable oil products); sleep on me (sheets, pillow cases, mattresses); ride on me (every automobile contains 65 pounds of cotton); read out of me (book bindings); look at me in the movies (photographic film); rub me on your face (cosmetics); I make your radio play (insulation of all wire); fire me out of guns (smokeless powder); in planes (plastic parts); tanks (wiring, plastic parts); ships (the same and many more); descend with me in parachutes (cords and harnesses); float to safety in me at sea (collapsible boats). I'm present at your birth (hospital uniforms and baby's layette), and go with you to your grave (16,700 bales a year in caskets).

No wonder cotton has been called "the most important things that grows."



Dear Joe:

Still bronco busting!

Thought I'd left all that behind at the Lazy Y, but get a load of me in that snap.

That's an Indian Motorcycle I'm riding -- and believe me, it's a great machine. Easy and safe to handle, and it stands up under this cross country stuff like nobody's business. An Indian ought to last forever on a decent road!

I'm going to get me a personal Indian after this war and have some real fun. The old cycle fans in the outfit tell me it'll be the greatest Indian ever built. Write soon, eh?

INDIAN MOTORCYCLE COMPANY, SPRINGFIELD, MASS.



BUY WAR BONDS NOW

★ ★ TO BUY AN INDIAN LATER ★ ★



*There's been
a
big change*

IN THOSE EARLIER DAYS people didn't get around like they do now. Life has changed its tempo. Improvements have come so thick and fast, they sometimes escape attention.

For example, just compare the modern Tyson Cageless Bearing with the older, conventional tapered roller bearing. Tyson has more rollers. That's easy to see—and important, for rollers carry

the load. And size for size, Tyson "All-Rolls" Bearings last longer—almost *twice as long*.

There is plenty of proof that Tyson is the most advanced . . . the toughest . . . the longest-lived bearing ever built for heavy-duty transportation and industrial service.

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

Don't live in "an Igloo" again



KEEP WARM WITH BALSAM-WOOL ATTIC INSULATION



Did your home have the chill of an arctic igloo last winter? You don't have to let it happen again. For right now, quickly and inexpensively you can assure yourself of greater comfort with less fuel with Balsam-Wool Attic Insulation.

Balsam-Wool, highest efficiency insulation, is guaranteed to give you complete satisfaction or your money back. It is tailor-made to your attic—easy to apply. Hundreds of thousands of pleased home owners can testify to the lasting comfort and fuel savings that go on year after year as a result of the outstanding performance of this product.

Balsam-Wool is the original sealed Attic Insulation—windproof, moistureproof and fire resistant. Its quality is fully proved by twenty years of usage in the most frigid markets. Don't wait. Buy now while materials are available. See your lumber dealer about easy monthly payments or mail the coupon.

Balsam-Wool

SEALED INSULATION

WOOD CONVERSION COMPANY
Dept. 210-10, 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.....



The Bomber That Fights Anything

(Continued from page 87)

H. Smith, who paid a call with his Flying Fortress teammates on the St. Nazaire submarine base. Homeward bound, a burst from a Nazi plane caused an explosion amidship, wrecking the electric controls and starting a fire. Two men bailed out. A waist gunner got stuck halfway out the hatch, and Sergeant Smith pulled him in and got him to another escape hatch at the rear. He stuck around, himself. Wrapping a sweater around his face to save it from the flames, he administered first aid to another wounded gunner and then fought the pursuing Focke-Wulf fighter with first one gun and then another until the fire began exploding his own ammunition inside the fuselage. Sergeant Smith dumped overboard what blazing wreckage he could grab, emptied all the extinguishers and water available on the fire and then beat at the flames with his own hands. He had the fire about under control when Lt. Lewis P. Johnson brought the wounded plane down on English soil.

The waters of the Solomons were happy hunting grounds for Capt. John W. Carpenter's Fortress. He tells of one raid: "Hunting was good that morning. The waters were full of Jap ships. I was flying at 5,000 feet, just before dawn. First we located a cruiser, made several passes, but ack-ack coming up almost between the engines made it tough for us to get into the right position. I circled to make another pass and we spotted a battleship that was the biggest thing I've ever seen.

"The battleship took refuge between two small islands and hemmed herself so she could not dodge the bombs. On our first pass we dropped four 500-pounders which hit about 300 feet beyond the battlewagon. I turned and came right back over the battleship, expecting terrific ack-ack; surprisingly, the Japs didn't fire. Langjahr, our bombardier, dropped four more bombs and the next thing I knew, the bottom turret gunner yelled over the phone 'We blew the rear end off that big baby!' Then the tail gunner shouted 'Holy smoke! She just blew up!' Langjahr had made two direct hits and two near misses with four quarter-ton bombs. He must have hit the powder magazine; the ship blew up so completely it wasn't even burning when we returned later to survey the damage."

Among the Flying Fortress legends from Africa, the epic flight of Thunderbird holds a high place. Fighting off swarms of enemy fighters, shooting down six, the crew

(Continued to page 150)

AUTO-LITE SPARK PLUGS

IN SERVICE ON EVERY FRONT



"Gran'maw—thar's someone a-knockin' at the door!"

"PLUG-CHEK" WAKES UP SPARK-WEARY ENGINES

Today, opportunity is knocking at the garage doors of America's car owners. Here's the good news! If your car is "spark-weary" Auto-Lite Spark Plug dealers can help you make your gas coupons go further with "Plug-Chek" inspection service.

Actual tests by the American Automobile Association show "Plug-Chek" can increase gas mileage as much as 12%.

Get more essential miles of transportation. Ask your nearest Auto-Lite Spark Plug Dealer for "Plug-Chek" Inspection Service today.

THE ELECTRIC AUTO-LITE COMPANY
Toledo, Ohio • Merchandising Division • Sarnia, Ontario



Color and condition tell if plugs are operating properly. Matching your plugs with those illustrated on the "Plug-Chek" is the first step in getting new life for "spark-weary" engines.

A NAME WORTH LOOKING FOR when you need quality tools



THE NORMAL Millers Falls line includes hack saw frames in 18 models, each with its special features of serviceability, convenience, and economy. "Best of all breeds" for most tool users is No. 48 (illustrated), a higher-quality frame of unusual excellence in design, ruggedness, and value. Rigid; fine balance; polished and buffed finish; comfortable checked Lumarith unbreakable handle. Adjustable for 8 to 12 in. blades.



IDEAL companion for No. 48 is Tuf-Flex, the most efficient and economical general-purpose hand saw blade ever developed. Won't break, won't strip. Bites cleanly through tough rods or thin tubing. A good example of what we mean by "Millers Falls Quality."

STANDARD items of excellent reputation in the normal Millers Falls line are 52 sizes and styles of cold chisels and punches, hammer-forged of high grade steel selected for its extreme toughness. Superior heat treating — a Millers Falls specialty — makes these items uniformly the finest quality. Look for the Millers Falls name when you buy, you'll decide the results are worth extra care in selection.



MILLERS FALLS TOOLS

SINCE
1868

MILLERS FALLS
COMPANY

Greenfield, Mass.
U.S.A.

nursed the crippled plane home on two engines across deserts and an 1,800-foot mountain range. Lt. John L. Cronkhite, pilot, tells the story:

"The trip to Tripoli was like a cross-country trip at home, but on the bombing run over the Castelbenito air field trouble started. German fighters put No. 3 engine out of action. We pulled up near an escort of Lightnings for protection when suddenly No. 4 engine, also damaged by machine gun bullets, went out. German planes then went for us. The top turret gunner shot down one Messerschmitt."

The gunner describes these few minutes: "I cut the tail off one Messerschmitt with a burst, then I got mine. Two Jerries came at me from different angles. I traded shots with one of them and turned to fire at the second when I saw a puff of black smoke from his plane. Something hit the turret and I hit the floor."

The pilot continues: "A 20-mm. shell had hit the turret, wounding the gunner, but the bombardier climbed into the turret and bluffed the enemy fighters with empty guns. The Germans had put a shot through a pipe. When I looked over my shoulder I thought the whole plane was running with fluid. We were moving so slowly on two engines the remainder of the formation could not give us cover. We were attacked repeatedly for 75 miles. One Jerry nearly hit our nose in a head-on attack. I knew I was supposed to be hit by his fire, but I didn't feel anything.

"By this time the plane was laboring at 125 miles an hour at 900 feet. I was fighting to keep her level and the rest of the crew was keeping watch for more Germans and bandaging three wounded men. Our next problem was to lift the heavy bomber over the mountains. We nursed it up hundreds of feet and flew alongside the range, praying that No. 1 engine, which had been cranky in the past would not fail. Suddenly I saw a pass through the mountains. I asked the navigator, 'How about it?' He said 'Hell, go ahead. It's okay with me.'

"Holding my breath, I threaded the plane through the pass. When we cleared it, we sighted the desert beyond. The bombardier said 'We were so close to the mountain on my side, I could have got out on a wing and touched it with my foot.'

"We headed for our base with the gasoline gauges falling. We'd been flying so long we thought we saw the field five times before we did sight it. Everyone cheered when we reached home!"

These are the planes, these the men who are taking the war home to the enemy that started it.



They graduate from "Evinrude University" to serve on fighting fronts around the globe

EVEN before America went to war, companies of uniformed men began to fill the "class rooms" of Evinrude's long-established service school. Even then fighting Evinrudes were coming off the production lines. To keep them running under the toughest service conditions motors have ever faced . . . to patch up battle-scarred motors and speed them back for more — requires battalions of resourceful, highly-trained experts in outboard handling, maintenance and repair.

Since Pearl Harbor, "Evinrude University" has been in constant session. Swiftly and efficiently it has helped train class after class of outboard experts for the Armed Services. Veteran Evinrude instructors have streamlined their wealth of

experience into a few brief weeks of intensely practical training. Now, on fighting fronts around the globe, "old grads" of the service school know all the answers to *keeping 'em running!*

We are glad that our peacetime Dealer Service School was equipped, staffed and ready for its wartime job. Serving America's fighting forces with all our resources necessarily restricts service and parts available to Evinrude users. After Victory there will be sparkling new Evinrudes . . . and again, complete and satisfying service to every owner of an Evinrude motor!

EVINRUDE MOTORS, Milwaukee, Wis.
Evinrude Motors of Canada, Peterboro, Canada

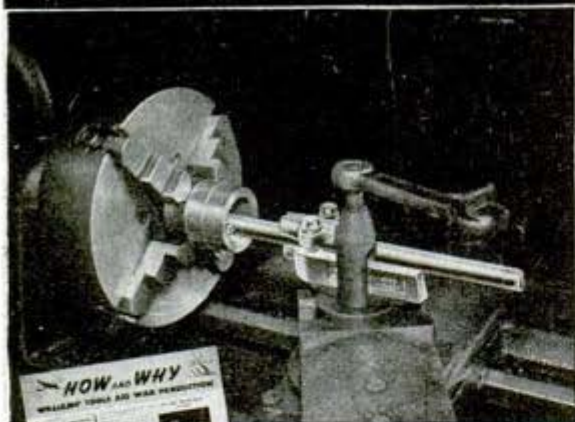


EVINRUDE
OUTBOARD MOTORS

★ HELP SPEED VICTORY . . .

. . . BUY MORE WAR BONDS

HOW TO USE WILLIAMS' LATHE TOOLS FOR INTERNAL THREADING



FREE! WILLIAMS' TOOL DATA SHEETS

Once explained, internal threading with Williams' Tools is simple. Data Sheet No. 15 tells how. Other Data Sheets in the series are listed below. Circle the numbers of those desired on coupon and mail today. They're punched for 3-ring binder.

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| 2. Data on Williams' Boring Tools. | 9. Saving Time with Williams' "Supersockets" |
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WILLIAMS
SUPERIOR DROP-FORGED TOOLS

Get Fit to Fight

(Continued from page 53)

if he lives in a noisy city. He has schooled himself not to pay any attention to what goes on around him or he would be driven frantic by distractions.

If you want to re-educate yourself, Colonel D'Eliscu has the exercises for this, too. In fact some can be made into parlor games.

Seat yourself blindfolded in the middle of the floor. Your friends are cautioned to move about quietly, but to try to grasp a stick which you hold in your hand. Whenever you hear a noise, you simulate firing in the direction you think it came from. If you are accurate, the person "hit" is "dead" after being caught in your line of fire.

If may be a game for you, but it's honest-to-goodness war training for our boys who will be facing death in the dark on distant shores.

The ability to see things without looking at them, says Colonel D'Eliscu, is important to all soldiers, but especially to aviators, who must concentrate on their flying and yet be on guard against sudden attacks. Peripheral vision also contributes much to the success of players in team games.

Look directly in front of you while other men on either side make some movement with hand, foot, or body. Try to tell what they are doing and check with them on the accuracy of your description. If you cannot see them, ask them to move a little more to your front and try again. With a little practice you will be able to see things at a surprisingly large angle from your line of direct vision.

To test your sense of touch, walk blindfolded into a room with your hands in the air, or into an enclosed space out of doors. You will step on or brush against a variety of objects. Don't feel them with your hands. After moving about, leave the room, remove the blindfold and write down what you think you touched.

You will be surprised, probably, how wrong you are. But you'll also learn what an American marine and soldier encountered in the dim and creeping jungles of the Philippines and the Solomons.

Now they're learning it over here, thanks to physical training advocates like Colonel D'Eliscu, who is resolved to leave no muscle unstretched until the men of this nation are fit to fight.

☐ You can obtain additional information about products described in this magazine by writing to the firms listed in the Where-to-Buy-It index. Say You Saw It in Popular Mechanics.

CHAMPION SPARK PLUGS

ON ACTIVE DUTY ON EVERY FRONT

In the heat of battle everywhere, on land, water and in the air, Champion-equipped engines add their roar to the thunder of our march to Victory. On the home front too, in a less spectacular way, Champion-equipped engines keep supply lines and transportation rolling with that characteristic dependability which is synonymous with the name Champion.



Spark plugs in today's high-output super-charged aircraft engines take a lot of punishment. The same qualities that made Champion the spark plugs of racing champions have skyrocketed them to favor for our most powerful aircraft engines.



Land battleships, with gas engines of greater size and power than those used by any other land vehicle, are most effective offensive and defensive weapons. Engines must not fail, and tanks with Champion-equipped engines are on every front.



"Handy Andy" of our armed forces everywhere, Champion Spark Plugs keep plugging away through hell and high water in the majority of all jeeps.



Patrolling our coastal waterways is an entire navy of smaller power boats. Champion-equipped gas engines give them extreme speed and maneuverability.



Cars, trucks, and buses, troop transports and commercial transports are all equally vital to the war effort. Champion Spark Plugs are actively in the service here.



Helicopters are destined to become a tremendously valuable defense against submarines. Sikorsky Helicopters are equipped with dependable Champions.

FOR NATIONAL SECURITY—FOR PERSONAL SECURITY—BUY WAR BONDS



"DURATION" HOME MECHANICS—Attention! Stop those leaks. Seal those cracks. Repair those breaks. Tighten those loose parts. Do it yourself—quickly, expertly, inexpensively. Do it like the professionals do—with Smooth-On No. 1, the metal cement that requires no heat, no previous experience. For nearly half a century a "must" with mechanics, plumbers, repairmen.

Repair your boiler, water pipes, steam pipes, tank, auto radiator, crank case. Tighten fixtures, tool and utensil handles, casters, hinge screws, etc. With Smooth-On you'll do jobs you never dreamed you could do, little and large repair jobs in home, shop, garage.

In wartime, with professional mechanics so scarce and so busy, *take over—yourself*. Get a can of Smooth-On today and have it handy. And be sure to get this—

FREE 40-PAGE REPAIR MANUAL

Tells and shows how to repair leaks, breaks, cracks, etc. in all kinds of household, auto and shop equipment—repairs that last. 170 diagrams. Simple instruction. Will save you plenty in reduced upkeep expense. Absolutely FREE!



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570 Communipaw Ave., Jersey City 4, N. J.

SURE, I want your Free Handbook!

Name.....

Address.....

10-43.....

Free

Do it with SMOOTH-ON

The Army's "Little Hollywood"

(Continued from page 59)

made for distribution to training centers throughout the country.

Other branches of the service, air corps, navy and marines, have followed the army's lead in adapting training films to their varied programs. Most of these films, however, are produced by private companies working under the direction of aviation, naval and marine officer technicians. War industries are also using films to teach men and women workers how to build tanks, ships and planes.

The Signal Corps' big studio at Astoria is more than a training film production center. It is a regular army post with barracks taking the place of former dressing rooms for movie stars. Hundreds of photographers are trained here and every man must be skilled in operating both still and motion picture cameras.

In making training films by the hundred, the Signal Corps has put America's greatest entertainment medium in uniform. When Johnny writes home from camp that he spent the morning going to a movie, don't worry about the army going soft. His movie glamor girl is probably a 155-mm. howitzer.

They Pack the K.O. Punch

(Continued from page 25)

10 to 13 battleships (figuring that 2 were lost in the Solomons); Italy, 5 to 8 battleships; and Germany 3. This makes a total of from 18 to 24 for the Axis against a possible 35 or 37 for the Allies.

No matter how cruelly the war lords of Japan and Germany drive their workers, they cannot hope to catch up with the stupendous shipbuilding program of the United States. American shipbuilding speed is one of the factors that Hitler and Tojo overlooked.

Secretary of the Navy Frank Knox has revealed that the U. S. Navy's five-ocean fleet, originally scheduled for completion in 1947, will be ready for service in 1945.

But even in this autumn of 1943, concentrating its naval might around the new battleships and carriers, the U. S. Navy will give a good account of itself. Watch and see what happens when hell on keels breaks loose against Japan!

☛ You can obtain additional information about products described in this magazine by writing to the firms listed in the Where-to-Buy-It index. Say You Saw It in Popular Mechanics.



"My *Buddy* back home
is my Harley-Davidson"

That's what the men in the armed forces say about the Harley-Davidsons they left at home. And typical of what the boys who ride Harley-Davidson Motorcycles in the war think is this excerpt from a letter: "Out here Harley-Davidsons are the best a man could ride. They have the guts to get up and pull out of any sand hole within reason. We climb sand dunes sometimes as high as 40 or 50 feet without any trouble at all. They take all the punishment we can dish out — cross territory even tanks can't get over. One of our ranking officers said the other day, 'our motor jockeys would ride those Harley-Davidsons through hell and back and make their own road.'" Sounds like the good old endurance run, hill-climb, gypsy tour and race meet days, doesn't it? Those days will be back, and when they are, Harley-Davidson will have even better Motorcycles for you. Mail coupon today!



Free

**HARLEY-DAVIDSON
MOTORCYCLES**

HARLEY-DAVIDSON MOTOR CO.
Dept. P, Milwaukee 1, Wisconsin

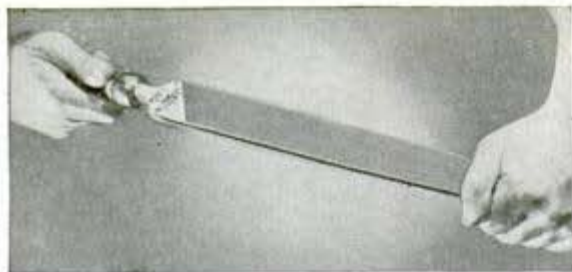
Please send at once free copy of 24-page "Enthusiast" Magazine, filled with motorcycle action pictures and thrilling stories.

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SEND COUPON NOW



ITS BIG TEETH HAVE LITTLE TEETH



Micrograph enlargement of serrated teeth of coarse double-cut file.

AN ODDITY? You might call it that. But in serrated tooth construction, Nicholson has demonstrated that even in such centuries-old implements as files, engineering science keeps finding new things to keep pace with industry's march.

Besides greatly increasing filing speed, serrated teeth virtually give Nicholson or Black Diamond files "second wind." As each "little" tooth wears down, another brings up a fresh cutting edge. Result: longer efficient file life; a greater number of effective strokes per file; more work per worker; more filing production at less cost.

Through four generations of file-making experience, Nicholson has contributed many advancements. . . . In improved file designs. In faster and more accurate methods of cutting file teeth. And in thoroughly controlling every step of manufacture. Whether you buy one or a thousand, you'll find these famous files so uniformly made and hardened that Nicholson can guarantee "*Twelve perfect files in every dozen.*"

FREE BOOK, "FILE PHILOSOPHY"—The most authoritative and interesting book of its kind . . . 48 illustrated pages on many kinds of regular and special purpose files; use and care of files—with additional information of inestimable value to purchasing and production heads, foremen, key mechanics, farmers, repairmen. *Send for your copy.*

NICHOLSON FILE CO., 22 Acorn St., Providence 1, R. I., U. S. A.
(Also Canadian Plant, Port Hope, Ont.)

NICHOLSON
FILES FOR EVERY
PURPOSE



Fighter Planes by Special Delivery

(Continued from page 32)

ticular flights. Those who are assigned to deliver planes into the cold north draw heavy winter flying clothes. Planes that are destined to cross water are equipped with rubber life rafts that inflate themselves automatically upon being opened, and that carry new radio distress transmitters. Such a transmitter sends out an SOS signal automatically when a crank is turned. The ground wire is tossed into the water and the antenna is carried aloft by a lightweight box kite or, if there is no wind, a small hydrogen generator is used to fill a balloon that can lift the antenna. Cross bearings on the SOS signals can be taken by receiving stations to locate the life boats, then a plane can be sent to rescue the men.

A jungle kit is provided to pilots who are going to the tropics. The kit includes a booklet that tells how to make a controlled crash landing, how to use a parachute for a tent, and convert a seat cushion into a sun helmet. There are instructions on how to find water and on how to recognize edible plants. The general rule is to eat anything that monkeys eat, and to eat the monkeys, too.

Airplanes as well as the ferry pilots need special equipment. In fact, relatively few airplanes as they come from the factories are ready for battle action. First they need to be modified for the area in which they are to be used. Part of the ferrying division's duty is to fly new planes to modification centers for their final preparation. Planes are "winterized" or "summerized" for arctic or tropical use by special carburetion and treatment of oil and fuel lines. Final camouflaging, depending on whether a plane is to be used over the deserts, jungles, or oceans, is also put on. New navigation equipment is put in place and other changes are made to meet specific requirements of climate and combat.

The Air Transport Command is hardly two years old and already it has delivered parades of planes and tons of equipment to many parts of the world. It has pioneered its own air routes, built its own fields, and even established its own weather stations in the Arctic in locations so remote that the weather crews are dropped by parachute. When the whole story of what the command is doing can be told, says General George, it will make reading that sounds like Jules Verne.

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

Out on a Limb

ABOUT WHAT BATTERY TO BUY ?



BUY THE BATTERY THAT IS THE CHOICE OF EXPERTS

When you buy a battery you won't be out on a limb—if you are guided by the experts who choose batteries for the world's toughest transportation services. For example a million-mile trans-ocean flying record has just been established by a Pan-American Clipper equipped with Auto-Lite batteries.

Auto-Lites, too, are specified for service with our fighting forces in tanks,

half-tracs, jeeps...wherever dependable power counts.

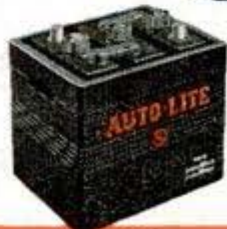
Gasoline rationing demands better performance than ever of your battery. Get the longer life... the extra power you need. Make your next battery an Auto-Lite — specified by leading automotive engineers—built by the world's largest independent manufacturer of automotive electrical equipment.

TOLEDO, 1 AUTO-LITE BATTERY CORPORATION OHIO
Manufacturing Plants at: Niagara Falls, Atlanta, Indianapolis, Oakland, Oklahoma City, Toronto



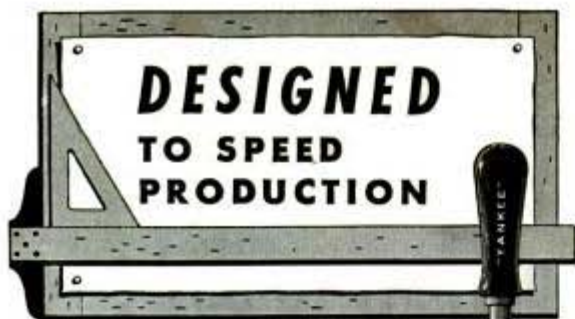
The "Million-Mile" Clipper uses AUTO-LITE Batteries for its ocean-spanning flights.

AUTO-LITE Batteries have been proved under fire on every fighting front.



AUTO-LITE means AUTO-LIFE

AUTO-LITE BATTERIES



As industry rewards employees who suggest ideas that speed production, so do "Yankee" Fine Mechanics' Tools reward industry by saving time and energy on countless jobs. From Spiral Screw Drivers to Tap Wrenches and from Automatic Drills to Bit Braces, each "Yankee" Tool has been painstakingly *designed* to get things done. Ingenious and dependable, "Yankee" Tools have contributed to the efficiency of American production for nearly half a century. Today, of course, they've gone to war and are not always available at your dealers.

"YANKEE" SPIRAL SCREW DRIVER No. 130A
A Size For Every Purpose



"YANKEE" TOOLS
make good mechanics better
North Bros. Mfg. Co., Phila., U. S. A.
Established 1880

Makers, also, of "Yankee-Handyman" Tools



Batteries have gone to war,
In the air, on seas, on shore;
You can't buy them as before:
When it's over there'll be more.



UNFAILING SERVICE
FOR 32 YEARS



Planes of 1953

(Continued from page 5)

properties was established, 100 octane was considered a perfect anti-knock fuel. Today for much work 100 octane gasoline is routine and super fuels giving much better performance when utilized with engines designed for their use are available.

Whether we go to squirt propulsion or not, our propellers themselves show constant improvement. The new contra-rotating types eliminating torque and providing much-needed blade areas to improve efficiencies are becoming available.

Progress has created another problem which engineering must consider. It involves assisted takeoff acceleration and perhaps landing acceleration. We are constantly running wing loadings higher, but airports can't grow much more; so either wing loadings will have to stop, or assisted takeoff by gravity, catapult, rocket or other device will have to be developed.

These are only a few of the engineering thresholds of today. Let us try to see what these thresholds may lead to within a decade.

First we shall have a nation and a world which will owe their freedom to air power. Security in the future will be synonymous with the dominance of air power. In the U. S. Army and Navy alone we shall have over 2,000,000 men returning to civilian life, each trained in some phase of aviation and most of them wanting to stay in aviation and probably wanting to operate an airplane of their own. In addition we have already well over a million men and women in the aviation industry. By way of comparison, airplane manufacture, including all its phases, which in 1939 ranked 44th in dollar value of products, today ranks first.

We shall also have in the peace many, many air fields built to feed this machine of war and then available to commerce. Aviation should then take its proper place in the transportation and private travel picture. I have always deplored the belief that aviation will replace other forms of transport. I doubt whether aviation will ever touch nine-tenths of the transportation now carried by rail, road and water. Each has its particular utility, and aviation has its purpose quite definitely defined. Among other things it will create new opportunities for trade and stimulate new desires to travel. Aviation will simply supplement and be supplemented by the rest of the vast transportation system.

With the advent of the transcontinental overnight sleeper plane it became possible

(Continued to page 160)

Finger Man - AT MIDWAY



To avoid the possibility of giving information to the enemy, illustration of the Torpedo Director, intended for this space, has been omitted.



↑ TORPEDO DIRECTOR
AUTOMOTIVE SPARK
PLUG



NEVER had aircraft done more damage to warships than U. S. torpedo bombers did in the great Battle of Midway. Some of the credit belongs to the torpedo directors which enabled our fliers to "put the finger" on the enemy.

Torpedo directors are accurate because they are made with extreme precision, and kept in condition by trained technicians.

Trained Technician Service Awaits YOU

America's automotive repair men are *your* trained technicians. They can give your spark plugs the cleaning and adjusting they must have. They can also give expert service on the eight other AC products with which millions of vehicles are equipped. Thus, these men can help you conserve gasoline, oil, and tires.

Take a minute, won't you, to read the few details (below) of the care your AC products should receive? When replacement becomes necessary, select AC—and be sure of complete satisfaction.



Awarded to AC on September 2, 1942, and renewed on June 19, 1943, for outstanding achievement in producing for Victory.

AC SPARK PLUG DIVISION — GENERAL MOTORS CORPORATION

SPARK PLUGS—Dirty or worn plugs waste as much gas as one coupon in ten. Oxide coating collects on the plugs and causes them to misfire,—especially when the engine is working hard. Dirty plugs also cause hard starting which weakens your battery. Under present slow driving conditions, have your plugs cleaned and adjusted every few months.

AIR CLEANERS—A dirty air cleaner increases gasoline consumption because it chokes down the flow of air into the carburetor. Your air cleaner should be rinsed whenever your car is lubricated.

FUEL PUMPS—Practically trouble-free. But, if yours has been in use thirty or forty thousand miles, it

may be worn to the point where a check-up is due.



DRIVING INSTRUMENTS—Speedometer, gasoline gauge, oil pressure gauge, ammeter, and temperature gauge seldom need service. But, if they give trouble, have them cared for at once.

OIL FILTERS—Slow driving accelerates formation of soot and carbon in engine oil. If not constantly filtered from the oil, this dirt will clog piston rings, cause increased consumption of oil and gas. So, replace your oil filter element whenever your dealer's AC Oil Test Pad shows that your oil is dirty.

BRING VICTORY QUICKER—BUY U. S. WAR SAVINGS STAMPS AND BONDS

THIS IS THE WHEEL, MR. JONES



Maybe you were stumped by grinding jobs before, but they won't worry you anymore.

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



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 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.

J. W. MORTELL CO., 522 Burch St., KANKAKEE, ILL.

for a New Yorker to spend a weekend on the Pacific coast, and vice versa. Many did. Certainly this travel did not come from any other source. No other source could provide the same service in less than a week. This was a new opportunity and the travel using it was new. The same will be true when a New Yorker can spend a weekend in London or Moscow.

Each prominent airport should become a beehive of industry in itself. All modern air terminals already have many auxiliary businesses—newsstands, barber shops, lunch rooms, in some cases branch banks, haberdashery stores and other shops, and certainly every airport in the future must have a large garage and drive-yourself system. A car-rental bureau at every airport would mean that a business man could walk directly from his air liner to the car station, make his business calls by automobile and return to the airport ready to fly the next portion of his trip.

So let us step over the thresholds for a minute and look at 1953 with a world at peace—and I hope with an international police force, with international freedom of the air, and in these United States some hundred thousand miles of modern airways; some of them multiple airways; a thousand cities served by air transport and many thousands of others on mail, express and perhaps passenger pickup, with transport service of one hour, every 30 minutes, from New York by air to Boston; two hours every 30 minutes to Chicago; seven hours every hour to the Pacific coast, overnight to London—and with a large number of people owning a private plane of rotating lift or conventional type.

Fanciful, yes—but I believe it can come true. Engineering wise it is possible. And if it does come true, I hope I can have a part in bringing it about.

Orchardist Acts as "Human Bee" To Aid in Pollination

Hand pollination of fruit trees is a growing practice among orchardists. A fine brush is used to transfer pollen from blossom to blossom. It is especially advantageous in high altitudes where there is little insect life to spread the pollen; in years of poor weather when bees are not abundant, and—in any climate—on the shady sides of trees, where bees are not so active as they are on sunny sides. The "human bees" can assure a good crop by activity during blossom time, and can aid in proper spacing of the fruit. The Washington State Apple Commission reported that 7,000 ounces of pollen were used in that state last spring.

Spokane, Washington

POPULAR MECHANICS

A GOOD NUT ALWAYS HOLDS

● When a nut slips it falls down on the only job it has to do.

When it shakes loose it fails in its sole purpose.

It takes a good nut to hold fast and stay put against stress and vibration.

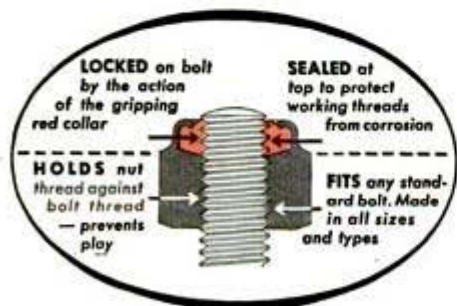
The Elastic Stop Nut does.

In its top is a red elastic collar. This collar molds itself tightly to the bolt. It keeps the nut and bolt threads in pressure contact. The nut can't wiggle or turn.

This is what makes the Elastic Stop Nut stay tight.

We've been making Elastic Stop Nuts for years. Millions of them every day go into war production. Some of our planes take as many as 50,000 in a single ship.

Yet of actual billions in use, we have never heard of one of these nuts that has failed to hold better than any other similar fastening.



ELASTIC STOP NUTS

Lock fast to make things last



ELASTIC STOP NUT CORPORATION OF AMERICA
UNION, NEW JERSEY AND LINCOLN, NEBRASKA



"Double Your
Money Back"

IF YOU DON'T GET
**BETTER AND SMOOTHER
MOTOR PERFORMANCE**
WITH **CASITE**

● If your motor has lost its pep and punch, get the quick, speedy relief that CASITE gives and guarantees!

CASITE restores performance—makes any motor run better and smoother, because it cleans out and keeps out power-destroying sludge, retards the formation of engine varnish, and frees up gummy, sticky valves and rings.

Join the thousands who are using CASITE to keep their war-weary motors at top performance. Get a CASITE tune-up today, from your car dealer, garage, or service station.

THE CASITE CORPORATION
HASTINGS, MICHIGAN



HERE'S CASITE'S
SENSATIONAL
GUARANTEE

Guarantee

YOU ARE THE JUDGE—

Add Casite to crankcase and run through carburetor according to instructions, then drive your car 100 miles or for 60 days, whichever is first. If not convinced that Casite gives you better and smoother performance, you get double your money back by filling out guarantee certificate and mailing it to The Casite Corporation, Hastings, Michigan. Maximum refund is \$1.30 per pint, which is twice the nationally advertised price of Casite.

CLEANS OUT MOTORS • KEEPS MOTORS CLEAN

"HEATAB" TABLETS OF Concentrated HEAT



NEW! CONCENTRATED HEAT TABLETS (and vest pocket collapsible grill) widely used by armed forces. Light instantly, wet or dry. Intense heat — cooks, fries, boils food or liquids, outdoors or indoors. Ideal for starting fireplace, stove or furnace fires, for picnics, hunting, fishing . . . warming baby's milk; emergency sick room uses, etc. Also many other household and industrial uses. Every Air Warden, Red Cross Worker should have this emergency fuel. **NO SMOKE, SOOT, ASH OR FUMES. Non-poisonous.**

\$100 for TWO LARGE BOXES OF HEATABS and COLLAPSIBLE GRILL. Enough tablets for 5 to 8 hours' heat. Order by mail TODAY.

J. W. SPEAKER CORPORATION

1673 N. WATER STREET, MILWAUKEE, WISCONSIN

Over **UNCHARTED** Trails

★ No uncertainty exists on confusing turns with HULL'S HULL OF REAMLEN'S COMPASS. Drivers of U. S. Army vehicles always know their direction. Wartime engineering improvements will make this reliable guide even more desirable for civilian motorists after the war.



HULL MFG. CO., P. O. Box 246—D10, WARREN, OHIO

EMPIRE "TORPEDO" LEVELS

★ **HANDY HOUSEHOLD TOOL.** ★
Smallest, and Finest Accuracy Level Made. "Clear-shoped," can't tear pockets. Walnut stock. Has Level, Plumb, and 45° vials. 9" long. Light weight, strong. No. 44 only \$1.10. Order from local dealer. Write for literature. ★

EMPIRE LEVEL MFG. CO., DEPT. P-215 17 SOUTH SIXTH STREET MILWAUKEE, WISCONSIN

Keep car radiators cleaned out for greatest motor efficiency. Use

Sani-Flush 10c and 25c sizes
Directions on can

**DIE-LESS
DUPLICATING**

Many small parts can be formed without dies, to duplicated accuracy of .001" with DI-ACRO Precision Machines.—Benders, Brakes, Shears—saving Man Hours and Critical Materials. **Require priority of A-1-A or higher.** Write on business letterhead for catalog, or state if employed in War Production.

O'NEIL-IRWIN MFG. COMPANY
341 8th Avenue S., Minneapolis 15, Minn.



Shear

Bender

Brake

RADIONICS*

“AYE, AYE, SIR.”

In old English “Aye” meant “Yes.” But the Navy’s “Aye, Aye, Sir” means far more. It really says . . . “Your order is understood and will be obeyed.” The Navy has given Zenith many “orders” since the 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.



**“the impossible we do
immediately . . .
the miraculous takes
a little longer”**

—ARMY SERVICE FORCES

—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 → Electronics, Radar and Radio)—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

WILL YOU BE READY...



When the Air Age Comes?

You can be ready to enjoy the coming air age and fly your own Piper Cub . . . if you prepare yourself now!

Take aviation subjects at night school, study aeronautics at home. Then, when peacetime comes, see your Piper Dealer and learn to fly. He can solo you with as little as eight hours of dual instruction in a Piper Cub.

Send Today for Your "HOW TO FLY" Booklet!



Prepared by a certificated flight instructor. Clearly explains basic flight principles. Send 10c for booklet and Piper catalog to cover postage-handling. Piper Aircraft Corporation, Dept. PM103, Lock Haven, Pennsylvania.

16mm. SOUND FILM

"The Construction of a Light Airplane." For distribution points write: Supervisor, Audio-Visual Aids, Extension Services, Penna. State College, State College, Penna.



PIPER *Cub*

POINTS THE WAY TO WINGS FOR ALL AMERICANS



ONAN

ELECTRIC PLANTS

Electricity for Any Job - Anywhere

ONAN GASOLINE DRIVEN ELECTRIC PLANTS provide electricity in locations where it is not otherwise available, and for emergency standby service. Thousands of units are doing a winning job in the war.

Sizes from 350 to 35,000 watts. A.C. 50 to 800 cycles, 110 to 560 volts, D.C. 6 to 4000 volts. Also dual A.C. and D.C. output models. Air or water cooled.

Details gladly furnished.

D. W. ONAN & SONS

1086 Royalston Ave. Minneapolis, Minn.



Just Off the Press

Free Fall Catalog

Showing Hunting Footwear, Clothing, and forty-three other leather and canvas specialties of our own manufacture for campers and hunters.

L. L. Bean, Inc.

Catalog Dept. No. 18
Freeport, Me.

The Dennison Handy Helper says:

"BEFORE YOU PARK IT, LABEL IT.. MARK IT"

Dennison GUMMED LABELS

Transparent Mending Tape • Mailing Labels
Gummed Reinforcements • PRES-o-ply Labels
Index Tabs • Shipping Tags • Crepe Paper

DENNISON MFG. CO., Framingham, Mass.



BUILD YOUR OWN ARC-WELDER

For Light or Heavy Work

No rewinding necessary—use coils taken from old auto generators. Works on 110 or 220 A.C. Has 20 different heats. Complete plans and BIG Catalog 35c.

LEJAY MFG. CO., 3347 LeJay Bldg., Minneapolis, Minn.

PALMGREN

ANGLE VISES

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 1 1/2" to 8" Jaws. Orders filled on plant priority—ratings only. You may qualify. Write: Chicago Tool & Engineering Co. 8365 South Chicago Ave. Chicago, Ill.

FREE CIRCULAR "101 ANGLE OPERATIONS" describes complete line, gives many uses and details of CASH PRIZE AWARDS.

PRECISION WORK AT ANY ANGLE

EVEN THE GENERAL CHANGES HIS HAT



In time of action the leader must lay aside his trim hat, strip off his gold braid and sleek attire. He looks different—but his ability and character remain the same!...PLUMB, too, dons a "service uniform". Because of Government Limitations the appearance of some Plumb Tools has been changed. But the "hidden qualities" remain the same. Plumb Tools have the same hang and balance, design and temper that won them a quality reputation for nearly ninety years. While the fine finish has gone for the duration you will recognize Plumb design and balance by the ease and speed with which it works... Plumb is proud of its service uniform! Fayette R. Plumb, Inc., Dept. M-5, 4968 James Street, Philadelphia, Penna.

Quality Comes First — PLUMB is FIRST in Quality



NAIL HAMMER

BALL PEIN HAMMER

SINGLE BIT
MICHIGAN AXE

HALF HATCHET

PLUMB

TOOLS ARE
VITAL FOR
VICTORY
GIVE ONLY THOSE
WHICH ARE
VITALLY NEEDED

HAMMERS • HATCHETS • AXES • SLEDGES

PUSHIN' THE BRUTES AROUND

If you've been inclined to look upon outboard motors only as vacation equipment, take another look. Outboard motors have come of age. Years of development have made them mechanical marvels—and today they are doing man's work in the armed services everywhere.

A few pounds of metal, fashioned into a modern Sea-Horse, provide power to handle tons of equipment and supplies and men. With dispatch. And with **DEPENDABILITY**.

Johnson has made the outboard motor an instrument to be reckoned with—in industry as well as in war—and an instrument of infinite pleasure for days of peace. Development goes on. Someday, after the war is won, you'll see even finer models—lively, rugged offspring of the grand Sea-Horses that are in the war today.

JOHNSON MOTORS, WAUKEGAN, ILLINOIS



THERE IS NO SUBSTITUTE  FOR EXPERIENCE

JOHNSON
SEA-HORSES
for **DEPENDABILITY**

DO YOUR DUTY — BUY WAR BONDS

Better model-making—
better arts and crafts—

WITH THIS **REVOLUTIONARY KNIFE**

The very knife-design makes you do a better job. The handles make your fingers deft. Super-keenness makes effortless cutting on hard woods, cardboard or plastics. Special blade-shapes make X-ACTOS follow guide lines easily; and surgical sharpness minimizes splitting. NOW, at first sign of dulling, instant change to a new blade renews the surgical keenness. Re-blade to re-sharpen.



No. 1 X-ACTO knife for light, delicate work. 3 styles of blades. Complete with one blade. 50c. With 5 extra assorted blades \$1.50

No. 2 X-ACTO knife for heavy cutting—5 styles of blades. Complete with one blade. 50c. With 5 extra assorted blades \$1.50

No. 42 Double Set 2 handles 12 blades. \$2.00.

No. 82 Fitted wooden chest 3 handles, 12 blades. \$2.50.

GET FREE BOOK, TELLS "HOW" to build Model Planes prepared by experts. Profusely illustrated, simple, easy to follow instructions. Build solid models for Army and Navy spotter planes.

Write for **FREE "How to build Model Planes,"** Send 5c to cover handling and postage. At your local Hobby Shop, Hardware or Department Store or order direct. Extra Blades 50c for pack of 5

X-ACTO
CRESCENT PRODUCTS CO.
440 Fourth Ave.
New York 16, N.Y., Dept. PM



X-ACTO **Ever-Keen** **Knife**
RE-blade to RE-sharpen



See you saw it in *Popular Mechanics!*

Wanted! New Products!

Long-established and well-known company with modern plant for production of precision devices wants new products for post-war manufacture. Particularly interested in small and medium-sized motor-operated tools or appliances. Ideas need not necessarily be completely developed. Send only description of product, indicating purpose, market and advantages for complete, prompt, and confidential consideration. If your idea has possibilities, and will fit into our plans, further arrangements can then be made. Address Research Department, **The Dumore Company, Racine, Wisconsin**



SAVE YOUR TOOLS

in a genuine Gerstner Chest. Free Catalog to toolmakers and machinists.
GERSTNER TOOL CHESTS
443 Columbia St. Dayton, Ohio

ARMSTRONG TOOL HOLDERS

enabled American industry to change to war production "over night." For they are the permanent, multi-purpose tools used by 96 per cent of the machine shops and tool rooms, on lathes, planers and shapers—the tools used to make dies and jigs, to build production machines. They are the tools you will want for your own shop after the war—**ARMSTRONG TOOL HOLDERS** for industry, **ACE Tool Holders** for home work shops.



ARMSTRONG BROS. TOOL CO.
"The Tool Holder People"
368 N. Francisco Ave., Chicago, U.S.A.



POPULAR MECHANICS

"Good Pictures" bring you to him



1st Lieut. Bernard Shaw, 28 year old son of Mrs. Veta Shaw, who is serving with the U. S. Army in the South Pacific.

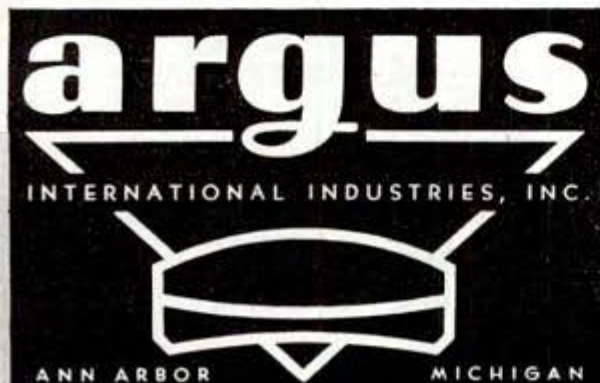
Dear Mom and Mary:

Civilization has long been a dream to us, and when we look at a magazine or pictures from the good old U. S. A. it is like looking at Mars or some far-off, mythical place where all good soldiers go.

I'm not quite up on the local situation, I want to hear about Ann Arbor, Detroit, how people act, think, and what is going on. People at home have no idea how it is not to see a building, a church, a pretty girl for seven long months.

We are not ungrateful, it's just that we always want our World held up before us—it makes it easier to go on.

Love to all,
Bernard



Mrs. Veta Shaw, who kindly allows us to publish her son's letter, is helping him by working on the production front in our Optical Division.

Get the best out of your present camera, take care of it and get "Good Pictures." Pictorial records of your daily life will be of great interest to your men abroad. Send them pictures of the things they are fighting for. Here at Argus we are building steadily 100% War Production for Victory and preparing for that time, when our new cameras will replace those that are giving such good service today.



AWARDED TO PLANT 2
OPTICAL DIVISION

Good Pictures

Learn how to use your present camera to get better results . . . learn about lenses, filters and exposure, conserve your film—make each picture a "good picture." Send 25c today for this 56 page book.

When Worming for Tape,
Round (ascarid) and Hook Worms

You Cannot Worm Your Dog WRONG



—you're sure to worm right if you follow the easy picture-detailed directions with Pulvex (the combination treatment) Worm Capsules. Here's why:

Your dog can have Tape, Round (ascarid) and Hook Worms, any or all, at the same time! To worm for all three AS YOU ALWAYS SHOULD, especially tapeworms, YOU MUST USE 2 TYPES OF CAPSULES. No single-type capsule can expel those three worms. You definitely expel them (including tapeworms) when you use the 2 types of capsules, to be given a few days apart, in the Pulvex Combination Treatment Worm Capsule package.

Worm right; avoid worming wrong for those worms; use Pulvex Capsules. Packaged two ways: for puppies, for dogs. Either 50c. Double size package, 75c. Quantity discounts to kennels; write direct to—

WILLIAM COOPER & NEPHEWS, INC.
1957 Clifton Avenue, Chicago

PULVEX

Combination Treatment
**WORM
CAPSULES**



BRUSH PLATING OUTFITS

• for autoparts, reflectors, faucets, bicycles. •
No tanks necessary. Free particulars.

GUNMETAL CO., AVE. M, DECATUR, ILLINOIS

WITTE DIESELECTRIC PLANTS

A. C.
and
D. C.



For 73 years the WITTE plant has been serving America and the World.

Today WITTE is producing only for the War Effort. After Victory these improved WITTE plants will be available to all.

Remember us then.

WITTE ENGINE WORKS
LARGEST BUILDER OF SMALL DIESELS
KANSAS CITY, MO., U. S. A.

Fix Scratches, Dents, Nicks the Professional Way!



Get This Handy Kit!

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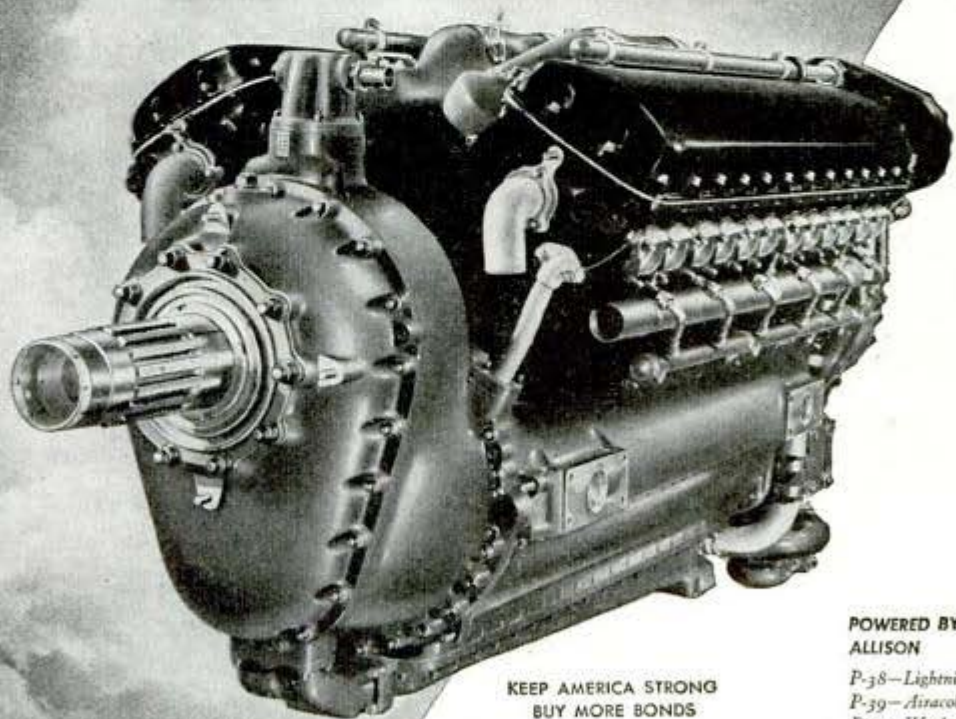
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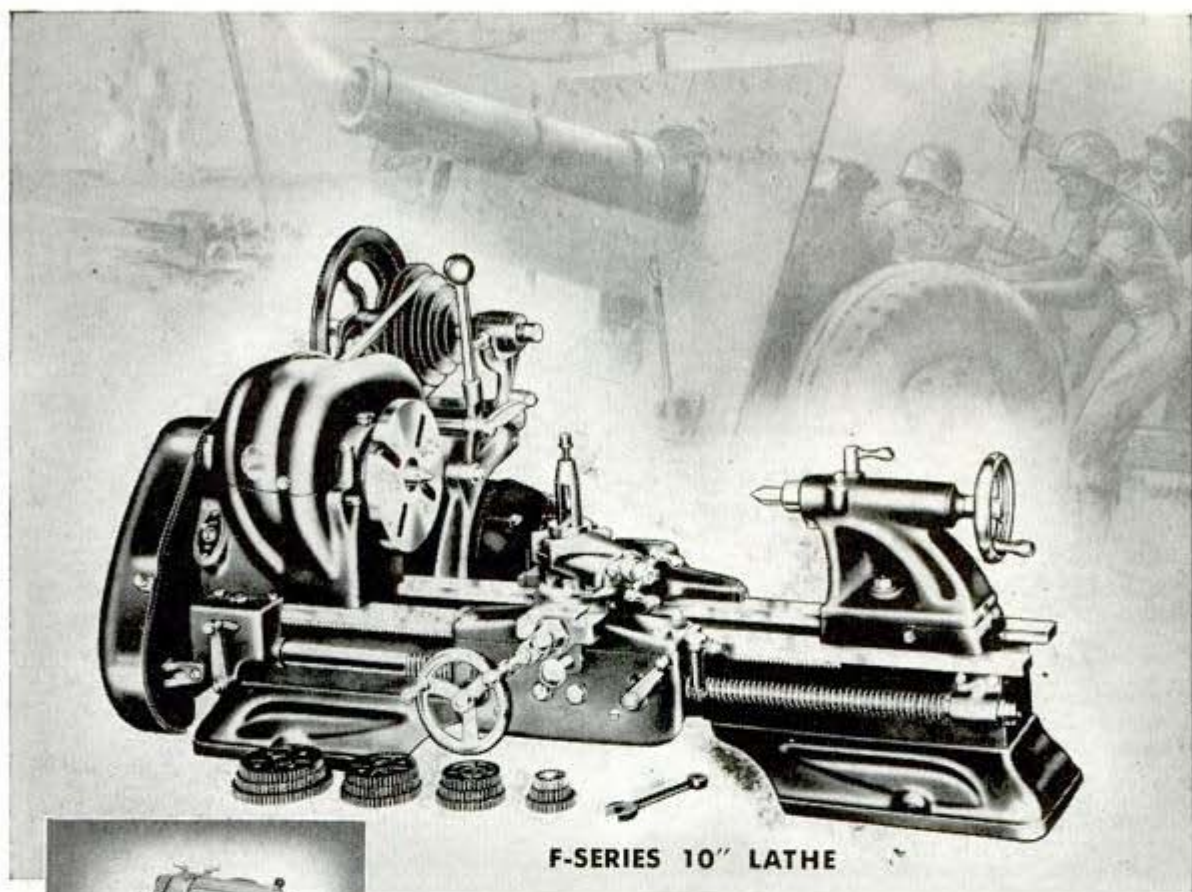
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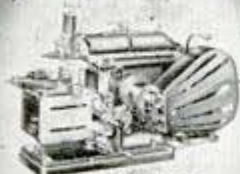
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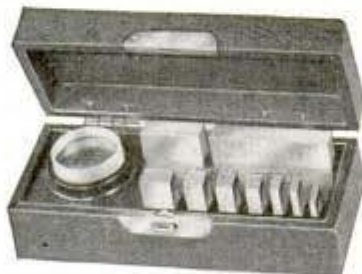
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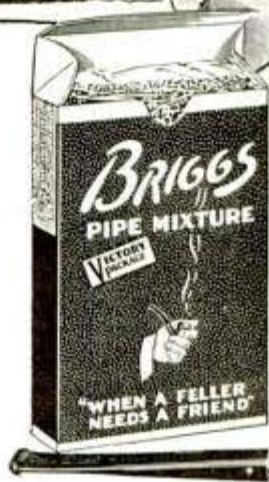
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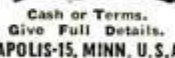
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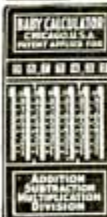
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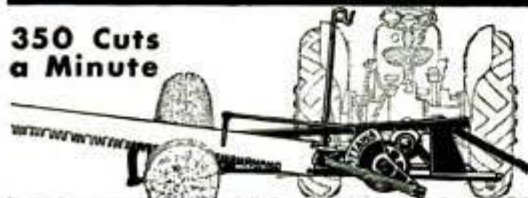
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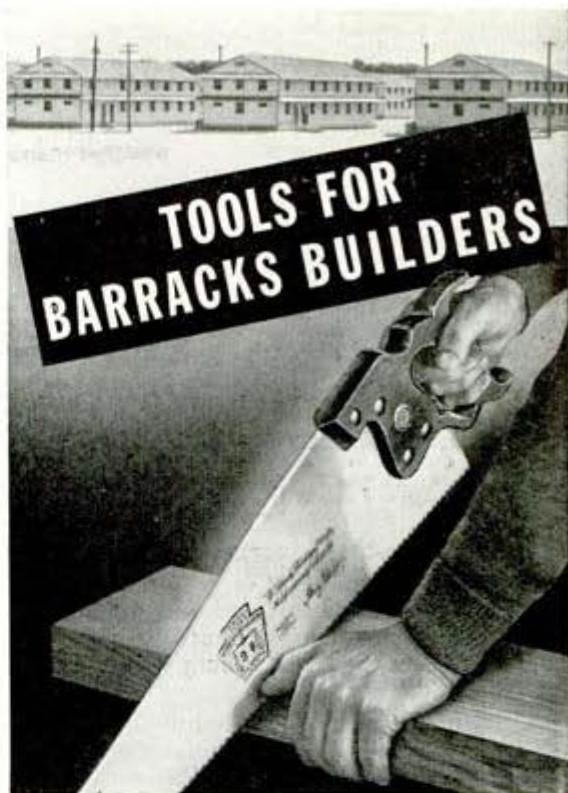


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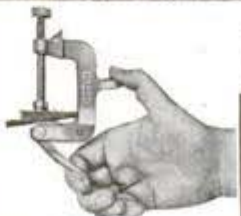


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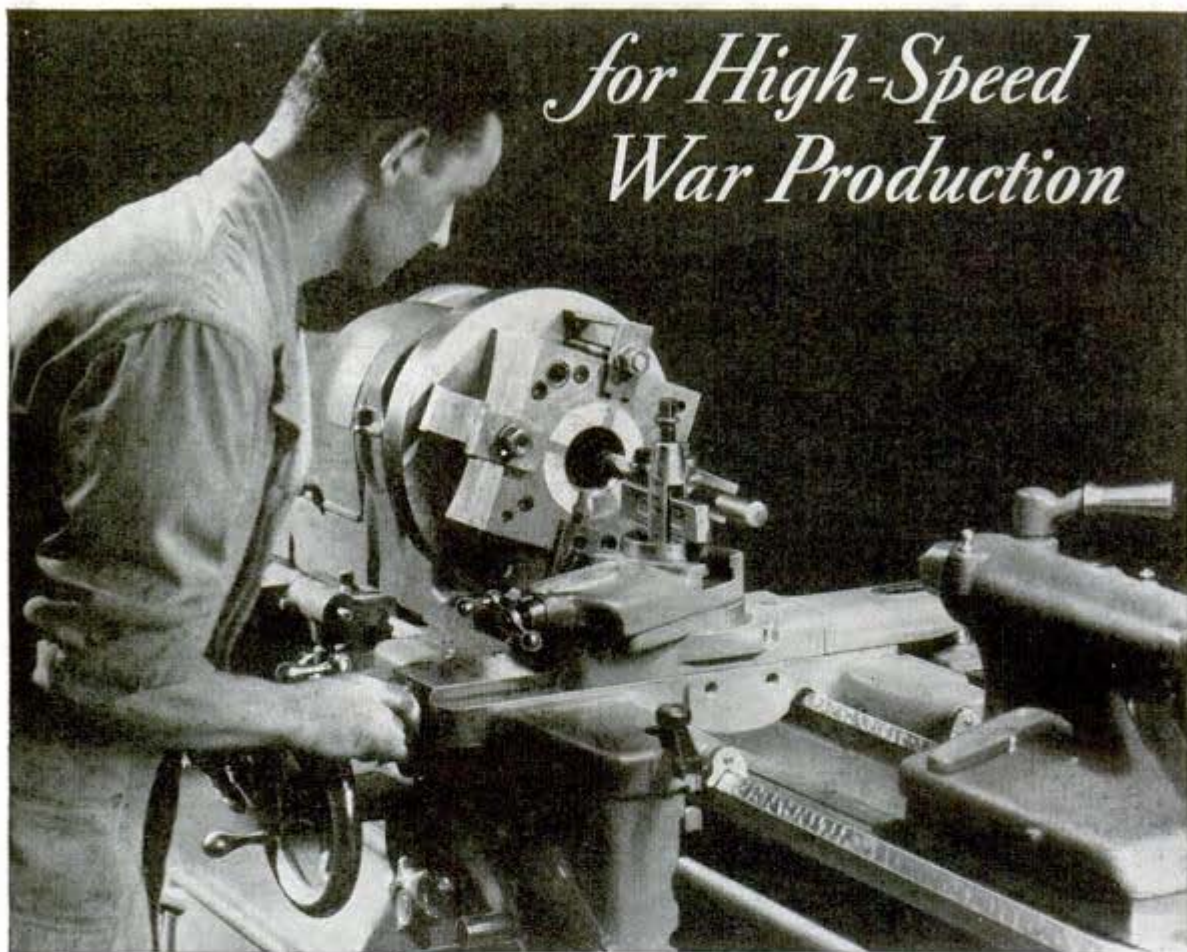
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