

POPULAR MECHANICS

MAGAZINE



WRITTEN SO YOU CAN UNDERSTAND IT

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NOVEMBER
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12 PASSENGER
HELICOPTER
PAGE 49



BEAUTY TAKES A BOW



When you see those new cars with Body by Fisher—you'll be quick to say that beauty takes a bow. They are truly beautiful.

It's easy to see that the Fisher Body organization has come out of the war with its skill and craftsmanship at a new peak.

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It stands today, as it has stood for more than 37 years, as the sure sign of a better automobile. It means that all the skills inherent in the Fisher Body organization have now been combined to bring you greater beauty, to give you greater comfort and safety.

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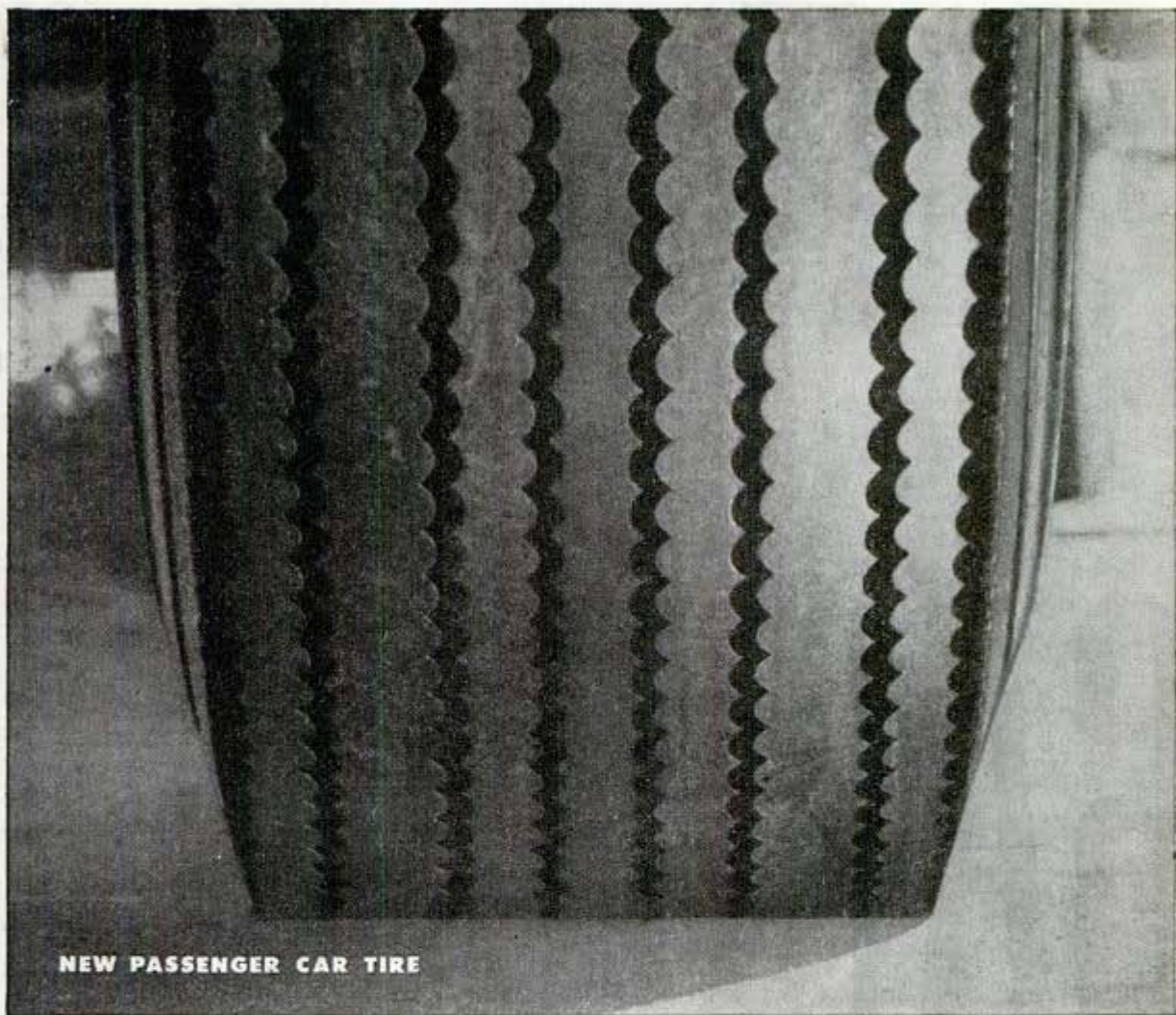
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NEW PASSENGER CAR TIRE

COMING SOON: A SYNTHETIC TIRE THAT WILL OUTWEAR PREWAR TIRES

THIS isn't a guess. A new kind of tire has been developed, and tests show that *it will outwear prewar passenger car tires.*

It is made of a new kind of synthetic rubber developed by B. F. Goodrich—different from the ordinary synthetic rubber in general use by the tire industry.

The new tire has had more than 2,000 separate tests. Taxicab fleets, state police departments and the B. F. Goodrich test fleet have run it 16,800,000 test miles. Not only does it give longer tread wear than prewar tires, but it has more resistance to bruising or damage

from accident.

A new, slightly different shaped tread—we call it the "road level" tread—is another feature that means longer wear. Engineers had wished for years to make a tread just slightly flatter. But that more desirable shape always set up strains in the tire body, or "carcass," as it is called. B. F. Goodrich developed an entirely new and stronger cotton cord, designed it into a carcass that stands all these strains and permits the use of the new flatter, longer-wearing tread.

In a few weeks these new tires will begin to be produced in large

volume for shipment to our dealers, but supplies may be limited for quite a while. So take good care of the tires you have—make them last until you can replace them with these new, better B. F. Goodrich Silvertowns. *The B. F. Goodrich Company, Akron, Ohio.*



NOVEMBER 1945

This One



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1A

• • •



TINY GIANT WITH A HISTORY

Long before the war, the men who design your Bell Telephone System were looking for an electron tube with frequency capabilities never before attained. With it, they could transmit wide bands of telephone messages—hundreds of them simultaneously through coaxial cable—economically, and over long distances.

They developed a tube which set a new standard in broad-band, high-frequency amplification. So minute that its electrode system had to be inspected under a magnifying glass, the tube could amplify either the voices of 480 people talking at the same time, or the patterns of television. Long-distance, broad-band transmission became a commercial reality.

6AK5



When war came, this tube excelled all others as an amplifier in certain military equipment. It then grew into the 6AK5, one of the great little tubes of the war. Besides producing 6AK5's in large quantities, the Western Electric responded to emergency needs of the Army and Navy by furnishing design specifications and production techniques to other manufacturers, of whom at least five reached quantity production. On every battlefield it helped our ships and planes to bring in radio signals.

Developing electron tubes of revolutionary design has been the steady job of Bell Laboratories scientists ever since they devised the first practical telephone amplifier over thirty years ago. Now tubes like the 6AK5 will help speed the living pictures of television, as well as hundreds of telephone conversations simultaneously over coaxial highways of the Bell System.

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

Next Month

BEFORE the war most motorists couldn't tell an octane from an octopus. They learned about octane rating of gasoline during the war when automobile engines revived the game of "Knock, Knock, Who's There?" The "who" in this case was a fuel of low rating. A December feature tells what petroleum experts have achieved since 1940. It's enough to make your postwar car sit up and purr.

CHRISTMAS is just around the corner—and so are a few million Christmas shoppers. Let the millions mob the department stores; you can do your shopping in your basement. An article next month suggests personal gifts you can make for every member of the family—and how to make them.

SINCE Leopold S. Schmidt came to America 51 years ago he has made 20,000 of those lifelike figures you see in show windows and museums—the kind you almost tip your hat to. "Meet the Model Man" in next month's issue.

YOU'VE heard someone remark—"You should have seen her expression! If only I could have snapped her picture!" But emotions flicker and vanish, and a posed smile is frozen. The best rule is to "Stop It With a Flash." Fred Korth offers tips on fast action photography in December.

CONVERTING an old 16-mm. silent home movie projector for sound was not a difficult problem for one radio experimenter who did it successfully at low cost in his home workshop. A two-part construction article in the Radio and Electronics section, beginning next month, tells you how to do it.

WHAT makes an invention click? The Crosby Foundation, subject of a December article, helps sort duds from winners.

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Assistant Managing Editor.....	Wayne Whittaker	
Shop Notes and Crafts Editor.....	James R. Ward	
Radio and Electronics Editor.....	Frank L. Brittin	
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3A



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All things begin with thought—it is what follows that may take your life out of the class of those who hope and dream. Thought energy, like anything else, can be dissipated—or it can be made to produce actual effects. *If you know how to place your thoughts* you can stimulate the creative processes within your mind—through them you can assemble things and conditions of your world into a happy life of accomplishment. *Mental creating* does not depend upon a magical process. It consists of *knowing how* to marshal your thoughts into a power that draws, compels and organizes your experiences into a worth-while design of living.

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**"What's he got
that I haven't got?"**

LOOK at the successful men you know. "What have they got" that you haven't?

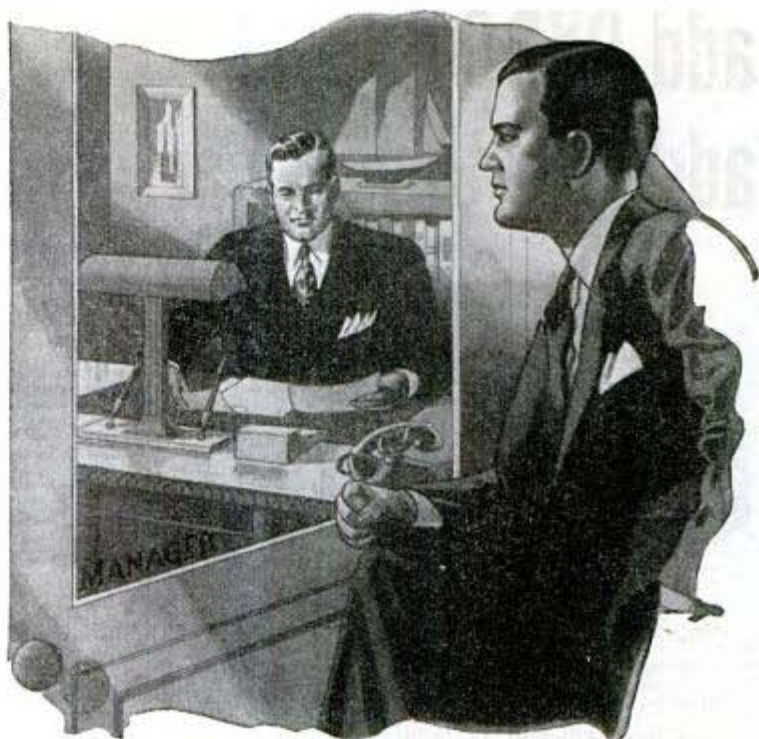
Very little, probably. In most ways these men are no brighter or naturally more capable than average. Many of them probably have no more formal education or better natural aptitudes than you.

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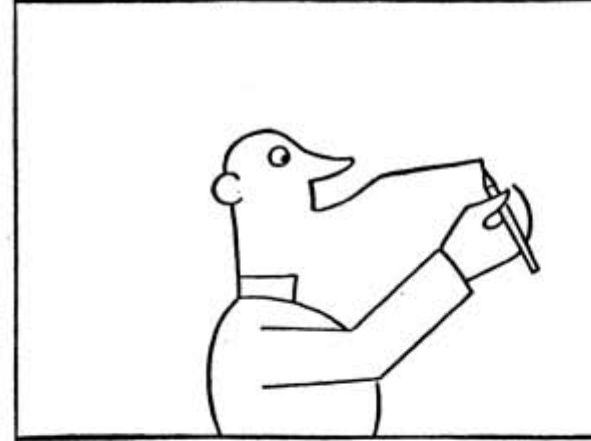
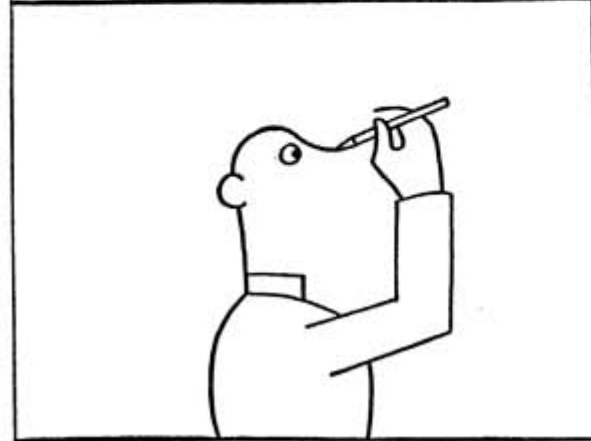
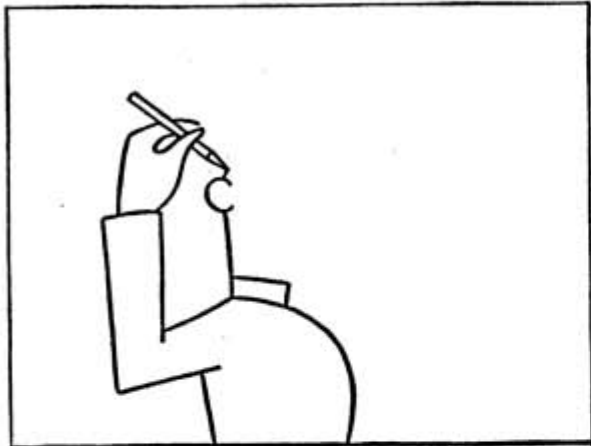
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 Name engraved in tin plating identifies steel traps.....140

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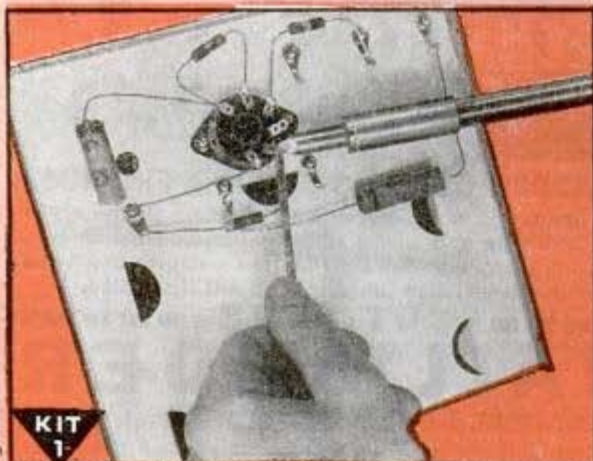
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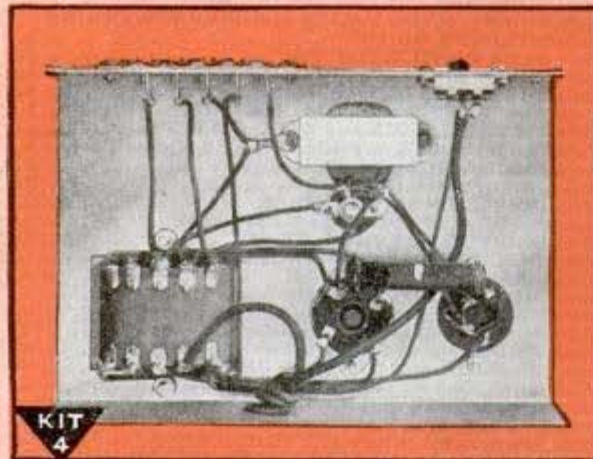
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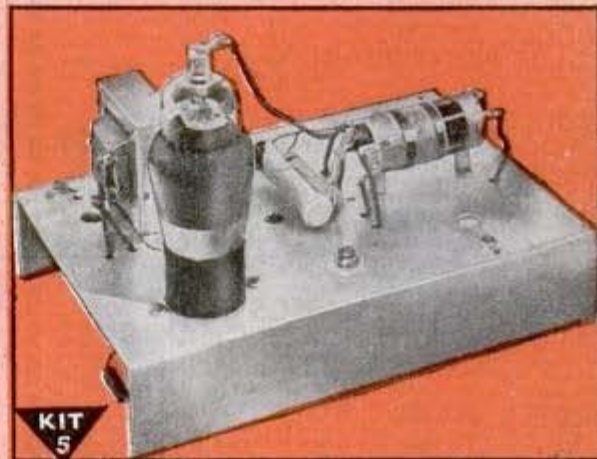
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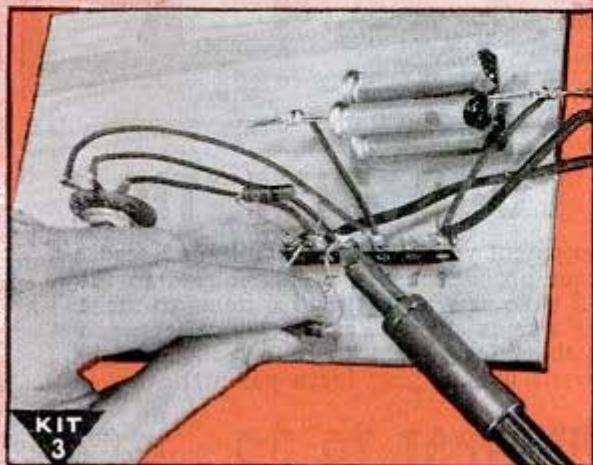
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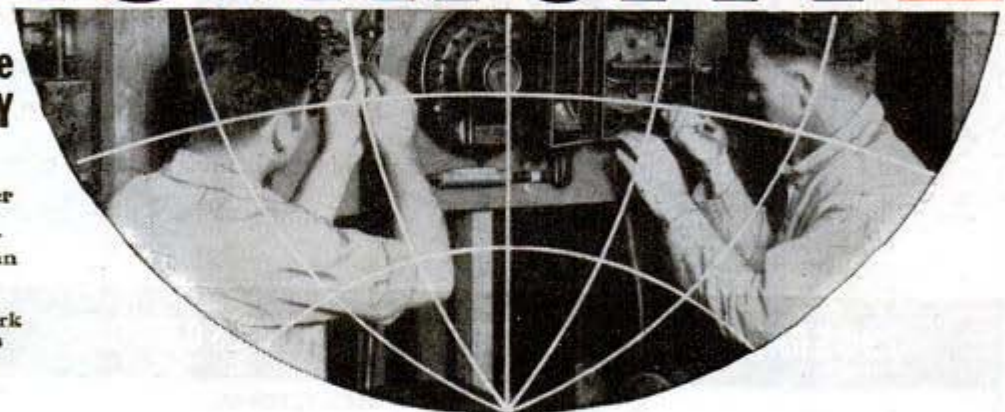
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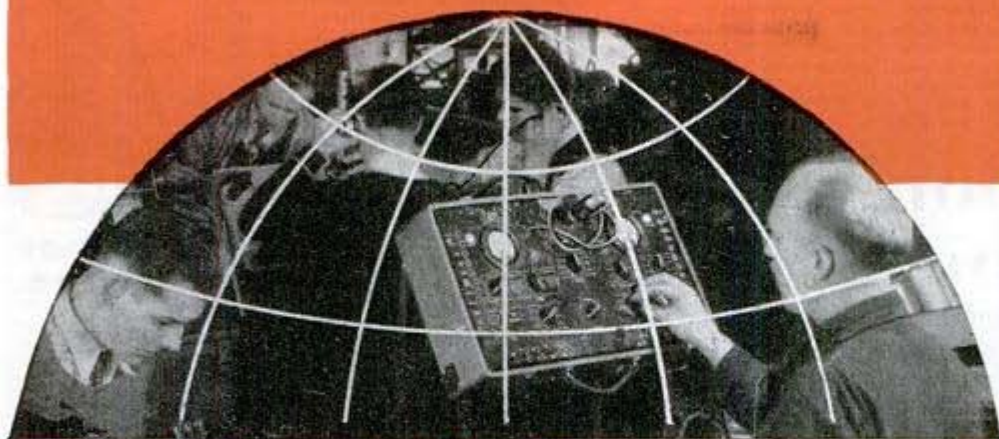
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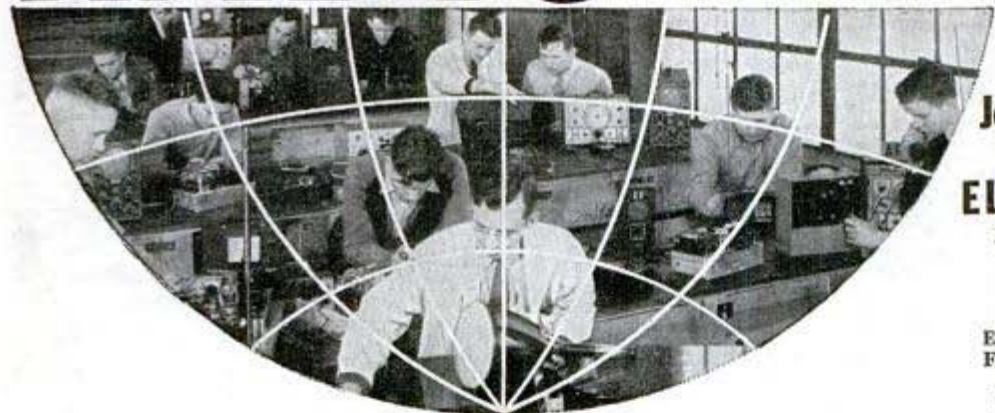
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STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933, of Popular Mechanics Magazine, published monthly at Chicago, Illinois, for October 1, 1945.

Subscribed at Illinois, County of Cook, ss.
Before me, a Notary Public in and for the State and county aforesaid, personally appeared H. H. Windsor, Jr., who having been duly sworn according to law, deposes and says that he is the Editor of the Popular Mechanics Magazine, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 357, Postal Laws and Regulations, printed on the reverse of this form, to-wit: First. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Popular Mechanics Company, 200 East Ontario St., Chicago, Ill.; Editor, H. H. Windsor, Jr., 200 East Ontario St., Chicago, Ill.; Managing Editor, R. M. Grant, 200 East Ontario St., Chicago, Ill.; Business Manager, F. H. Dunakin, 200 East Ontario St., Chicago, Ill. Second. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) Popular Mechanics Company, 200 East Ontario St., Chicago, Ill. H. H. Windsor, Jr., 200 East Ontario St., Chicago, Ill. H. H. Windsor, Jr., Trustee for H. H. Windsor III and Wm. T. Windsor, 200 East Ontario St., Chicago, Ill. Third. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages or other securities are: (If there are none, so state.) The Equitable Life Assurance Society of the United States, 29 S. La Salle St., Chicago, Ill. Fourth. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him. Fifth. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the twelve months preceding the date shown above is Not daily publication. (This information is required from daily publications only.) H. H. Windsor, Jr., Editor. Sworn to and subscribed before me this 17th day of September, 1945. N. E. Toole, Notary Public. (My commission expires March 24, 1948.)

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By S. T. CHRISTENSEN
the "Fix-it Man"

WELL, I guess I'm the fellow to see, for I've repaired thousands of refrigerators (home and commercial both), vacuum cleaners, radios, washing machines, irons, fans, lamps, mangles, motors, etc. In fact, many of my customers call me their "electrical appliance doctor." And, "doctoring," I might add, has paid me a good substantial income for quite a few years. Funny, in a way, how I got started. Always liked to tinker and by experimenting around I found that most electrical appliances had many things in common. That, regardless of what the appliance was used for, or who the manufacturer was, the basic principles were much the same. From fixing my own appliances to fixing friends' and then for strangers at a fee, seems now to have been but a small step.

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At first, I let the owner decide the charge and, frankly, I was amazed at what I earned per hour. But then, when one figures what initial costs are involved in buying most electrical appliances, one can readily see that spending extra dollars for repairs is well worth while. Before long I was making more in my spare time repairing than from my regular job. The result . . . I went into business for myself. When war came, business boomed, for new appliances were not available.

For a while, repair parts (needed on some

jobs) were a little difficult to get. But that situation seems to have adjusted itself for many repair parts have today the high priority rating of AA2. After all, we must provide for the health and well-being of our civilian population.

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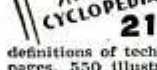
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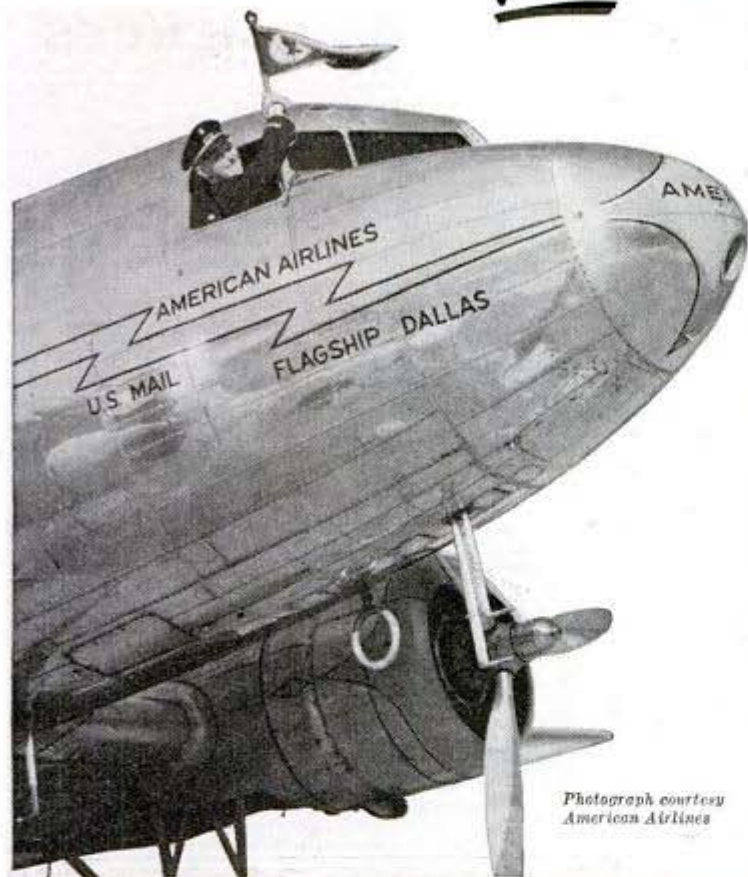
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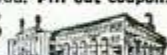
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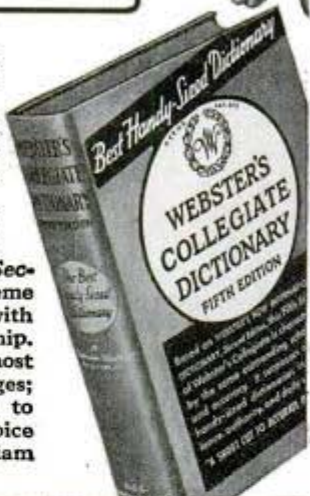
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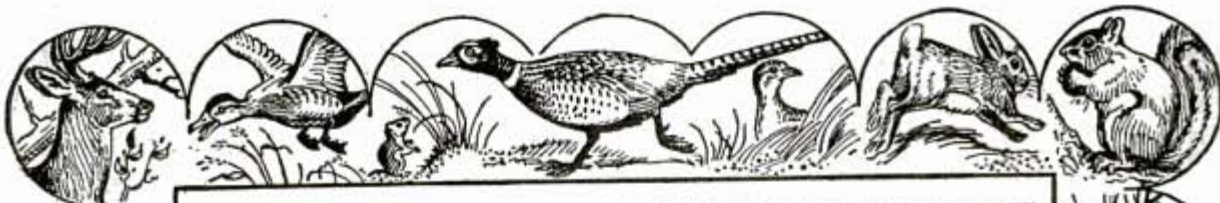
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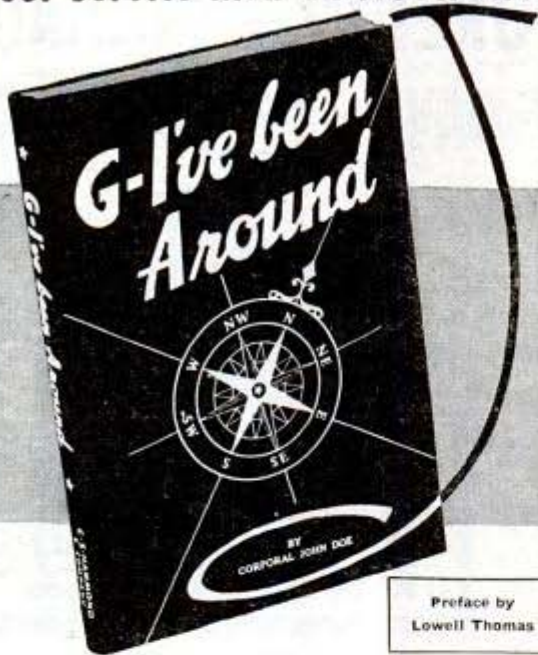
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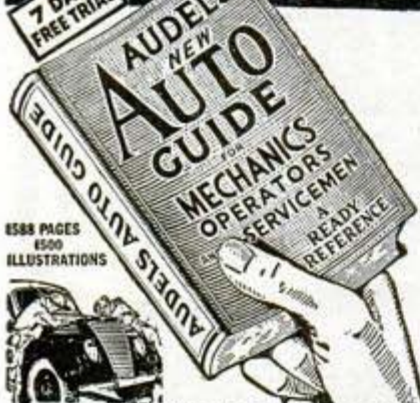
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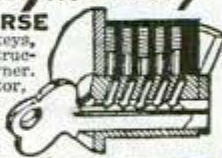


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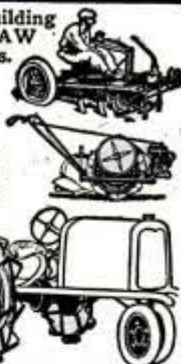
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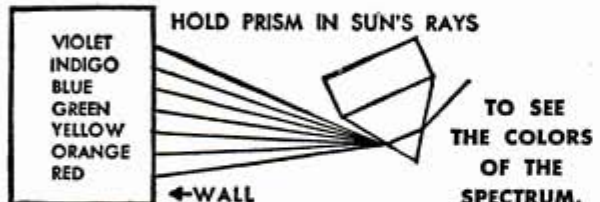
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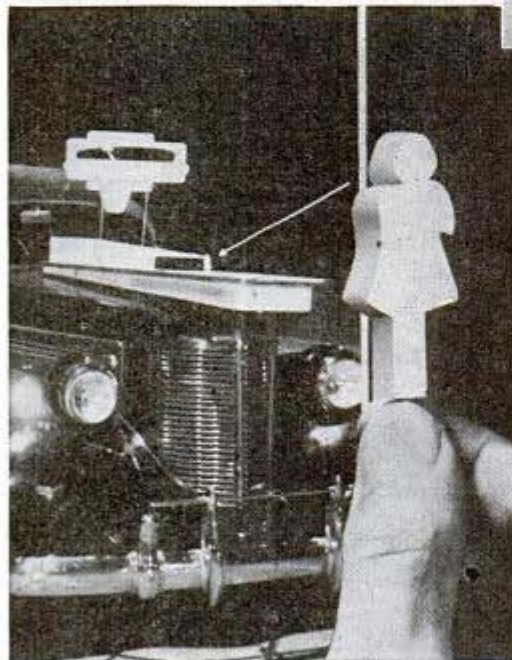


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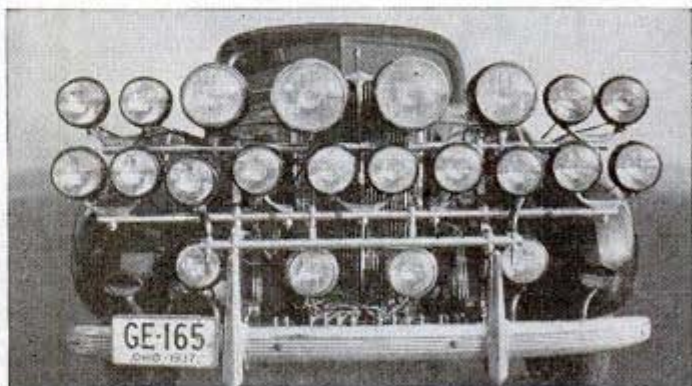
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Radar prevents collision. This actual photograph taken on the bridge of the "American Mariner," U. S. Maritime Service Training Ship, shows General Electric's new peacetime radar Electronic Navigator helping plot a safe course. The officer is looking at the G-E Navigator's radar screen, which shows him the position of the ship and the objects around it. On ships or planes, in fog or darkness, radar will warn pilots of unseen hazards.



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Vol. 84

NOVEMBER 1945

No. 5

BRINGING THE ATOM DOWN TO EARTH

By
Wm. F. McDermott

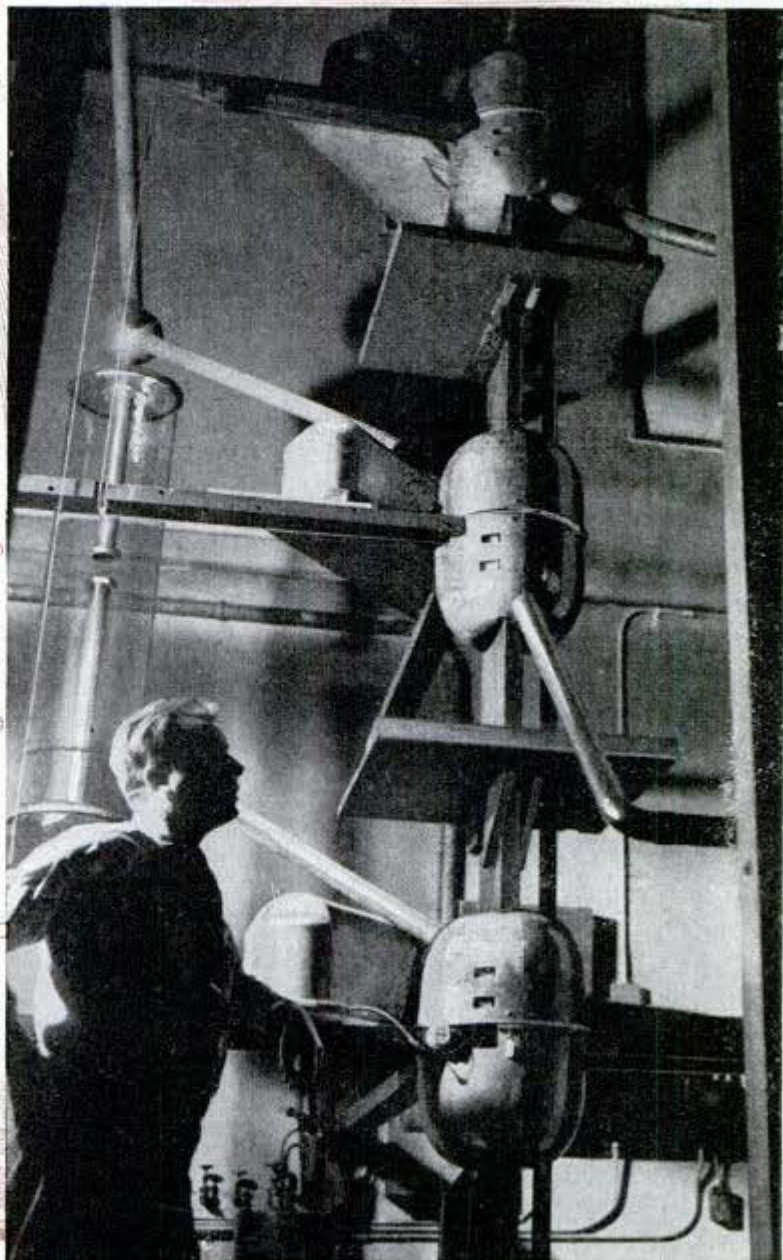
THERE were three atom bombs and four explosions: New Mexico, Hiroshima, Nagasaki and, the fourth and most shattering of all, the blast that plummeted the minds of untold millions into the strange new world of atomic energy.

The fact is that the dreaded but alluring atomic age is already here. Whole nations have grasped that fact almost with the speed of light. They may cringe before it—but they want it for its advantages and in spite of its dangers.

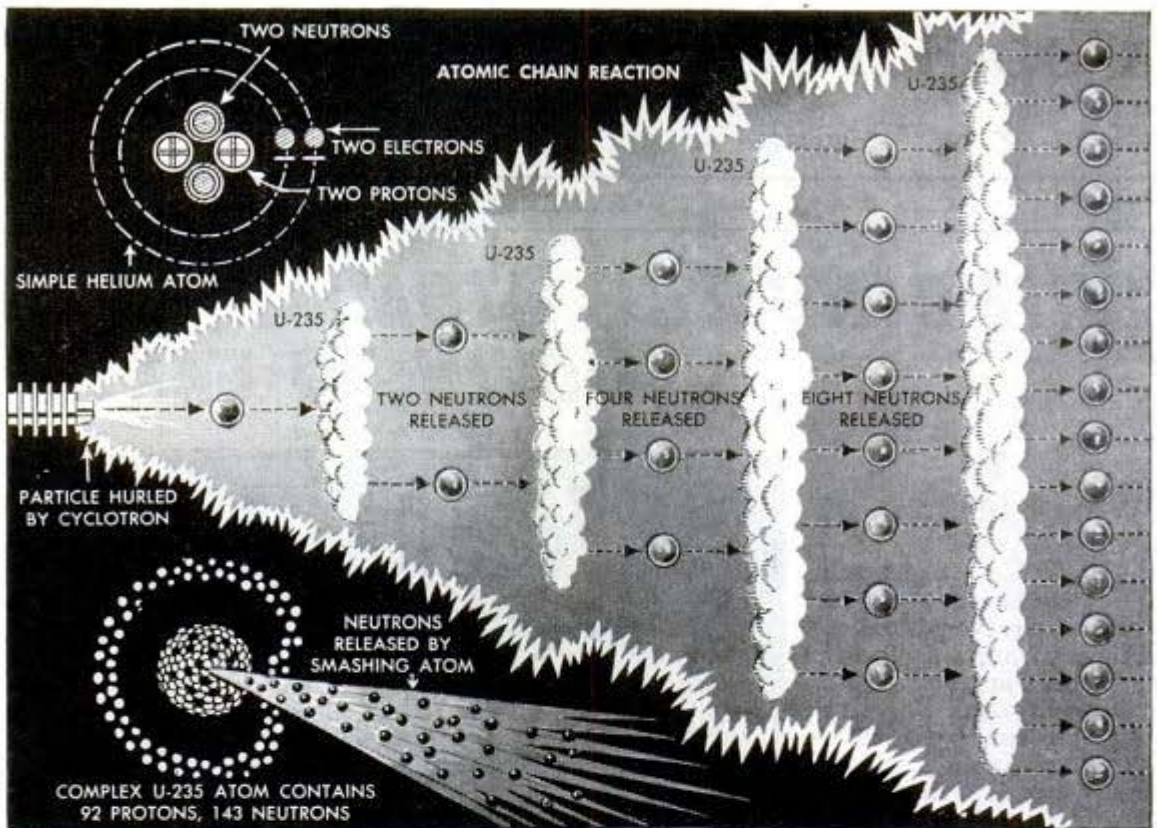
What does it portend for the future? Is a breath-taking revolution—industrial, social and even political—at hand? Has a new starting point in history arrived? Are science and invention, in unleashing unlimited power, about to turn the world upside down? Here's a prediction:

Within five years the first harnessing of the atom for peace will have been achieved, and within 10 years it will be the useful servant of man in a score of different ways.

Before we do any crystal-gazing, however, let's look at what some of the world's greatest thinkers and scientists, including several who were in on



Dr. Samuel K. Allison, head of the University of Chicago's new nuclear institute, inspects one type of atom smasher—a voltage multiplying unit



Simplified version of atomic chain reaction which releases tremendous energy; not shown are unstable atoms formed by splitting U-235 which throw off gamma and beta rays as well as the "trigger" neutrons

the miracle of the atom bomb, have ventured to foresee about man's capture of this secret of the universe:

1894—H. G. Wells predicted world-wide use of atomic energy and the employment

of atom bombs by 1954, saying that civilization would either destroy itself or adapt itself to a life as different as that of another planet.

1905—Einstein, declaring matter to be highly concentrated energy, calculated that 10 billion kilowatt-hours of energy are locked up in a pound of matter.

1926—Prof. James F. Morris, Massachusetts Institute of Technology, asserted that matter consists of "unthinkable amounts of

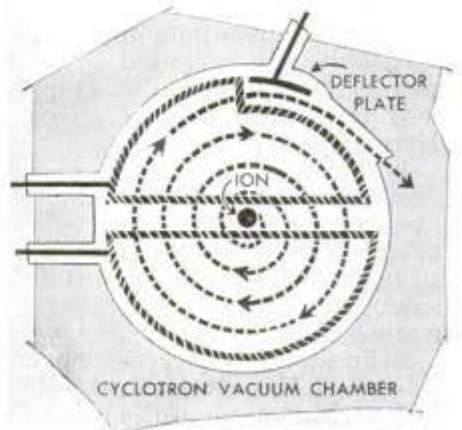
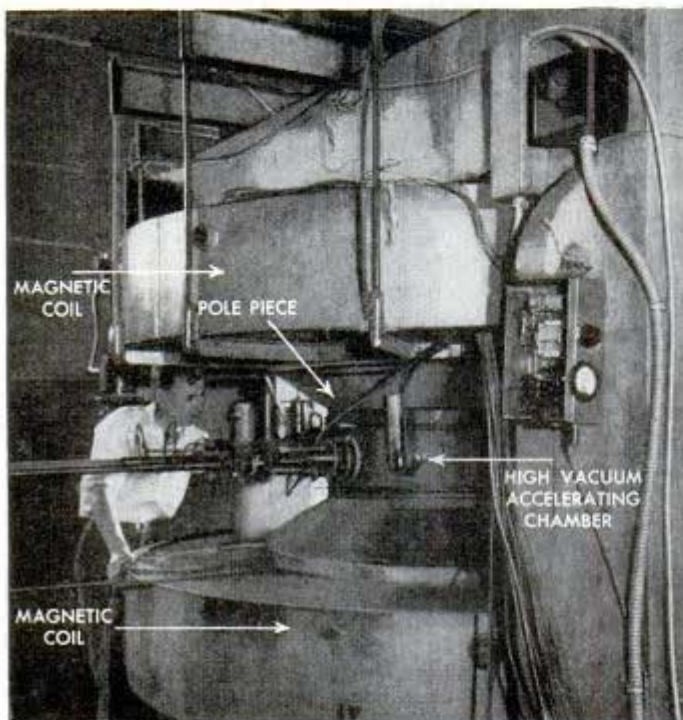


Diagram shows spiral path of ion in vacuum chamber of cyclotron at left; leaving chamber it is hurled at U-235

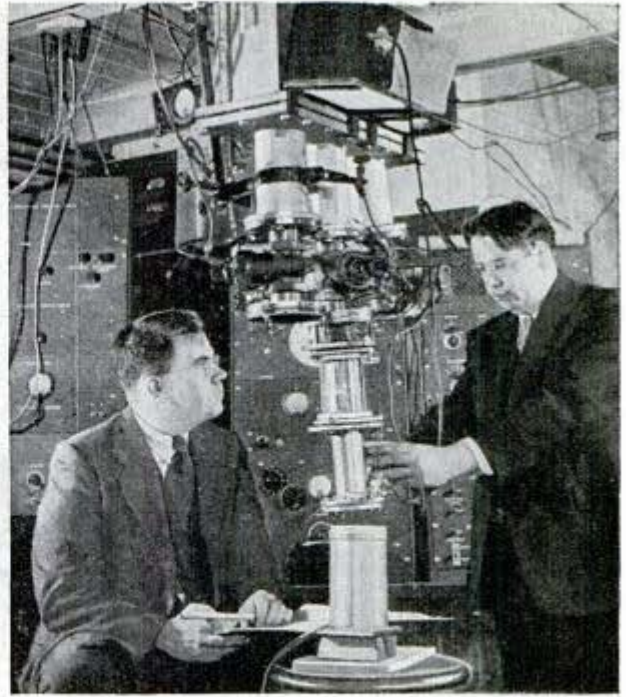
bound-up energy," while Dr. Karl Schlessel, German scientist, forecast: "The time is not far distant when, with the liberation of the atom, man will forget there ever was such a thing as suffering or poverty."

1939—Dr. Arthur H. Compton, Nobel Prize winner, addressing the Association for the Advancement of Science, said that atomic power, long-sought goal of science, was nearer man's practical use than was even dreamed of a year before. This power, locked in the nucleus of the atom, is of such tremendous order that a minute quantity of it would be sufficient to transport a liner across the ocean or to fire a gun from Chicago to Berlin.

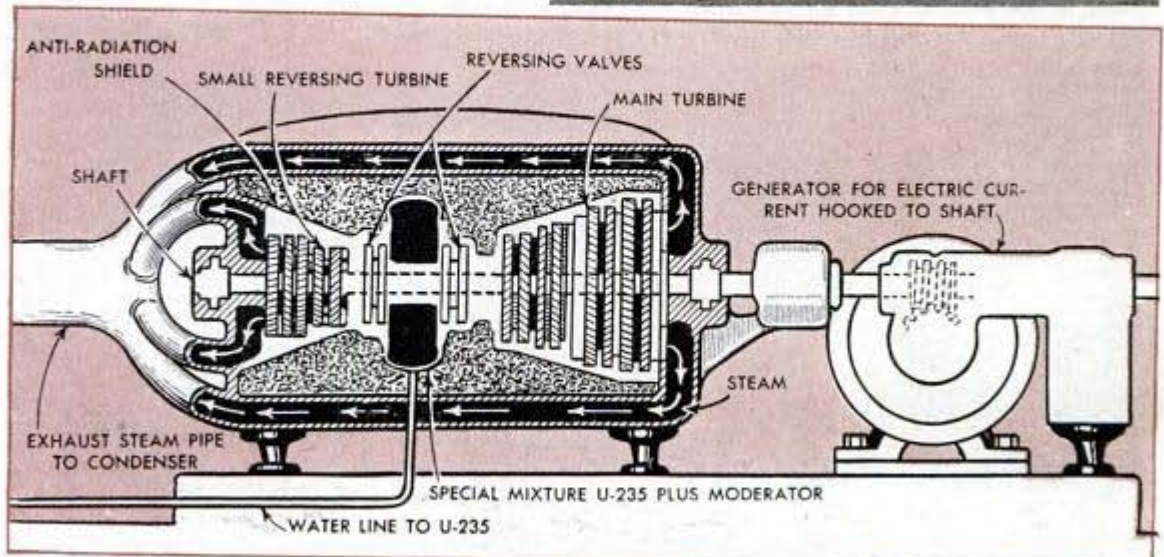
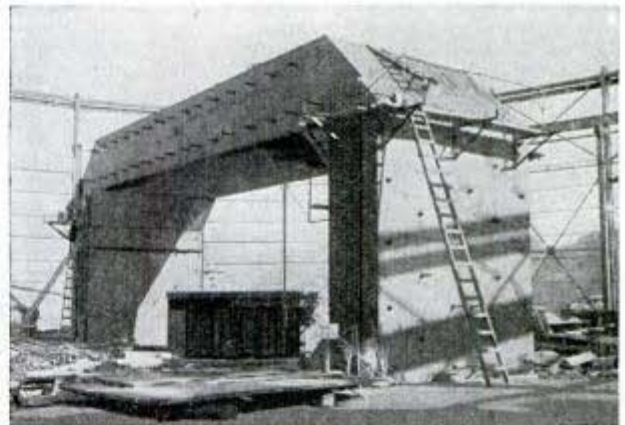
1940—Dr. R. M. Langer, California Institute of Technology, one of the leading scientists in the development of the atom bomb, predicted that atomic energy would "change the face of the earth," with Sunday driving in a propellerless plane 50 miles above the ground, with free power for everyone for all possible uses and with unimaginable convenience for everyone's pleasure.

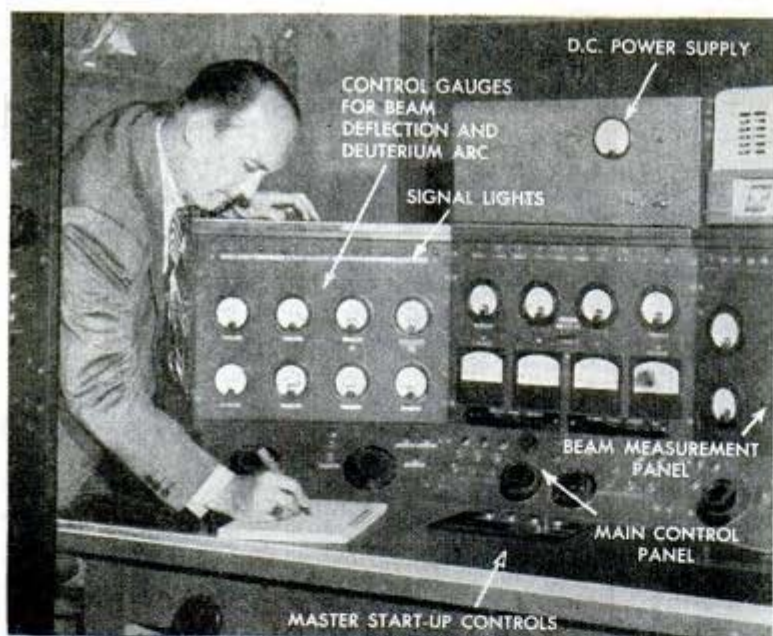
Even before Pearl Harbor, the curtain was quietly drawn on atomic developments, but the most feverish experimentation in all history swung into full speed. Four years later, that curtain was literally torn to pieces with the crash of the bomb on Hiroshima. The unleashed power not only met every expectation, but seemed to give prophetic promise of the fulfillment of every amazing chronicle of what the release of atomic energy might mean to the future of mankind.

Below, artist's conception of uranium engine adapted from 1941 issue of Popular Mechanics



This is the target end of 90-ton atom smasher in Westinghouse research laboratory. Below, iron core of electromagnet built for cyclotron at University of California





Control panel of cyclotron at University of Chicago permits remote and accurate control during experiments and protection from dangerous rays



Pittsburgh Press photo
Demonstrator at atomic power show in Pittsburgh Buhl Planetarium shows how slow-moving neutron enters nucleus of U-235 atom, splitting it to release second neutron which strikes another atom. Below, radium neutrons hit U-235 embedded in paraffin and screen records splitting atom



Cautious scientists, whose secrecy for years had equalled their applied genius — both complete — lifted the veil for a peek into the future. They who had worked closest to the atom bomb foresaw near-miracles to come. One of the most effective projections into the future was made by Dr. Reuben G. Gustavson, eminent scientist and dean of faculties of the University of Chicago, whose work on the atom bomb was of major importance.

Energy 400,000,000 times more powerful than derived from any other power source can be delivered, he told the Executives Club in Chicago. And just as important as that was his assertion that, if resources were made available, an experimental atomic plant could be placed in operation by next April, and in five or 10 years production of such power could be made economical! He added that atomic developments may bring about the long-sought cure for cancer.

The logical first step will be to capitalize on the knowledge of the atom bomb — namely, apply the known controlled form of atomic power. That is as a superexplosive. Where could constructive use be made of such devastation as was visited on the two Japanese cities, laying waste many square miles at a single blow, and leveling as many as 18,000 buildings?

One of the likeliest effective services would be in checking forest fires. Even as enemy cities were being blown to pieces, a great conflagration ravaged more than a quarter of a million acres of fine timber in Oregon. Fire fighters struggled in vain to make clearings

The story of atomic research has been told as it developed through recent years in these articles in previous issues of Popular Mechanics:

Smashing Atoms	- - -	March 1937
Putting the Atom to Work	- - -	May 1938
Sharpshooting at the Atom	- - -	July 1940
Harnessing the Atom	- - -	Sept. 1940
Exploring the Heart of the Atom	- - -	Nov. 1940
The Miracle of U-235	- - -	Jan. 1941
Siege Gun of Science	- - -	Sept. 1941
Giving Atoms the Third Degree	- - -	Nov. 1941
"Tracer Bullets" of Science	- - -	May 1942
Atomic Power for War and Peace	- - -	Oct. 1945

beyond which the onrushing flames could not go — yet a path a quarter of a mile wide in advance of the blaze, such as controlled, minute atom bombs might blast in a single second, would have done what thousands of men couldn't do.

Already there is speculation as to the possibility of some weather control by atomic forces. The mayor of a Florida city asked that a bomb be exploded in the midst of a hurricane, to see if it might scatter or check it. That raises the question whether something akin to a vast tidal wave might be started whose destructiveness would be still greater. It is believed, however, that the atom bomb does affect the weather. Although the sun was shining brightly when the atom bomb was dropped on Hiroshima, a missionary reported that a hurricane struck the city half an hour after the bombing. In



Electrostatic generator of California Institute of Technology performs same work as cyclotron in atom-smashing experiments. Below, scientists in New Mexico used tanks coated with lead inside to guard against radioactivity in studying first A-bomb explosion





Scientist holds Roentgenometer testing for radioactivity in sand after first explosion in New Mexico. Note canvas bags over shoes

another case a storm cleared away soon after a bomb was exploded.

A tremendous iceberg sank the Titanic, luxurious liner which was the pride of all the seas in its day, back in 1912. Even today icebergs are a menace to navigation, and their presence must be taken into account in charting the courses of vessels.

This scene in Hiroshima testifies to tremendous power of A-bomb



Atom bombs, or well placed atomic explosive charges, offer the possibility of clearing the oceans of these floating dangers. Broken into icy slivers, they might dissolve in the warmer water and disappear. The terrific heat engendered by an atom bomb, shown by the way sand was fused into slabs in the New Mexico experiment, indicates that heat as well as violence would aid in vaporizing the icebergs.

Icebergs do not form the only frozen barriers of the sea to man. Vast expanses of ice tie up harbors often for six months or more of every year. Russia is an example of a great nation virtually ice locked half the time because her ports are so far north. She may get year-round ports as the result of this war.

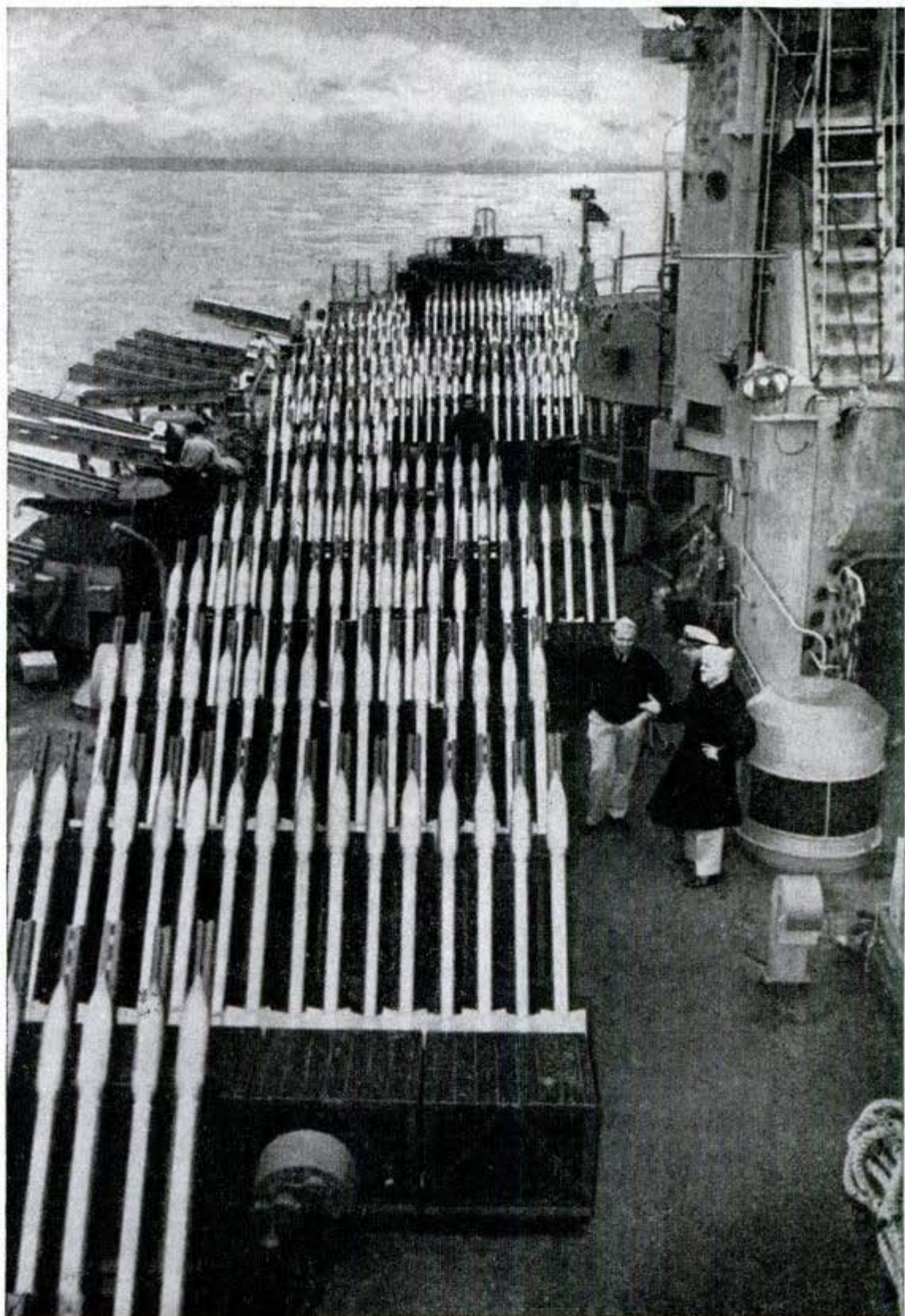
The question arises: Does not atomic power make possible keeping open those ice-bound ports the whole year round by recurring blasts, or at least opening ports weeks sooner than usual and keeping them open weeks longer? The use of heavy ice-breaking boats may give way before long to a string of atomic explosions that will make a winter path for ships as clear as in summer time.

Sea power was shown in this war to be as effective as ever in the history of the nations. While air power is a new and major factor, yet it has neither eliminated nor minimized seagoing traffic; also, with "one world" at hand—at least in trade and commerce—there is bound to be undreamed-of traffic on the seven seas. Now, if ocean floors could give up their dead—sunken ships—there would be a parade of watery ghosts which would probably stretch farther than the merchant marines of the world today, and many of them would be found to have been the victims of hidden rocks and treacherous shoals.

Here the tumultuous power of the atom may soon come into play. Explosions that level cities can also lay waste many a granite "hell gate" where ships totter into a watery grave. With the limited

(Continued to page 160)

Rocket "Pipe Organ" Played Dirge for Japanese



Row on row of rockets were all set to be turned loose against the Japs—if they hadn't surrendered. This photograph—recently released by the Navy—shows rocket launchers on the deck of a landing craft.

NOVEMBER 1945

MORE POWER for globe-circling civilian transports is foreseen with the successful combination of jet propulsion and reciprocating engine in the Navy's new fighter, the Ryan FR-1 Fireball.

This low-winged fighter, designed for quick takeoff from a carrier, is powered by a Wright Cyclone 1350-horsepower radial engine in the nose and a General Electric jet propulsion engine between cockpit and tail. The engines can be used separately or in combination.

The reciprocating engine drives a broad-bladed Curtiss propeller and gives the Fireball a maximum speed of 320 miles an hour. The thermal jet alone, far more powerful than a conventional engine of the same weight, drives the fighter at 300 miles an hour. Top speed with both engines is still a Navy secret, but is believed less than the total of the two figures. At a cruising speed of 207 miles an hour, the regular engine gives the Fireball a 1500-mile range.

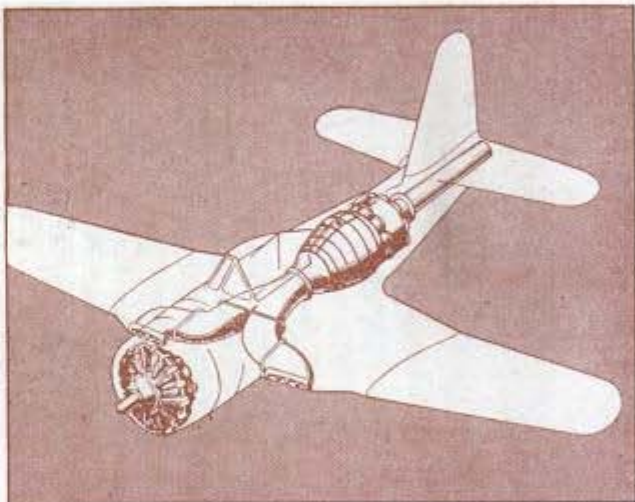
In addition to greater speed, the combination of jet and propeller affords a quick getaway and fast rate of climb. Thirty seconds after the G-E jet engine is started, the fighter is ready for takeoff.

Improved maneuverability is another operational feature of the Fireball. At a demonstration in Washington, D. C., a squadron of 12 of the new fighters did a tight loop in formation at 400 miles an hour. This squadron was in training for an attack on Japan, but the war ended first.

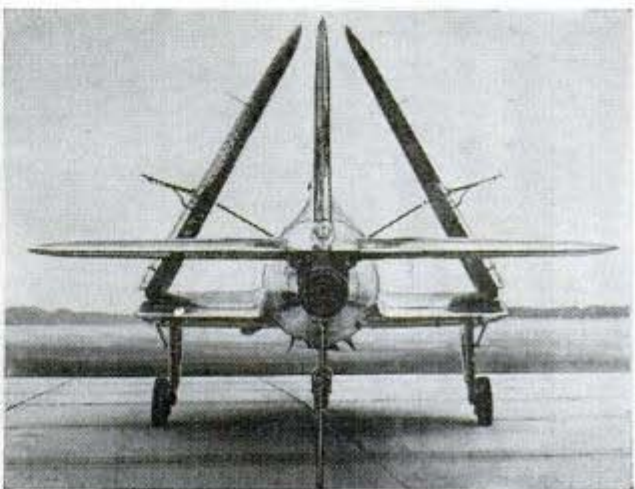
Designed and built by the Ryan Aeronautical Company of San Diego, Calif., the Fireball is a single seater, exceptionally streamlined for a twin-engine craft. Both engines are completely enclosed. Air scoops for the nose engine are within the engine cowling, and the intakes for the jet engine are in the leading edge of the wings near the fuselage.

This propeller-jet fighter packs a lethal wallop. It has two .50-caliber machine guns in each wing and carries a 1000-pound bomb under each of the wings. Instead of bombs, it can carry rockets or droppable fuel tanks, depending on its use.

Aviation enthusiasts, however, are more interested in the impact of this plane on future aircraft power plants than against any potential foe. The thermal jet, as a primary or auxiliary source of power, may help boost huge transports into the air and provide a powerful and smooth functioning engine for the stratosphere. The compressor can take in air at 76 degrees below zero, while in the same engine the turbine is working in extreme heat. The jet burns almost any kind of liquid fuel and consumes less fuel at high altitudes due to decreased drag. The jet unit is an improved model of the engine used on the P-59 Airacomet.



The unique combination of reciprocating engine in the nose and jet propulsion engine back of cockpit gives the Ryan Fireball balance as well as speed and maneuverability. Below, wings fold up. Fireball is first Navy carrier plane with tricycle landing gear



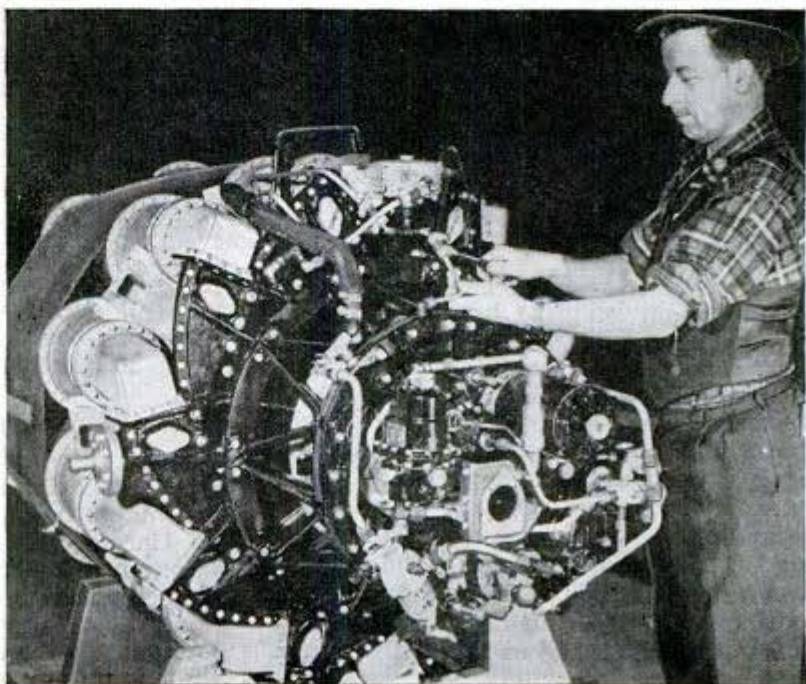
JET = FIREBALL

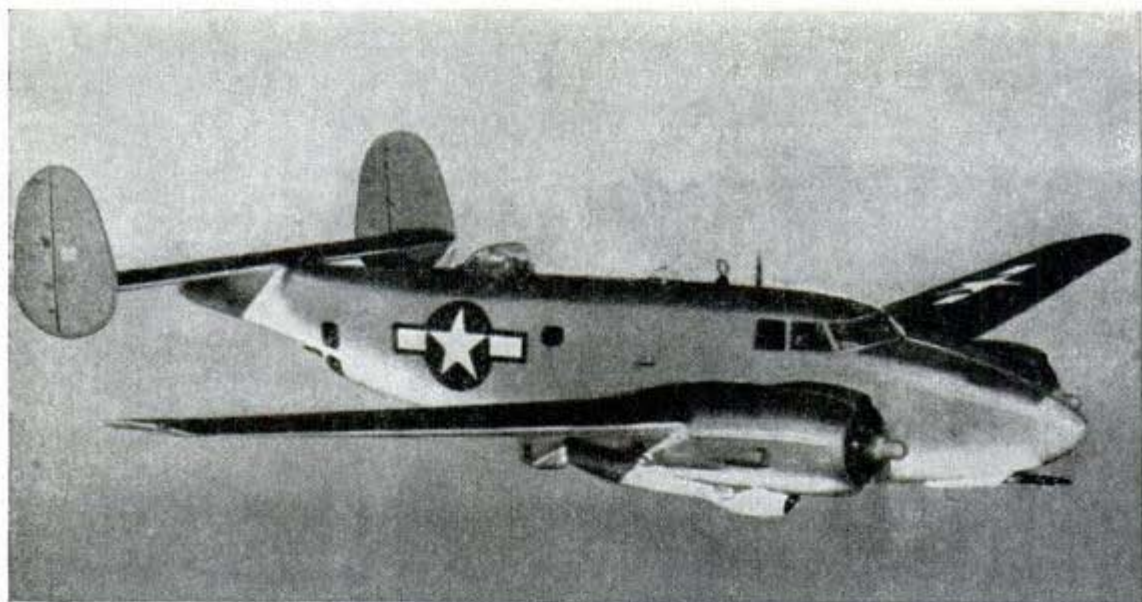


With both engines completely enclosed, Fireball looks like single engine fighter. Exhaust for jet comes out under tail, and air intakes are in leading edge of wing near fuselage. The fighter carries rocket launchers (right) under each wing, 1000-pound bombs or droppable fuel tanks



Silhouettes show distinctive lines of new fighter. Right, mechanic adjusts fuel line on front of General Electric jet engine





2000-Mile Navy Bomber

Taking part in the final knockout of Japan was a new Navy medium bomber, the PV-2 Harpoon, with a range of more than 2000 miles. The Harpoon carries a full size 1800-pound torpedo, has four rockets under

each wing and is armed with ten .50-caliber machine guns. It has a speed of over 300 miles an hour. Built by Lockheed Aircraft Corporation, the two-engined bomber was flown on dangerous 1500-mile round trip missions from Aleutian bases to Jap positions in the Kurile Islands.



Nazi 'B-29' Carries 90 Men

Among enemy craft being analyzed at Wright Field is a giant Junkers-290, one of the largest planes built by the Nazis. It was captured near Munich and flown to Dayton, Ohio. The huge craft, comparable in size to the Boeing B-29 Superfortress, has four 1700-horsepower engines, a wing span of 138 feet and length of 92 feet 10 inches. Built as a transport which can be converted into a bomber, the plane can carry 10,000 pounds of bombs or 90 men and has a range of 2000 miles. Maximum speed is about 240 miles an hour at 18,000 feet. The "Alles Kaputt," as this "all-through" bomber is appropriately named, is not a

high altitude craft like the B-29, which has a ceiling well over 35,000 feet. The B-29 has more powerful engines (2200 horsepower), greater range (about 3600 miles), is faster (over 300 miles an hour) and can carry 10 tons of bombs.

Wax-Free Lubricant for Engines

Particular advantages in cold weather are claimed for a nonpetroleum lubricant for internal combustion engines developed by Carbide and Carbon Chemicals Corporation. Wax-free, it can be made to any desired viscosity and has a density approximating that of water. Carbon residues are low and sludge and varnish formation in the engine are practically eliminated.



The BIG PIT

PART 2

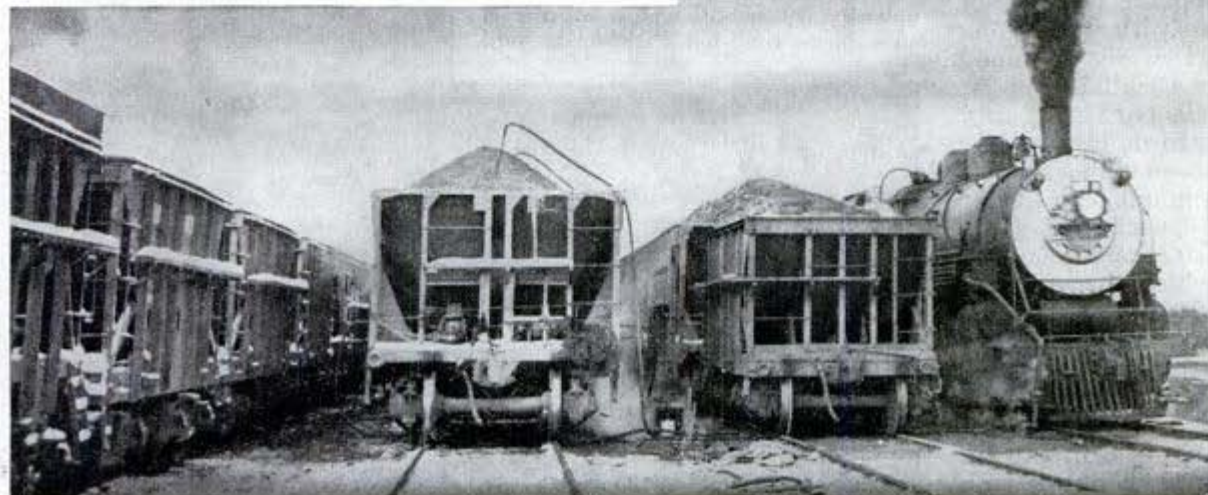
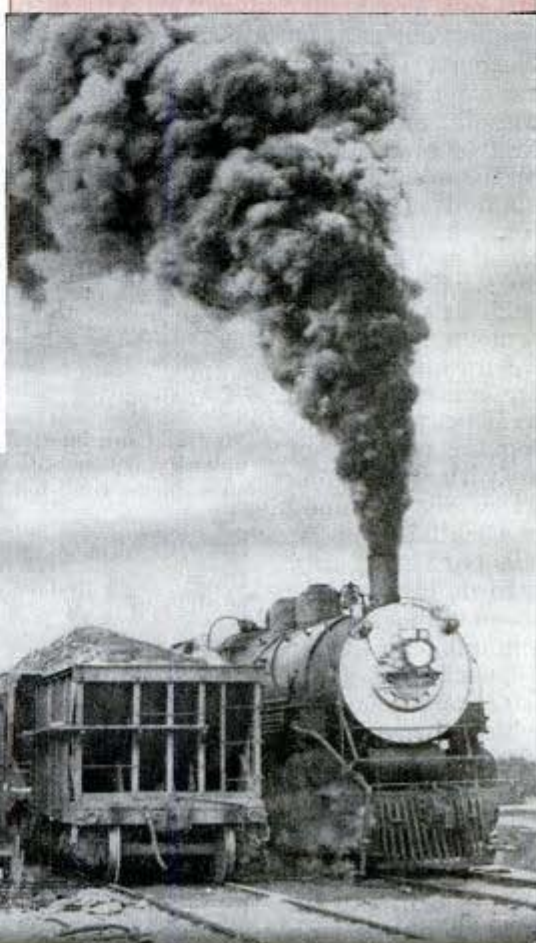
MOTHER NATURE is an old party with a great deal of foresight, which she exercised admirably when she placed the iron ore ranges of the Lake Superior district close to the waters of the Great Lakes.

Proximity of the Mesabi, Cuyuna, Vermilion, Gogebic, Menominee and Marquette ranges to the low-cost transportation offered by the lakes has probably contributed more than any other factor to the tremendous development of our iron and steel industry. Removal of millions of tons of ore from the open pit and underground mines in Minnesota, Wisconsin and Michigan, as described last month, is only half the story. Transportation of the ore to the blast furnaces of the great iron and steel centers is a gigantic operation that has taxed all the mechanical ingenuity of the railroads, lake transportation companies and the iron and steel makers.

More than 40,000,000 tons of ore were hauled overwater to the mills up to last August 1, almost 50 percent of the quota of 92,000,000 tons set before the end of the war. The operators expect a good peacetime ore demand for years, meeting huge requirements of the heavy industries—railroads,

Great Northern Railway photo

Oliver Iron Mining Co. photo
 "Endless" ore train leaves Hibbing, Minn., en route to docks at Duluth. Below, thawing out ore in car with steam from a locomotive





Samples of iron ore from loaded cars are analyzed in Hibbing laboratory to obtain proper grade for mills

automobile makers, construction companies—for civilian iron and steel equipment.

The Mesabi Range, whose pride is the three-mile-long Big Pit, affords a good illustration of what happens to the ore after the electric shovels have gouged it out.

Highest grade ore can be loaded into the ore cars and hauled by rail directly to the loading docks at Duluth, Superior or Two Harbors. Unfortunately, this simple process can't be applied to all the ore mined at Mesabi, and much of it must be treated first to obtain the proper grade required by the mill. Various

methods are used to remove useless material and condition ore for the furnaces, such as washing to remove sand; drying for ore with water content as high as 15 percent; roasting for removal of sulphur; crushing when ore is mined in rocklike chunks; sinterizing, by which the ore is fused with a specific amount of coke for a specialized purpose; nodulizing, in which the ore goes into a concentrator and a magnetic separator takes out unwanted material.

All this processing is done to fill specific orders on

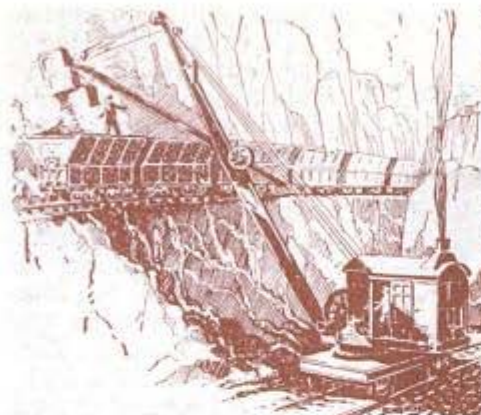
hand from the mills. After an ore car has been loaded at any of the treating plants, or loaded directly, five samples of its contents are removed for testing. By the time the ore trains reach classification yards on their way to the docks, a report has arrived showing the exact composition of each carload of ore—its iron, phosphorus, silica, alumina, manganese and moisture content.

Phosphorus content is highly important, since the ore used in Bessemer furnaces for making steel must contain no more than 0.045 percent phosphorus, while high phos-



Way bills are inserted in machine which automatically records weight of cars in scale house near big classification yard

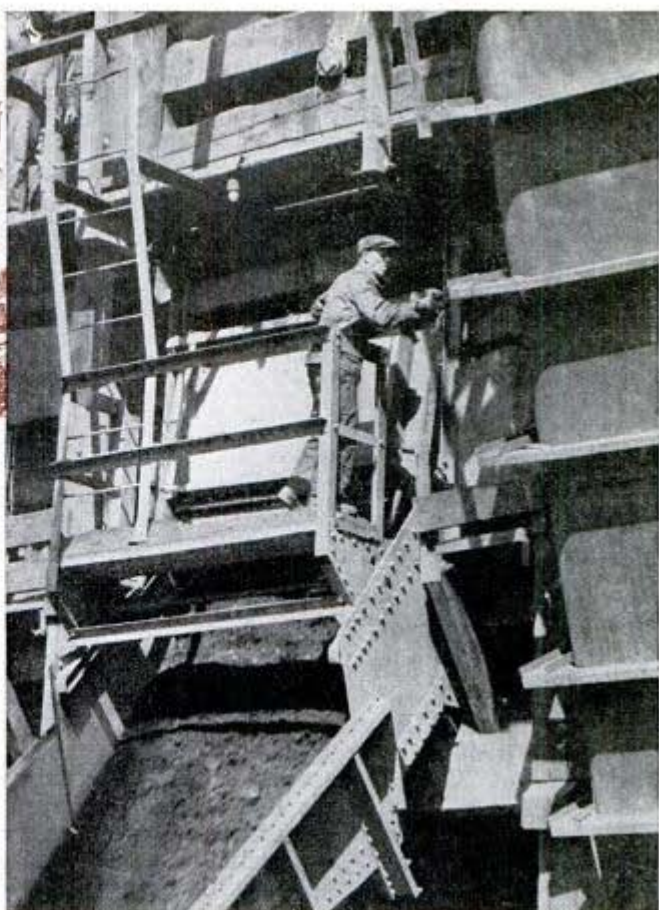




phorus ores are satisfactory for open hearth furnaces. Highest grade ore being extracted today contains about 52 percent natural iron.

Armed with the chemical data on each car and its weight, taken at the classification yard, the yard grader then distributes the cars into blocks sufficient to fill a specific vessel, and containing a grade of ore ordered for delivery to a certain mill.

Eight railroad lines find ore hauling a profitable business: The Duluth, Missabe & Iron Range Railroad; the Great Northern Railway Company; Northern Pacific; Soo; Chicago and North Western Railway; Chicago, Mil-



Great Northern Railway photos

Ore rushes down chute from dock "pocket" on way to vessel. Below, moving iron ore from train to boats at Allouez Docks





Pittsburgh Steamship Co. photo
 Unloading new 639-foot ore boat which carried to Conneaut, Ohio, one of largest iron ore cargoes—16,383 tons. Hulett unloader is at work

waukee, St. Paul & Pacific Railway; Duluth, South Shore & Atlantic, and the Lake Superior & Ishpeming.

Serving a 50-mile area of the Mesabi Range about 100 miles northwest of Duluth, the Great Northern's ore assembly point is at Kelly Lake, Minn., a train yard of 2588-car capacity. The trains routed through here serve 68 mines, with hauls from mine to lake averaging 110 miles. The cars carry about 60 tons of ore.

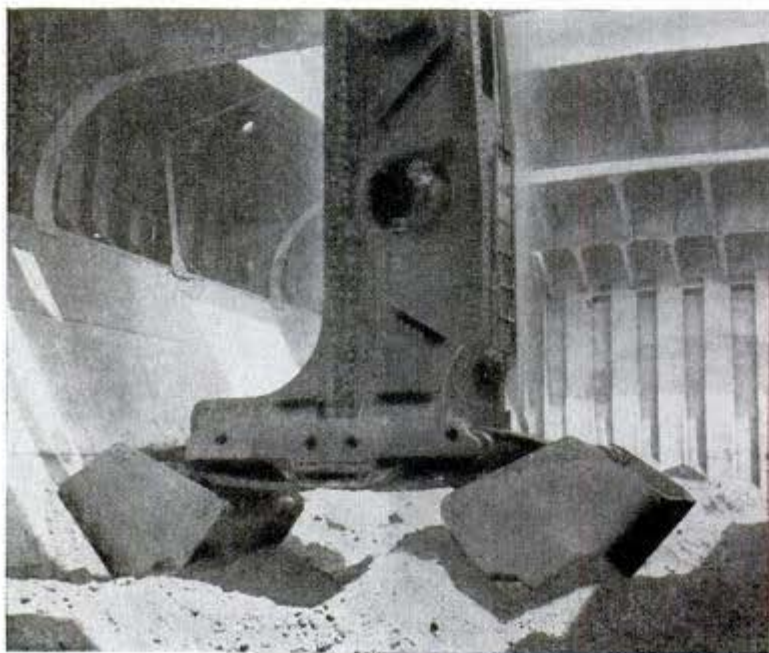
The 90 to 130-pound rails are fully tied-plated with heavy plates equipped with rail anchors. Lines are well ballasted with a minimum of 4000 cubic yards per mile of processed gravel or mine tailings. There are 3250 hardwood ties per mile.

the Mesabi pours into the 1352 pockets of the four docks, each pocket having an average capacity of 326 tons. Three of the docks are of steel and concrete construction and the fourth of timber. They are from 1868 to 2272 feet long, exclusive of approaches.

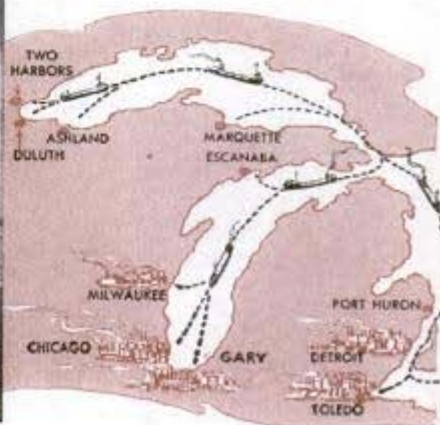
Each dock has four tracks on top, at a level 75 to 81 feet above the lake. Pockets are spaced to correspond with the hatch spacing of the ore boats which tie up below them. Ore cars run out over the pockets, dump their loads, and the ore then is cascaded into the boats by long rows of chutes suspended from each pocket. A record for loading in a 24-hour period was set June 19, 1944, when 22 boats were loaded

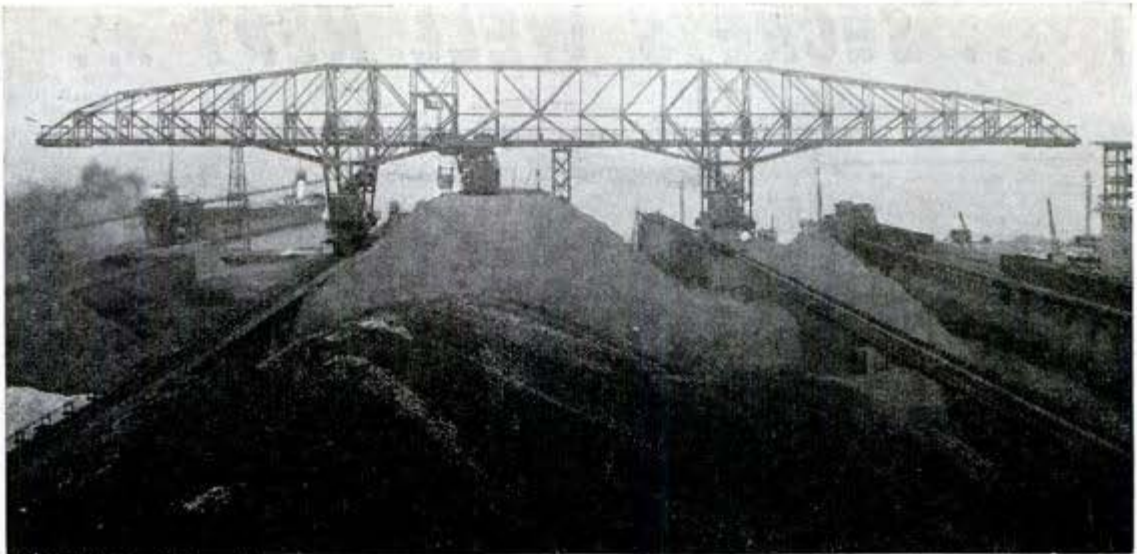
Except for one mile of single track, all the Great Northern ore lines are double tracked and block-signalized. Electric air compressors located at three points on the range save 30 minutes formerly required for the locomotives to pump enough air for brakes. All the locomotives are steam and burn coal from the East, much of it carried in by ore boats returning from the lower lakes.

Near Superior, Wis., the Great Northern operates the Allouez Docks, largest iron ore docks in the world, with a total capacity of 441,800 gross tons of ore. Here ore from



Operator sits directly over bucket in Hulett unloader and rides down into hold of boat as it takes huge bite of ore at Gary, Indiana, steel works





U. S. Steel Subsidiaries photo

Automatic "grabs" run on tracks along arms of bridge carrying ore from ship's hold to stockpile or cars

at Allouez with a total of 266,804 gross tons of ore. Twenty-four vessels can tie up at the dock at once, and 16 can be loaded simultaneously. A total of 2184 vessels was loaded there in 1944.

The Duluth, Missabe & Iron Range Railroad maintains huge docks at Duluth, Proctor, and Two Harbors. In a speed test at the latter port, a freighter cleared the dock with 12,506 gross tons of ore in 16½ minutes. Other docks are maintained at various points on the lake by the other railroads serving the different ranges of the district.

Each spring brings a literal rebirth to the open pit country, since winter operations there must be confined to stripping and maintenance work, and mining goes on

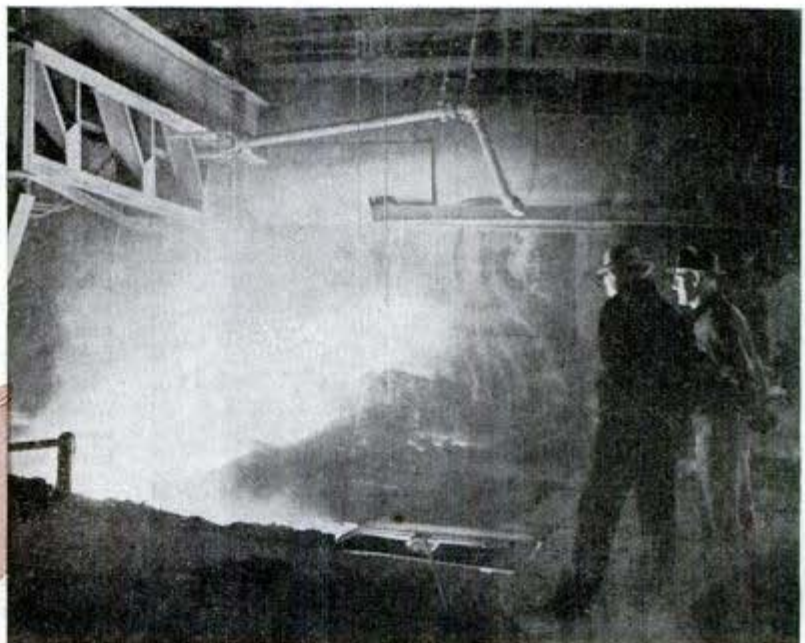
only in the underground mines, the ore being piled into stock piles to await transport to the mills.

First comes the ice report for the Great Lakes by the Weather Bureau, early in March. Near the estimated date at which the waterways can be opened, the railroads supply cars for loading at the mines, usually coinciding with the date the ore boats leave lower lake ports for their first cargoes. Coast Guard icebreakers, among them the new \$10,000,000 icebreaker Mackinaw, smash through the last recalcitrant ice to clear a passageway. The earliest shipment was made on March 27, 1942, from Allouez, and the latest cargo left the docks there December 5 of that year, a

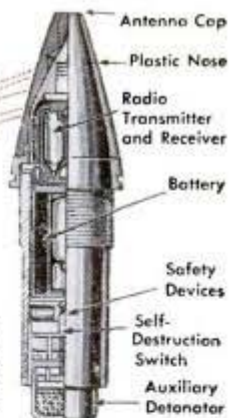
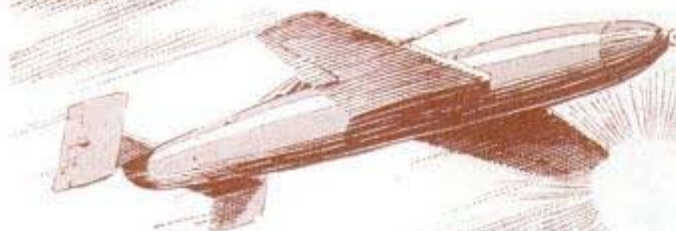
(Continued to page 158)

Journey's end — molten iron made from the ore in blast furnace flows into ladles at works of the Carnegie-Illinois Steel Corporation in Gary

Map shows lifeline linking iron ore docks in north with great iron and steel centers



... SECRETS WELL KEPT ...



Jap suicide plane at top is blasted by a projectile exploded by a radio proximity fuse. Above, right, closeup of fuse. It also fought secretly in combating the Nazi buzz bomb attacks on London in 1944. Smaller than a pint milk bottle, the fuse automatically exploded 5-inch shells that came within 70 feet of their targets

Detonator-type primer half as big as aspirin tablet exploded "goop" fire bombs



Another well-guarded secret was the flight, in June 1944, of six Navy patrol blimps from this country to the Mediterranean to fight Nazi subs. Two others went to Africa

The Germans had developed a torpedo with a range of 80 miles which had an acoustic head that "listened" for targets

Floating tank raises its canvas walls to convert it into a sea-going weapon. Below, disguised by the boatlike framework that enables it to swim, the flotation equipped tank lumbers ashore

The world's biggest gun—built for the Nazis by the Krupp Works—was discovered by an American officer in a Bavarian forest soon after V-E Day. Weighing 1344 tons, the monstrous gun fired 8-ton, 31.5-inch shells a distance of 30 miles. Designed for use against the Maginot line which crumbled without this intended blasting, the gun was employed against Sevastopol



Worn-out Flying Fortresses, carrying no pilot or other crewmen, crashed down on the heavily defended German island of Helgoland with 11-ton bombs. An Allied pilot and co-pilot would take the B-17 up in England, head it across the North Sea and then bail out before crossing the English coast. Radio control did the rest

When the European war ended, the Nazis were preparing to build jet-propelled U-boats with underwater speed of 25 knots

CRUISERS ARE A TOUGH BREED

The story of the fighting cruiser *Columbia* as interpreted from her log by Thomas E. Stimson, Jr.

MAYBE you are one of the landlubbers who thinks a ship is just a piece of machinery. Brother, that's wrong.

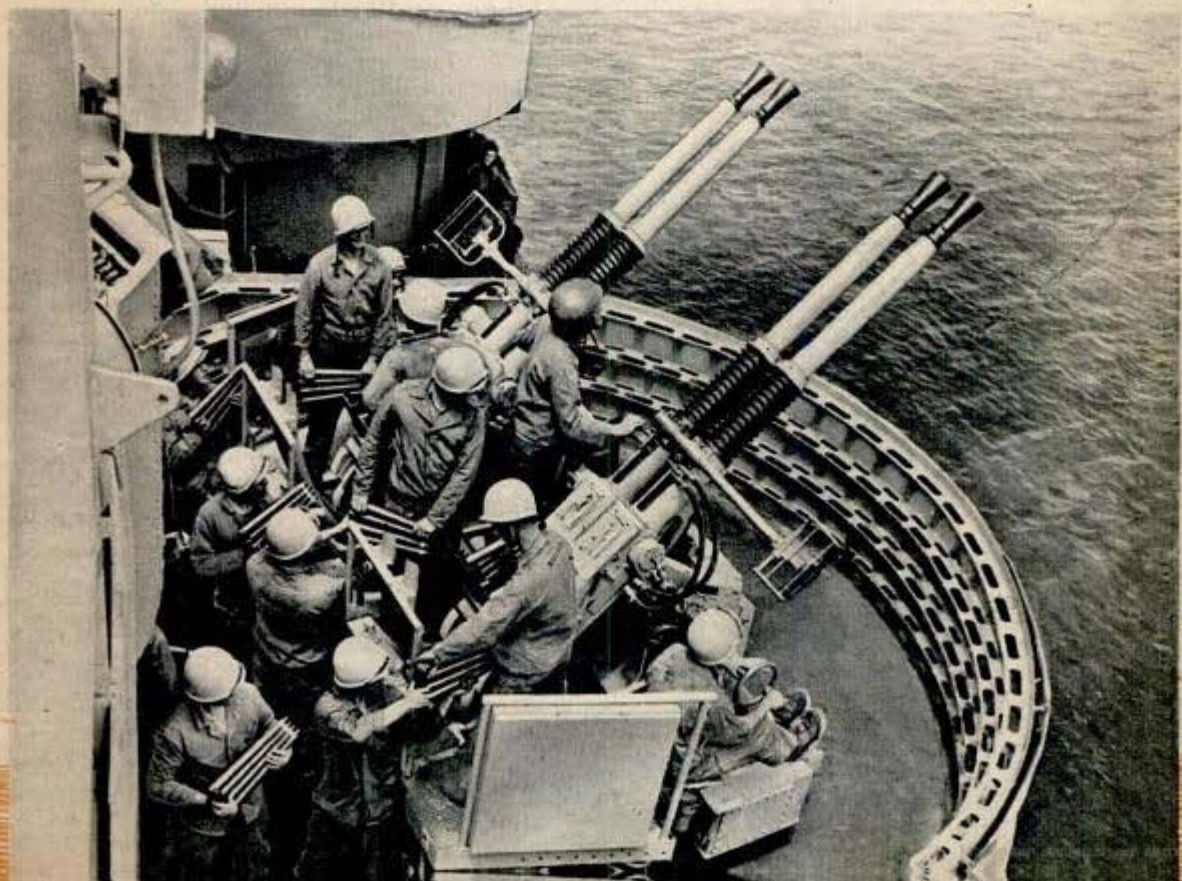
Take me. I'm a 10,000-ton cruiser, a lightweight, fast and tricky. I've been scared at times and I've been lucky and I've even been embarrassed. You can't say that about a piece of inert machinery.

I've kept on fighting when I was badly hurt. I fought at Guadalcanal, at Munda, I bombarded Bougainville, I helped at Leyte, Mindoro, Lingayen Gulf, and I've been in half a dozen other sea fights besides.

My guns fired 45,000 rounds of shells during one four-month period alone—800 tons of metal—and my



Last-minute supplies are loaded on USS *Columbia* by a crane. Below, the cruiser's anti-aircraft guns dealt with Jap planes





Mask, gloves save spotter from Jap plane flames
Below, ammunition handlers for anti-aircraft gun



score card includes two Jap warships sunk, 24 Jap planes downed, and an uncounted number of enemy shore installations knocked out during eight bombardments.

I've seen more action than lots of ships several times my age. I'm three years old.

We cruisers are a tough breed. Some of us have had our bows blown clear off but only a few have been sunk. We come in three sizes, light, heavy, and large. We are raiders, we act as anti-aircraft ships to protect transports and carriers, we bombard the enemy shore, we back up amphibious landings and take part in fleet engagements. We carry aircraft and do long-range scouting.

As a light cruiser I have very little armor and depend on my main batteries of six-inch guns, twin-mounted five-inch dual purpose guns, and 40 and 20-millimeter automatics for protection. I'm a floating porcupine although the books say I'm supposed to run from heavier ships that out-gun me. The war wasn't fought that way and as an example I'll tell you about my worst scare, the Battle of Surigao Straits during the initial Philippine landings.

It was a few hours before daybreak. A big part of the Jap fleet with the battleships Fuso and Yamashiro in the lead was closing with an American task force. I was in front, with nothing in front of me except the Japs. It was a very uncomfortable place, for one salvo of 14-inch shells could have sunk me without a trace. Jap shells began to land so close the men on my deck were splashed by their spray.

I'll dip my flag to our destroyers. They ran in past me and hit the Japs with torpedoes. That slowed down the Jap battle-wagons but didn't put them out of action.

By now the range was so short that my sister cruisers and I were getting in some hits with our relatively light guns. All in all, we punched so many holes in the big Japs that we set them on fire and sank both. A lot of Jap ships went to the bottom that morning and I take credit for helping



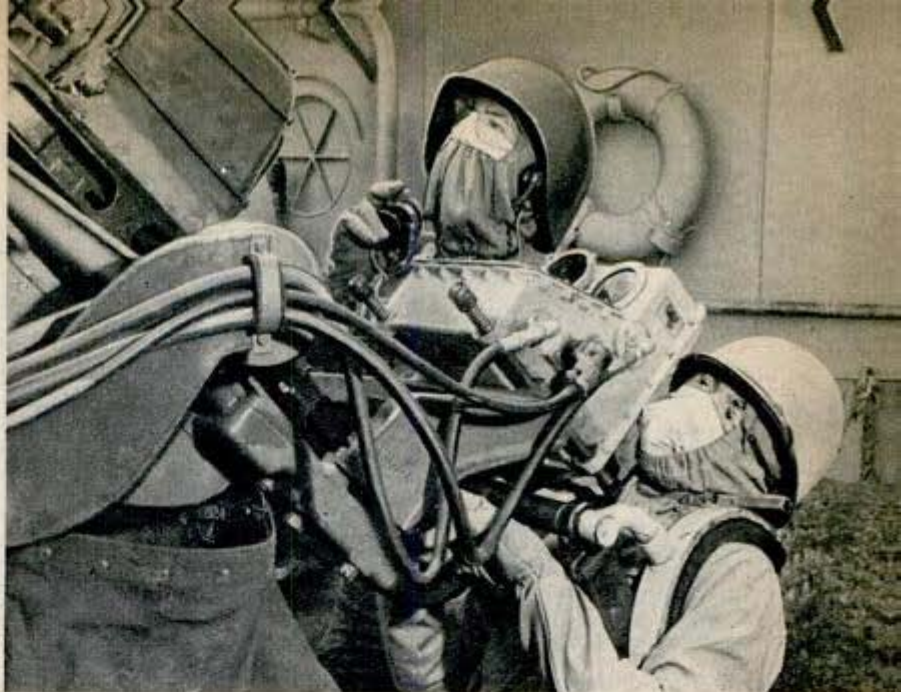
sink those two. I wasn't scratched.

At daybreak there was nothing in sight except two blazing pools of oil where the battleships had been, and a Jap destroyer scurrying around looking for survivors. My fire control men adjusted their instruments, trained a turret around to bear on the destroyer, and sank her.

My most embarrassing moment was earlier in the war. For a few hours one night I was the most unpopular ship in the Pacific. We had been in a scrap that day and I'd taken a small hit under the bow. No one on board knew I'd been holed, for I was shaking with recoil at the time.

After dark, however, other ships in the task force signaled that we were showing a light. My skipper couldn't understand it, after an inspection showed we were completely blacked out. The other ships still insisted I had a light burning, an obvious advertisement to any Japs in the area. Finally my crew found a light in the forepeak, shining through the hole the Jap shell fragment had made. Under the bow, it wasn't visible from deck.

This is the USS Columbia, a tough cruiser which KO'd two Japanese ships and 24 planes



With flashproof clothing protecting their bodies and faces, two gunners operate a 20-mm. antiaircraft gun. Below, seamen move shells encased in metal containers to ammunition magazines below deck





If fire control instruments are knocked out, five-inch turret guns are pointed by this manually operated sighting device mounted on top of the turret

In the old days, they tell me, a warship's crew was pretty well protected during battle. Everyone was below, or in turrets, or in the armored conning tower. The airplane has changed that. Today lookouts, anti-aircraft gun crews, damage control parties, and other groups all have to fight in the open. They have little protection beside metal helmets and antifeather clothes.

These men on the topside stations are parts of a coordinated team. En route to the Lingayen Gulf landing, for example, a Jap "kamikaze" suicide plane was sighted by the lookouts, headed straight for me. The anti-aircraft gunners began to pick the plane to pieces as soon as it came within range. The shells tore off parts of the plane's structure, killed its engine and no doubt killed its pilot, but the plane kept heading in. It swerved between my stacks and dived into the sea alongside, so close that gasoline was sprayed on my deck. At once the damage control parties went to work with fire hoses, washing the gasoline over the side before it could catch fire. That was teamwork.

It was teamwork, too, that kept me afloat during the next few days while Jap suicide planes pounded me. One suicide plane got through my anti-aircraft fire in spite of numerous hits, crashed into my stern and exploded.

For a few seconds I thought I was coming apart everywhere. A magazine was blown open, I was on fire and my bottom

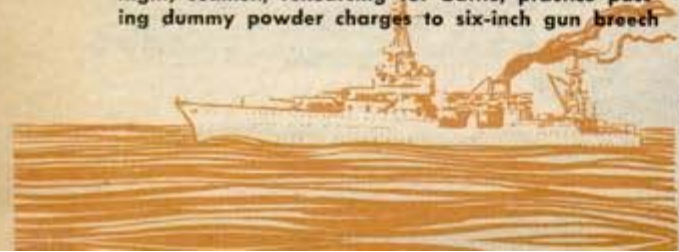
Right, seamen, rehearsing for battle, practice passing dummy powder charges to six-inch gun breech

had opened up. A huge cloud of smoke and flames jetted up through the hole the plane had made. My whole after end was a shambles but the damage control parties got it doused and then rigged pumps to get rid of the water coming in through my hull.

Meanwhile it was discovered that my steering gear was wrecked and my after turrets were out of action. The electrical system was shorted by water. But my engines were still unharmed, and I could maneuver by using my twin propellers.

I'd been hurt but that wasn't the time to quit. My forward turrets were as good as ever and I kept on firing. Meanwhile other Jap planes kept coming in. My anti-aircraft barrels stayed hot all afternoon and I knocked down every plane that got close. A diver went over the side, in full view of the Japs on shore, and put on temporary patches. That helped a lot and for two days I continued my shore bombardment.

Then I caught it again. A Jap plane got close enough to slam a bomb into my for-



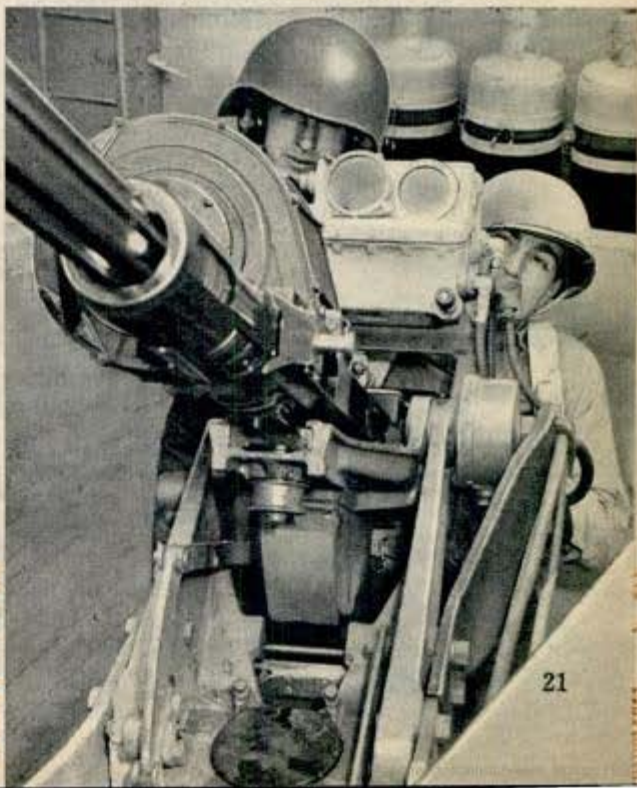


ward control station, putting it out of action and starting several fires. Hastily, phone circuits were rigged to connect forward turrets with after control stations. I wasn't efficient, but I was in action. Nearly a quarter of my crew had been disabled and the men still at their stations had had little rest for four days. Pumps were going constantly and my steering gear was still faulty. Radio Tokyo meanwhile was telling the world I'd been sunk.

I stood by, pitching shells ashore, until the beachhead had been secured. Then began the long, slow trip back to a repair station on the West Coast. With many men killed in action, it was a solemn voyage.

That's my story. My crew were the heroes of it. Me, I'm content with a message a sister ship flashed in my direction when I had to request some medical supplies at Lingayen Gulf. The message read, "Only too glad to assist in every way possible a ship that has fought bravely, and though battle-scarred is unbowed."

Stern deck is hidden beneath ammunition which is being moved below by line of men. Photo below shows gunners operating 20-mm. anti-aircraft gun



LIGHTWEIGHT "KICKLESS" CANNON ABSORB OWN RECOIL



Firing artillery shells with no more recoil than a .22 rifle, 57 and 75-millimeter "kickless" cannon were used successfully against the Japs. Weighing only 45 pounds, the 57-mm. rifle can be fired from the shoulder or a small tripod and tosses a three-pound

Recoilless 75-mm. rifle, above, left, weighs 110 pounds. The 57-mm. rifle can be fired from a tripod, above, or shoulder as at left

shell two miles. Telescopic sights permit great accuracy in firing. A 14-pound shell is thrown more than four miles by the 75-mm. rifle, which weighs 110 pounds. A regular field artillery 75 and wheeled carriage weigh 3400 pounds. The kickless guns, while resembling rocket weapons, are rifled, increasing accuracy, and fire standard artillery ammunition rather than rocket projectiles. Secret of the recoilless gun is in the breech and the cartridge case fitting into it. Instead of being tightly closed to prevent the backward leakage of gases when the gun is fired, the breech is left partly open, with a series of tubes to guide the flashback. Cartridge case walls are perforated, permitting part of the gases to flow outward and back. This force is sufficient to offset the recoil, but the escaping gases compel the men to work at the side, rather than the back, of the gun.



Cab of Tomorrow for Paris

Parisian taxicabs, beloved but ancient, will be replaced by five to six-passenger vehicles designed for comfort rather than beauty. The motor is placed between the two front seats, and the vehicle, though long, is almost as low as the jeep. Doors slide sideways to open and close. The roof is transparent and opens halfway, while large windows give the driver a better view for dodging pedestrians. A roof fixture shows whether the cab is empty or full

POPULAR MECHANICS

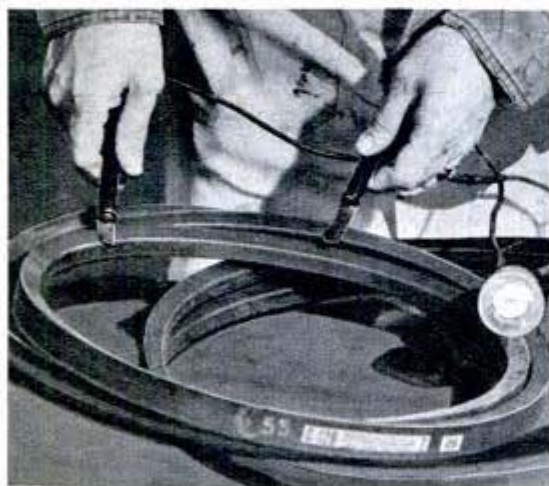


SYNTHETIC STEED OF STEEL

"Synthy," a synthetic horse made of a steel barrel suspended by ropes from each of the four uprights of an unused radio tower, took the place of Texas horses that went to war. Missing their regular horseback rides, a group of Port Arthur girls rigged up the substitute, complete with



saddle and sawdust on the ground below. By pulling on the ropes in rhythm, the girls cause "Synthy" to trot, lope or gallop. When they jerk the ropes out of unison, the steed becomes a real bucking bronco.



Neon Lamp Lights Up on Tester If Rubber Is Conductive

Conductivity of rubber belts or other rubber articles is easily determined by a B. F. Goodrich Company testing apparatus. Static-conducting rubber is used where static sparks might cause explosions, and has peacetime applications for washing machines and other household appliances. The tester consists of lamp cord and plug, two-watt neon glow lamp in socket, and two metal clamps or flat terminals with insulated handles. Terminals and lamp are connected in series. Small areas on the tested article are moistened with water and one clamp applied to each area. If the lamp glows, the rubber is a static conductor.

Jap Engine Powers Motorcycle Built by Coastguardman

Parts of the homemade motorcycle constructed by Coastguardman Gerald G. Grant in the Southwest Pacific include a Japanese outboard engine, a sprocket and two chains from a Jap motorcycle, two wheels from a Signal Corps wire cart, a cut-down bicycle frame, and a seat from an old lifejacket. He got the engine from a New Guinea native for six packs of cigarettes. The cycle does 40 miles an hour and travels 100 miles on a gallon of gasoline.

☐ The world's largest penicillin factory is being erected near Liverpool, England.



GRANDPAPPY OF THE DUCK



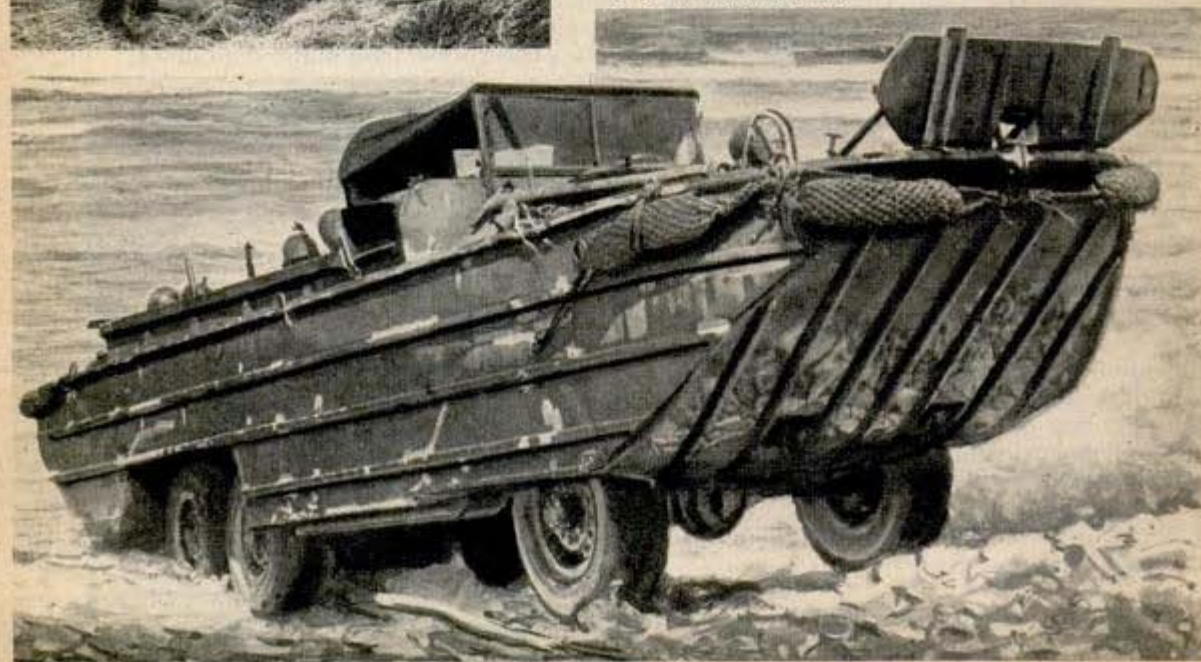
National Geographic photo
Dr. Thomas A. Jaggard, Jr., sitting beside
Sea Turtle, amphibious motor car resulting
from his experiments with Sand Crab.
Below, Sea Turtle on an Aleutian island



Rugged descendant of Sea Turtle is the Weasel which
can climb steep bank; it's powered by Studebaker engine



National Geographic photo
Sea Turtle takes to the sea during Aleutian expedition.
This 21-foot steel craft was the second amphibious car
designed by Dr. Jaggard. It was powered by a Ford Mod-
el T engine and had twin screw propellers. First used to
study volcanic formations, Sea Turtle fathered wartime
DUKW shown below grinding ashore with full load
U. S. Marine Corps photo



AND WEASEL

By Master Technical Sergeant Jack Black,
Marine Corps Combat Correspondent

ANYTHING is possible in war—even the breeding of a species of duck with a turtle and a crab among its ancestors.

That's the family history of the amphibian truck, familiar to every invasion beachhead as the "duck," derived from its military designation DUKW. This invaluable tool for waging war was fathered by a sea turtle and had a sand crab for a grandsire.

Dr. Thomas A. Jaggar, Jr., noted University of Hawaii volcanologist, invented the first practical wheeled amphibian.

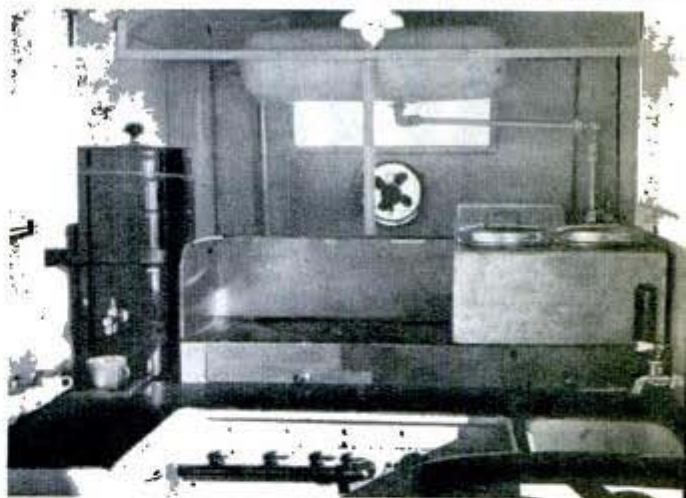
An Alaskan expedition to study explosive Mount Katwain in 1927 furnished Dr. Jaggar with the motive for developing an amphibious motor car. After several months of experimentation, he completed his pioneer water bug and dubbed it "Ohiki," which is Hawaiian for sand crab.

Several hundred skeptical spectators witnessed the formal launching January 17, 1928, at Hilo, Hawaii. Many wagers were lost as the Ohiki lumbered off the highway and trundled along the beach into the water. Editors hailed the "auto that sails the seas and boat that runs on land." Dr. Jaggar's initial amphibian was a skiff 21 feet long with a beam of five feet four inches, mounted on an elongated Ford chassis. A Smith "Formatruck" axle was used in the rear. Just forward and mounted through the sides of the boat was a Ruckstall axle to which sidewheel paddles were attached. The rear wheels were chain driven from the Ruckstall axle. The front wheels were disked and served as rudders.

As the testing progressed, improvements were added to the Ohiki. An eight-horsepower outboard motor doubled the original speed of two miles an hour. On land the maximum speed was 25 miles per hour.

The first steel model, 21 feet long and weighing 3700 pounds, was called "Honukai"—Sea Turtle. Twin screws had replaced the paddles. Watertight compartments were built into the hull, fore and aft. The radiator was on top of the cabin. A cooling pipe for the circulating water encircled the boat below the water line. Gears were specially contrived to give numerous low speeds and allow all combinations of propellers and land drive.

During the junket in the Aleutians the Honukai was used with success. Returning to Hawaii, Dr. Jaggar continued experimenting. When war clouds gathered he made his amphibian data available to the War and Navy Departments.



FEEDING FIREMEN while they battle stubborn blazes is a problem that's been licked by the Los Angeles Battalion 2, which purchased a milk truck and converted it into a self-contained commissary unit. A steam table was made from old boiler plate and ice cream containers and old stove parts from junkyards provided a hot plate and two-burner gas plates. Fuel for several days is provided by a butane tank while a butane coffee urn provides plenty of steaming java.

METAL WING TANKS salvaged from C-47 Skytrains by M/Sgt. Merrill A. Shaw of Seattle, Wash., were put to good use as cabin ferry tanks for long hops across water. The metal tanks conserve about 30 percent in space, compared with papier-mache bolero tanks used formerly in C-47 long hops, and carry 200 additional gallons of gasoline. They support light baggage and make room for 5 to 7 more passengers.



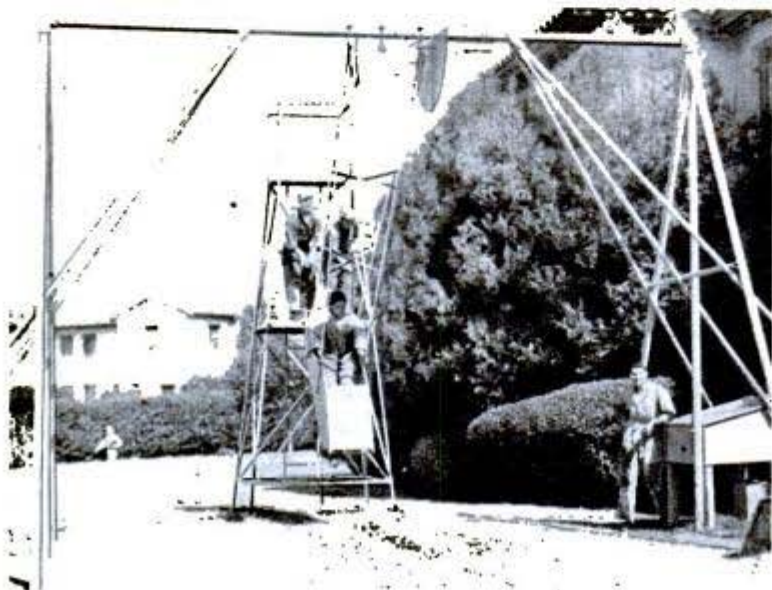


Eight Parachutes Float Rescue Boat Down to Sea

Easily attached to the bomb rack of a PB-4Y, an 18-foot plywood airborne rescue boat is now standard equipment for the air-sea rescue activities of the Coast Guard. Weighing 1500 pounds, the rescue boat is equipped with water, rations, motor, sail and Gibson Girl radio, all protected against shock. Footholds on the hull make it easy for swimmers to get aboard. The boat is dropped at an air-speed of 90 miles an hour and eight standard parachutes open and buoy it gently into the sea. Eight men can be accommodated aboard the lifeboat. A larger airborne rescue boat used by the Army Air Forces weighs 3500 pounds and carries full provisions to keep 12 men 15 days at sea. A few minutes after the AAF boat is dropped, it can be moving under power provided by two engines able to do eight knots.



Rescue boat attached to PB-4Y; sail, oars or motor propel it

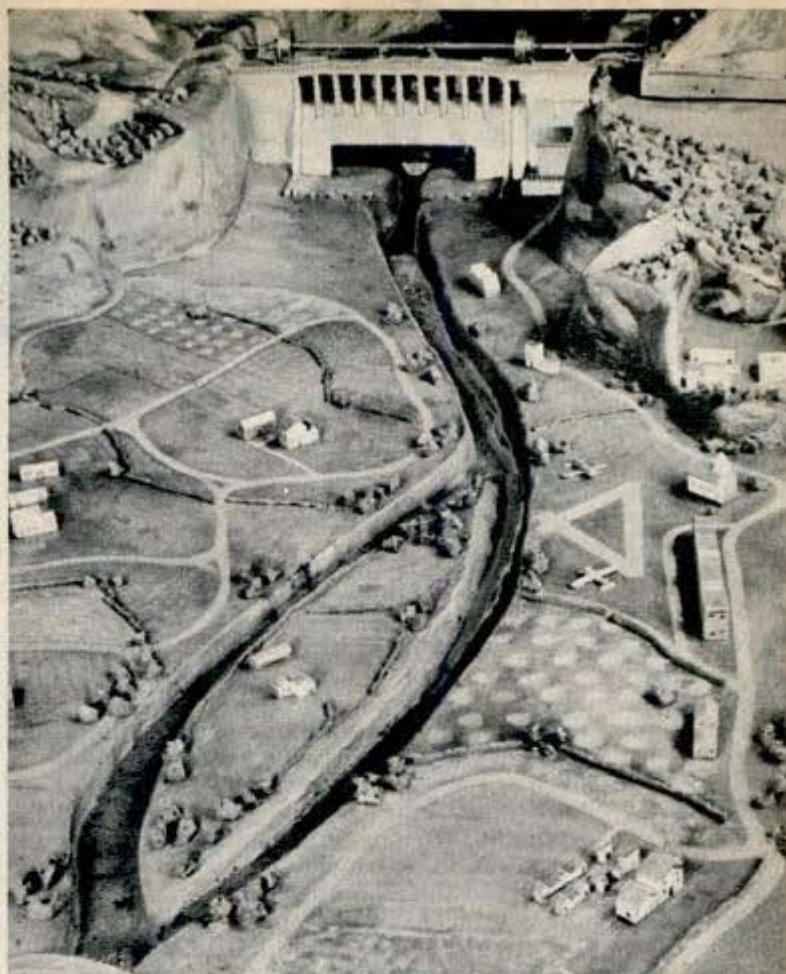


Cadets' "Air Legs" Tested by Swing

Susceptibility of student pilots to airsickness is determined by giving them a ride on a swing much like that on a school playground. The AAF School of Aviation Medicine notes that there is no sure cure for airsickness, and advises flyers and passengers to eliminate all known causes of worry and fear, to get plenty of sleep and to avoid overeating, especially fatty foods. Even a veteran pilot may lose his air legs, the school cautions.

Electrical Valley Tells Dam's Story

What actually happens in the working of a dam is demonstrated by a scale model dam and river valley, electrically operated. The model, designed by C. S. Lynch, executive vice-president of the Arkansas Power & Light Company, and built by Frank H. Beale, is supplied with water by two electric pumps. One runs constantly to represent the normal stream flow, and the other supplies water which is stored in a large glass tank at the head of the model and is used to create miniature floods. The model valley is complete with farms, roads, bridges, industries, an airport and a hospital. The model is being shown throughout the Southwest to demonstrate why flood control dams must have empty reservoirs and power dams require full ones.



Bunks and Galley For Air Campers

If the postwar pilot of a Trimmer amphibian spies a wilderness lake that looks like good fishing, he can stop there for two or three days and live in comfort. The three seats in this twin-engine plane can be made up into two comfortable berths and there is a built-in galley for hot meals. Designed as a combination business-pleasure plane, the Trimmer has two 85-horsepower engines, top speed of 132 miles an hour and a cruising range of 600 miles. The wing span is 35 feet 6 inches and the weight empty is 1470 pounds. With a full load of 2200 pounds, the plane can take off from water in 635 feet. Landing speed is 48 miles an hour. The Trimmer, which is be-



ing built by Commonwealth Aircraft, Inc., is expected to be used for short commercial services as well as by private pilots.

FIGHTING WITH FIRE



By John L. Kent

IN THE closing days of the war, our Air Forces set out methodically to burn Jap cities to the ground after naming their targets many hours in advance.

Fire bombing of the enemy's manufacturing centers had been stepped up from 1000-ton incendiary raids in March to 6000-ton flights in August. According to Major General Curtis E. LeMay, commander of the 21st Bomber Command, 1000-plane raids carrying 10,000 tons of incendiary bombs were planned, since our bases on Okinawa were in close range and the B-29s could increase their bomb load.

In medieval times attackers tossed balls of burning pitch over castle walls with improvised catapults. In World War II, our flyers carried fire over the Jap walls—in this case their anti-aircraft artillery and fighter planes—in fire bombs.

Using fire in war is not new, but it was the English who first planned to use fire in recent times as a fighting weapon. Flaming death awaited Hitler's hordes had they attempted an invasion of England during 1940-41. Having lost almost all their equipment during the evacuation at Dunkerque, the English devised methods of fighting off the threatened invasion of the British Isles with man's primitive weapon—fire.

"Oil defenses" capable of setting the Channel ablaze were evolved, and billowing smoke towering above an impenetrable strip of searing flames would have met the enemy's assault craft. Behind this barrier a secondary "inshore" line of oil defenses was set up. Reservoirs of petroleum were connected with the sea by large pipes hidden in the sand and running under the sea from 100 to 200 yards out. The petroleum was to be set aflame by chemicals like calcium phosphide which ignites on contact with water. The chemicals were to be directed through pipes in ball-like form to dissolve in the water and set the oil afire. This flame barrage could not be operated in rough seas, and was established only along the critical stretch of the coast in the Dover-Folkestone area.

Stories have been told of charred and burned bodies washed up on South English beaches. Perhaps Hitler did attempt to invade England in a small force, somewhat as we invaded the French coast at Dieppe to get first-hand information about

These flame throwers at an English Channel port stood ready to repel Nazis. Below, vertical jet used as defense against low-flying airplanes



B-29, right, drops incendiary bomb on Osaka. Center, droppable tank filled with explosive jellied gasoline. Bottom, Marines burn out Jap caves on Iwo



coast defenses. If he did, his men never reached shore.

In addition to the oil barrage, the English had portable flame throwers mounted on Bren gun carriers, which could throw a flame 150 yards. These were ready on the piers along the river mouths and inlets to repel any amphibious attack. The same flame throwers were used during the Allied landings at Normandy; because of the "sting" this device could deliver, the troops called it the "Wasp."

The English made another novel use of fire when they devised a method of lifting the perpetual fog which hangs over the





Ordnance men in England prepare incendiary bombs for plane getting ready to fire enemy installations

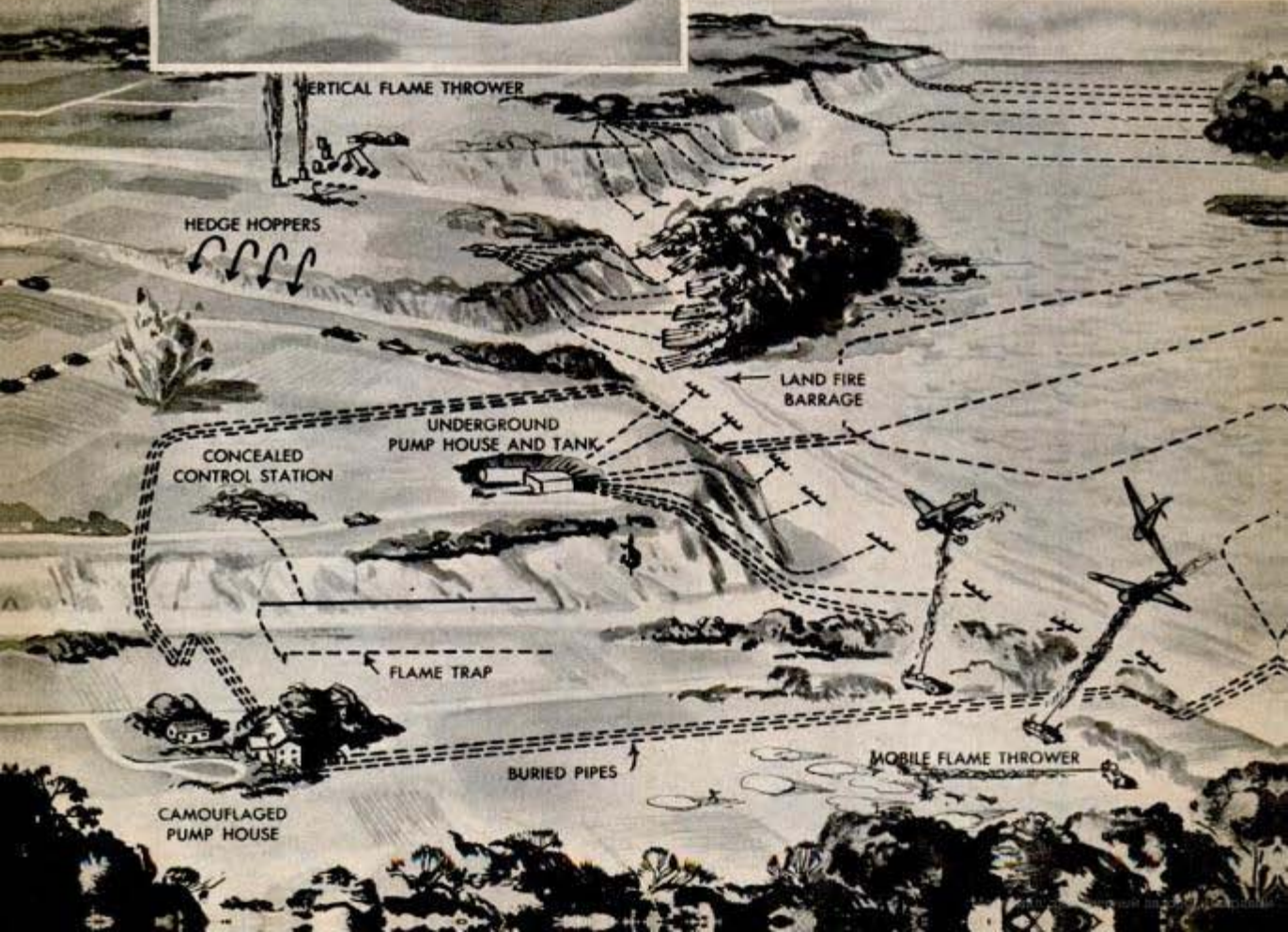


British Isles. It enabled the Allies to maintain round-the-clock bombing of Germany, regardless of weather. The fog was simply burned off the air bases by oil burners strung along the runways like lights. They generated enough heat to melt the fog like magic. One man sitting in a control tower could press a button and within six minutes planes were landing with perfect visibility. When the last plane was down safely, the operator pressed the "off" button and the fog immediately settled over the field. This invention was known as FIDO—meaning "fog investigation dispersal operation."

FIDO installations also helped American daylight bombers caught in fogs. In one day last winter, 91 U. S. Eighth Air Force planes landed at one FIDO base when their own field was blacked out by fog. Altogether, FIDO helped over 2500 Allied planes land safely since November 1943.

In the Pacific, fire first was employed by the Americans during the fight for Guadalcanal, when the M1A1 flame thrower, using thickened gasoline, proved effective in blasting Japs out of their holes. Early in 1944, the Chemical Warfare Service Tech-

Left, round oil patches grow larger, finally form a continuous strip to be ignited as an English Channel defense against invasion. Below, Britain's wall-of-flame plan prepared to turn back any Nazi landing



nical Command developed another model, the M2-2 portable flame thrower, especially designed to provide the tremendous pressure needed to eject the newer types of thickened gasoline. The development of "gel," as this thickened gasoline mixture is called, is a story in itself. The use of gel was made possible by the discovery of USAT, an innocent white powder capable of transforming ordinary gasoline into incendiary jelly. This powder can be shipped in small packages and mixed with gasoline in battle zones. The powder is poured into a drum of gasoline, paddled and aged for a few hours.

When flame throwers were adapted for use on tanks, the same gasoline mixture was used. Tank flame throwers were used in great quantities in the Pacific; on Okinawa one unit was completely equipped with flame throwers on tanks. Some equipped with extension hoses poured a searing fire on Japs holed up in steep, cave-

studded ridges. The hose extensions came in 50-foot sections which were joined to form lengths up to 500 feet. Coupled to fuel containers in the tank, the hose conveyed the fuel under pressure to the nozzle where two members of the tank crew controlled the hose, aimed the gun, and fired concentrated splashes of flame into Jap strongpoints.

The flame thrower's thickened gasoline also is used in the M47 100-pound petroleum bomb and the M69 10-pound bomb. The M47 is a thin-walled bomb which scat-

Clouds of smoke rise from oil piped to surface of English Channel to thwart possible Nazi invasion



Rain of fire bombs from B-29s heads for docks and warehouses at Osaka





Thirty-eight "Tokyo Fireflies," small incendiary bombs, fit into a big 500-pound missile, shown beside K. T. Keller, president of Chrysler Corporation

ters great chunks of fire for a distance of 40 yards. The M69 is dropped in clusters which open in mid-air by means of time fuses, releasing a shower of firesticks upon the target.

The Army's Chemical Warfare Service had other tricks up its sleeve. The latest of its incendiary bombs is the 500-pound blockburner or "goop" bomb. In addition to jellied gasoline, it contains powdered magnesium, liquid asphalt and other ingredients. These combine to form a synthetic lava that flows into corners and

other hard-to-reach places. A small-scale version of the goop bomb is the M74, a 10-pound tubular bomb that ejects its complex "insides" almost instantly after landing on a target.

The fire qualities of goop were discovered when a quantity stored in a California war plant suddenly burst into flame. Samples were rushed to Edgewood Arsenal, Md., for study. There, Chemical Warfare Service technicians added gasoline and other ingredients, plus white phosphorus. The resultant synthetic lava is a rubbery material which burns with an intensely hot flame. The "lava bomb" resembles a 19-inch length of hexagonal pipe. A collapsible metal tail springs open when the bomb is released from its cluster. A sensitive fuse in the nose ignites the incendiary upon impact.

Inside the bomb is a plastic cup which holds a small quantity of white phosphorus, a few pounds of the synthetic lava and a dome-shaped ejection diaphragm. Blown open by a burster charge, the diaphragm works like a piston, expelling the phosphorus and lava in a miniature eruption. Gobs of lava fly out 25 yards, cling to any surface and burn.

The Army also introduced a 165-pound fuel tank, which, loaded with jellied gasoline, was especially adapted to targets of Japanese construction. The tanks weigh 1100 pounds loaded, and two are easily mounted on the P-47 Thunderbolt or other bomber-attack plane. This tank was used with remarkable success in France, where 460,000 gallons of jellied gasoline were dropped on German-held Bordeaux.

During the first six months of 1945 the Chemical Warfare Service furnished nearly 160,000 tons of fire bombs to all theaters, but the incendiary bombs booked for Japan for 1946 amounted to nearly 850,000 tons—a total of 150,000,000 bombs.

That, as the Japs would have found out, is a lot of fire bombs.

U. S. tank flame thrower shoots out a stream of fire that reaches approximately 180 feet
Signal Corps photo





THREE-WHEEL DRUM TRUCK, with its third wheel forming a foot pedal to give greater leverage, can be loaded and moved by one person. Requiring no manual lifting, the truck easily and safely picks up and transports drums or barrels weighing up to 800 pounds. The truck is simply pushed up to the barrel, an adjustable hook is slipped over the top rim, and a pull on the handle automatically loads it. The foot pedal over the third wheel gives greater leverage for an easy "break-over." The added wheel also supports the load when the truck is standing alone.

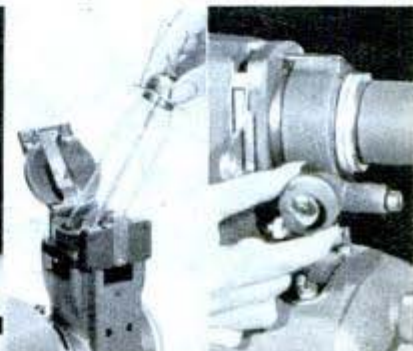


LIQUID INSULATION that brought amphibious landing vehicles through the surf in A-1 condition will find many postwar uses. This waterproofing liquid is used on electric motors, ignition systems, batteries, internal combustion engines or wherever protection against moisture or corrosion is required, and it is so effective that an electric motor covered with the liquid will continue operating even when submerged. In one test, a 1/2-horsepower motor and an exposed light bulb have been in operation under water for over two years. There is no short circuit in the water.



SCREEN IMAGES of particles being hurled through the air at amazing speeds are made with a phosphorescent screen. Viewed in a darkened room, shadow images of the particles at the moment of an explosion glow for half a minute. A paper disk about a foot in diameter is attached to a motor which rotates it at 12,500 revolutions per minute. At this speed centrifugal forces explode the disk and a ray of infrared light hits a photoelectric cell and operates a special mercury flash lasting only two billionths of a second. The light energizes all parts of the screen not shaded by broken parts of the disk, resulting in a shadow picture. This device was developed to test supercharger speeds up to 30,000 revolutions per minute.

BASE-UP LAMP which can be changed while hot is a feature of a postwar 35-mm. still projector for showing color or black and white slides. As shown in center photo at right, cap lifts off to expose base of lamp, which can be lifted out without use of gloves since it is unnecessary to have contact with heated glass. Lamp heat is reduced in operation by a motor-driven fan. Rack and pinion focusing mechanism is operated by turning a knurled knob.



ROBOT CREWS FLY THE AIR LINERS

MOST of the work of flying the postwar air liners is to be performed by robot flight crews. The human pilots and copilots are simply commanders-in-chief who direct the labors of their mechanical employees.

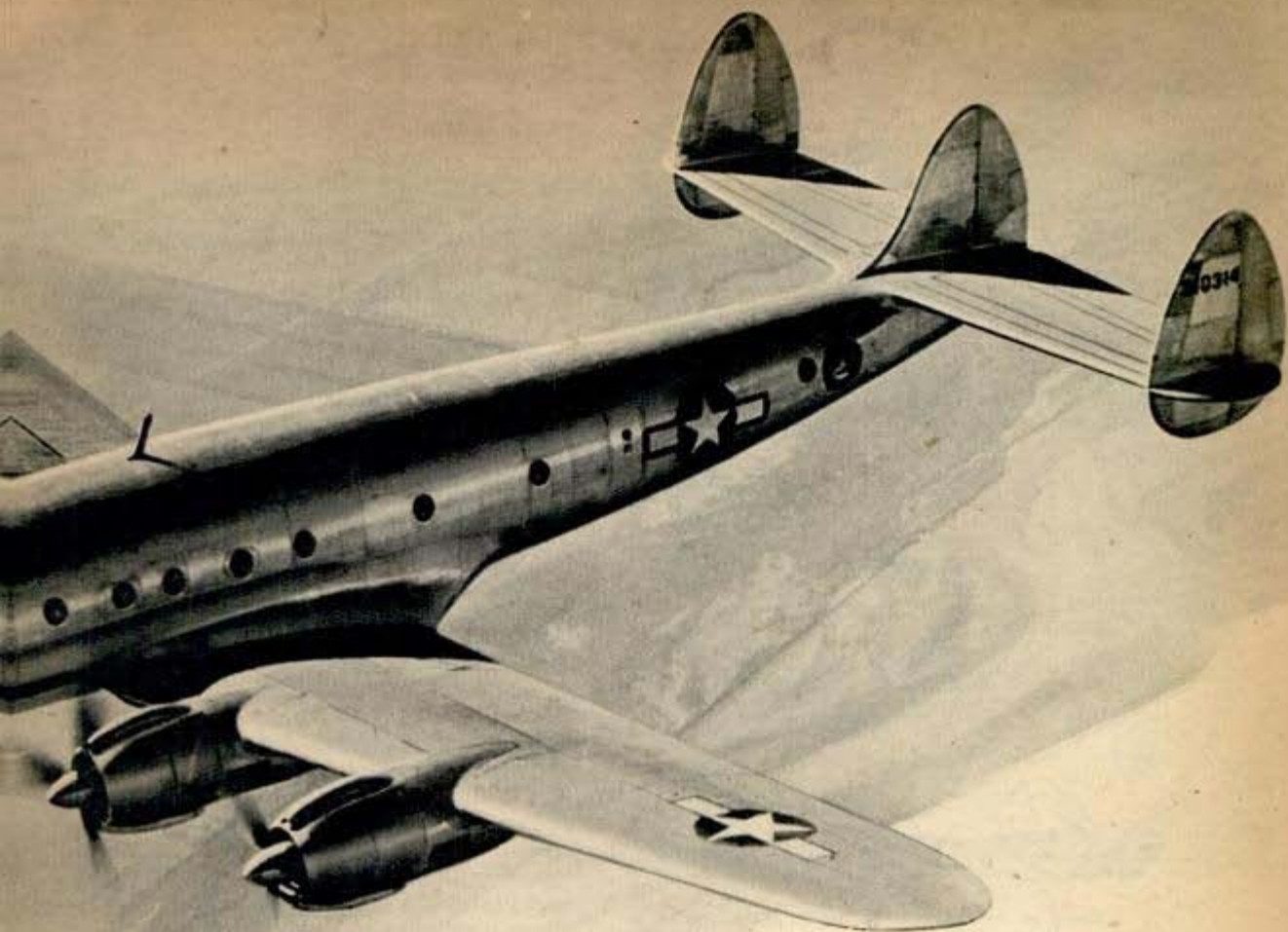
Such a flight crew consists of 100 or more different mechanisms, electric or hydraulic, each of which is built to do one job correctly and rapidly. The robot crew of the B-29, forerunner of the 100-passenger Boeing Stratocruiser that has crossed the continent in six hours and three minutes, consists almost entirely of electric motors. The robots that do the work on the Douglas Skymaster, on the other hand, are nearly all actuated by hydraulic force.

Even the 7000-pound landing gear of the B-29 is retracted by electric motors. Its electronic automatic pilot can make as many as 300 flight corrections per minute. The only hydraulic device on the plane is a booster for applying the brakes.

On the Lockheed Constellation, both hydraulic pressure and electric motors are used. A dozen powerful hydraulic slaves whose specialty is brute strength do the heavy work. They raise the ponderous landing gear and move the great control surfaces in response to the pilot's commands. They squeeze the brakes to bring



Spread out below are some of the 152 electric motors used on a Boeing B-29. Girl is holding up 1/4-horsepower motor



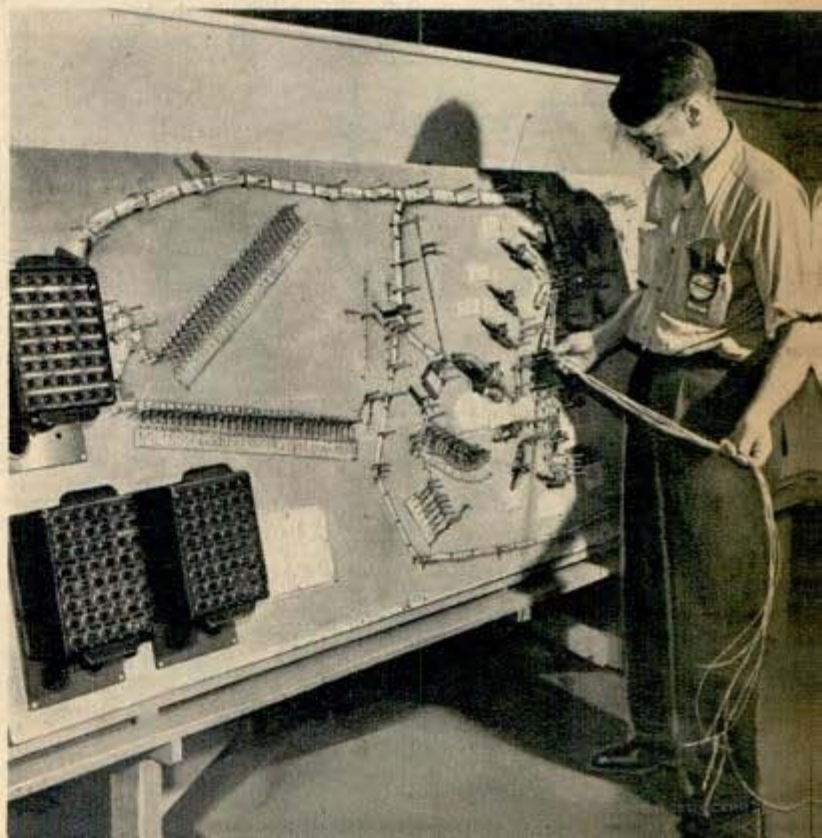
the 43-ton transport to a stop within a short distance after landing.

Smaller jobs are handled by servo-motors that are stationed at strategic points throughout the plane. Some of the motors act as electric muscles that work for the pilot, others have their own thinking apparatus and perform their duties automatically.

Such extreme mechanization is necessary because the two pilots and the engineer of a great air liner have neither the time nor strength to attend to all of their duties in person. Too, much of the work must be done in portions of the plane that are inaccessible during flight. In these places a tiny hydraulic valve or a small motor is installed.

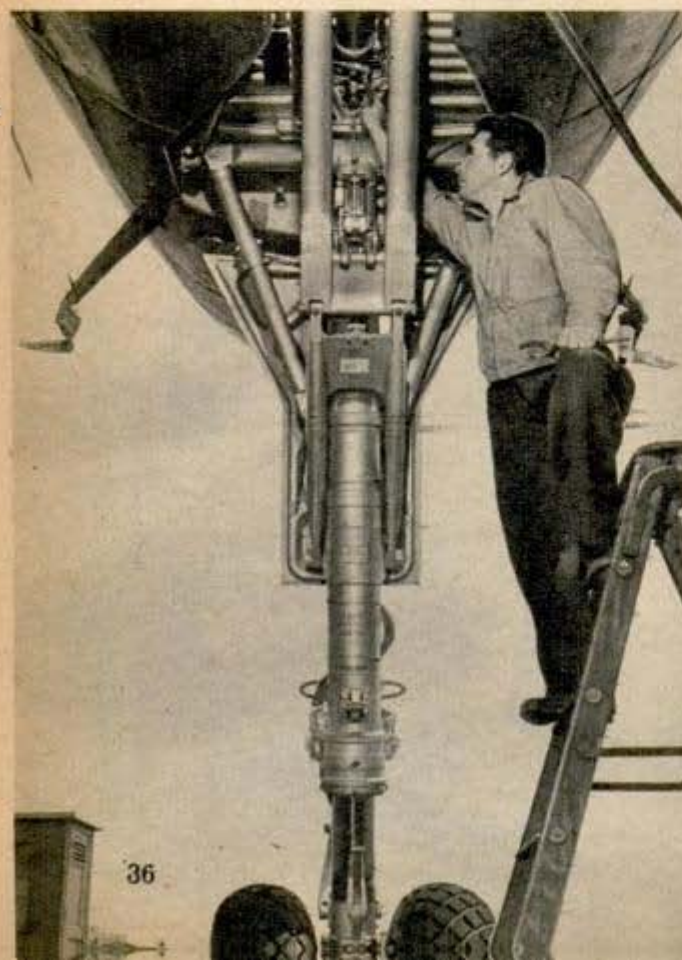
In addition to this mechanical labor battalion, the pilot of a Constellation has in his charge a fire alarm system and a fire fighting department. He is also the head of a complex intelligence network that keeps him supplied with up-to-the-instant news on the functioning of his aircraft.

On the 64-passenger Lockheed Constellation electric and hydraulic "slaves" perform the heavy work for crew. Below, testing one of the intricate wiring circuits for Constellation





Tiny autosyn motors back of panel operate engine instruments on Constellation. Below, checking hydraulic cylinder that retracts the Constellation's landing gear



An endless stream of reports is received in the flight quarters in the form of instrument readings and flashes of light from baby signal lamps. Typical examples are:

"All four of the ship's doors are closed and locked."

"Landing wheels have left contact with the ground."

"Hydraulic pressure is steady at 1700 pounds per square inch."

The reporting service shows when the landing gear is retracted and locked, the condition of the plane's cabin pressure system, operation of the plane's lights, and functioning of the four engines.

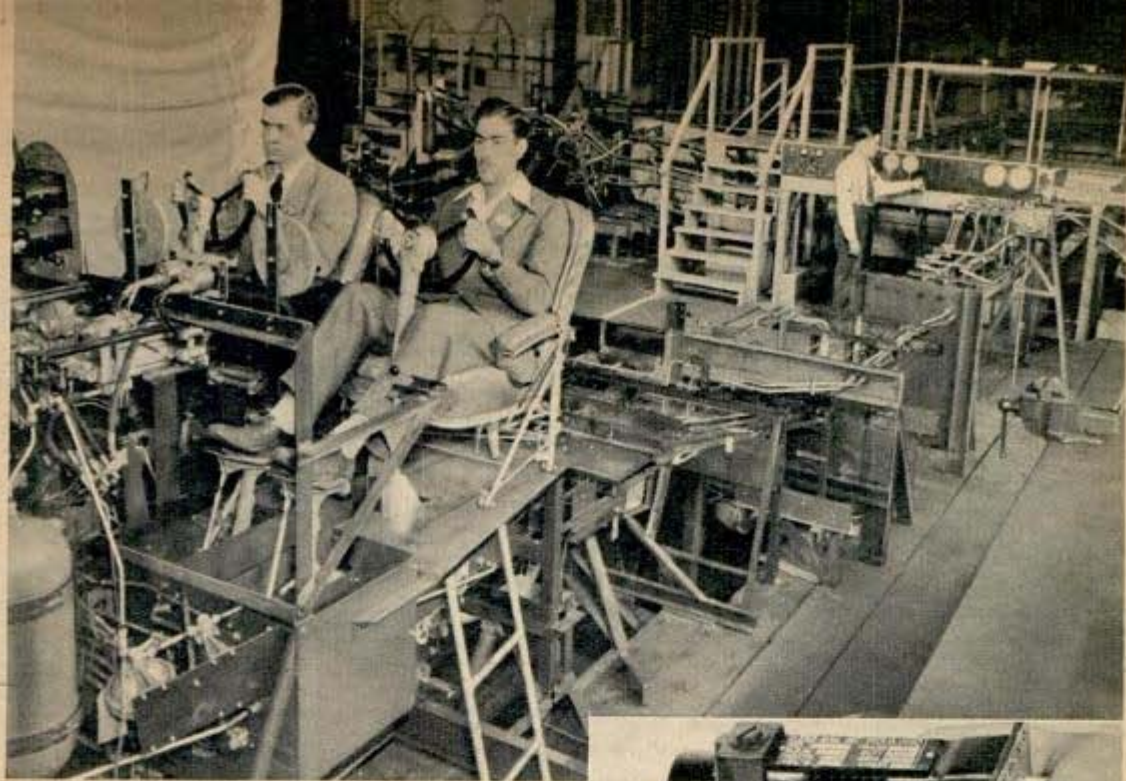
The Constellation has more than 50 electric motors in its "crew" and approximately as many more of the autosyn type that activate its instruments. All of the motors are of lightweight design and they range in size from 10-horsepower units down to $\frac{1}{2000}$ horsepower in an autosyn motor.

Some of the tasks to which motors may be put on an air liner include reeling in the trailing radio antennae, operating the governors of the propellers, opening and closing the cowl flaps of the engine compartments, and even supplying pressure to pulsate the rubber de-icing boots on the leading edges of the airfoil surfaces. On some transports, motors pump anti-icing fluid to the propeller blades. Other motors, back in the tail, boost the pressure in the long hydraulic lines that supply force for moving the tail surfaces.

"Gill motors" on a high altitude passenger transport open and close radiator intakes so that pressurized air may be cooled before it is admitted to the cabin. Similarly, small servo-motors regulate the amounts of fuel that are supplied to the cabin heaters. These fuel control motors operate automatically in response to cabin thermostats.

Other jobs that motors perform include pumping fuel to the engines, operating the windshield wipers, and blowing warmed air against the cockpit windows as an antifrosting measure.

The autosyn motors of the instrument systems are a special class of midgets. They work in pairs. One acts as a measuring device by metering the amount of current that flows through it and this current in turn operates its synchronous twin that is mounted behind the corresponding instrument dial on the engineer's instrument board. The armature of this second autosyn moves the needle of the dial itself. Autosyns are used for transmitting many kinds of information including engine heats, engine revolu-

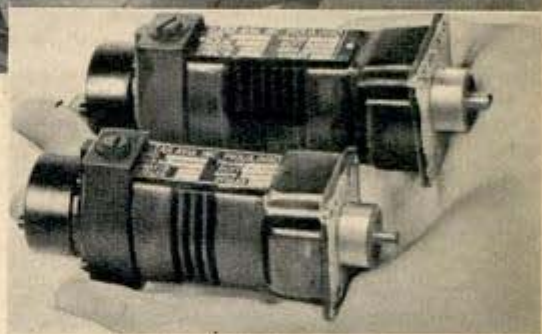


Full scale working model tests hydraulic apparatus and electric motors. Note "toe" brakes on the pedals

tions, and oil pressures and temperatures.

Some autosyn units weigh as little as five and a half ounces and may develop as little as $\frac{1}{2000}$ horsepower, but they are accurate to within one degree on a 360-degree circle when moving the needle of an instrument. They are assembled in air-conditioned, lint-free factories where the girl employees may use neither nail polish nor face powder because even tiny particles of these substances could unbalance the fine parts. An autosyn motor that is smaller than your thumb may have in it nine coils of wire of 50 turns each. Final inspection is with a 20-power microscope.

Solenoids, too, are used for specialized jobs. Opening a primer valve to build up fuel pressure before an engine is started is performed by a solenoid. Solenoids lock the landing gear in place and a solenoid vibrator boosts magneto voltage during the time the engine that spins the magneto is turning over slowly. An oil dilution solenoid injects gasoline into the oil system to insure easy starting in cold weather.



Lear, Inc., photo

These electrical "muscles" each weigh less than one pound; they move vital parts of air liner. Below, test rigging on elevators simulates flight loads to check hydraulic boosters that move controls in air





These electric motors for aircraft might be called "pilot" and "copilot." Between them is small rotor

The fire detection system on the Constellation consists both of thermostatic warning devices and a heatable link system, units of which are located at points where fires might start. A master warning light that is operated by either system furnishes an alarm for the pilot, while the location of the fire itself is shown by a bank of lights in front of the engineer. The fire fighting department consists of reservoirs of fire fighting substances, connected by lines to the areas that are served by the warning system. An external connection is provided so that the lines may also be connected to a ground supply of carbon dioxide, for use if fire should occur while the plane is on the ground.

On the Douglas Skymaster, hydraulic

pressure does much of the work that is done by motors on some other planes. The hydraulic installation, in addition to operating the landing gear, steerable nose wheel, wing flaps and brakes, also actuates the automatic pilot, the engine cowl flaps, the windshield wipers and the carburetor air-filter doors. Nevertheless, the Skymaster has a complete electrical system. The main supply is of the 24-volt d.c. single-wire type, the plane's structure serving as the ground return. In addition there are two alternating current systems for operating autosyn instrument motors, the remote indicating compass, the radio loop and other specialized equipment.

The sizes and speeds of passenger transports today are at the point where manual control of the plane's control surfaces, or booster mechanisms to do most of the work of moving the control surfaces, is optional. As sizes go up and speeds increase, manual control will become too difficult for any pilot, necessitating booster power for controlling all large, high-speed aircraft.

Mechanization of the civilian passenger liners is not yet complete, for a number of war-developed instruments are being adapted for installation on air transports. Most important of these is radar, by which a pilot will be able to see his surroundings on an illuminated screen in darkness or fog.

An air position indicator that tells at a glance the plane's exact position by latitude and longitude is another instrument that will be used, augmenting celestial navigation and radio position checks. Finally, blind landing systems that remove all guesswork and chance of error are being developed.

Waterproof motor fits in nose of Douglas Skymaster to operate blower that ventilates the pilots' compartment

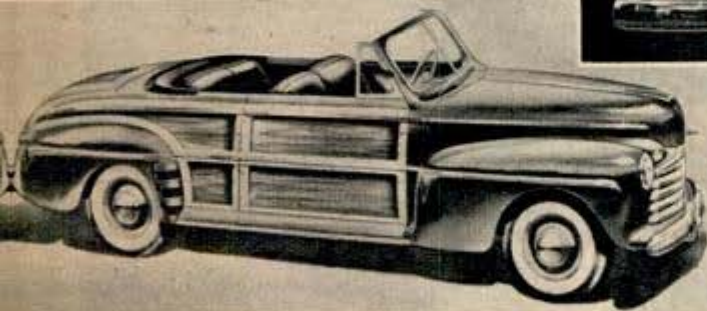




The '46 SHOW WINDOW



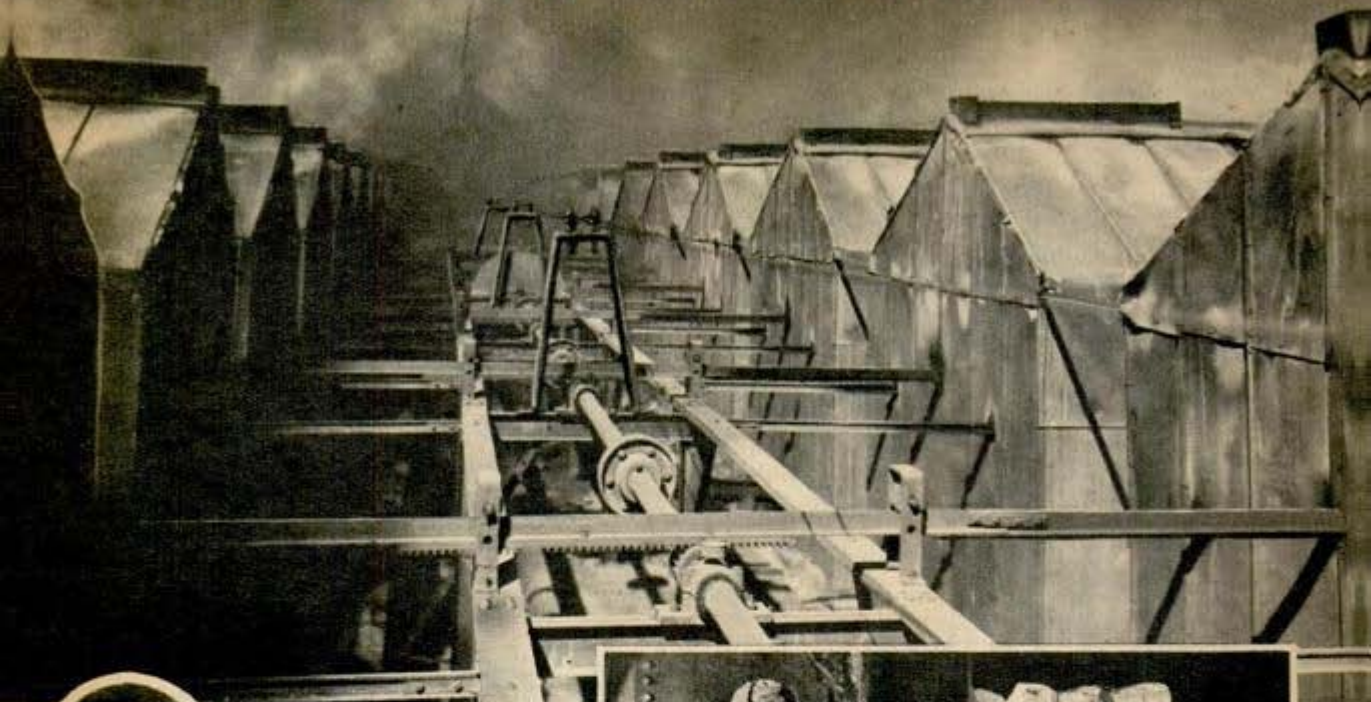
Top, Studebaker Champion is designed for taking the bumps without the passengers knowing it. Studebaker is building cars in four body types and variety of colors. Above, front view of Champion with horizontal grille. Note the new hood emblem



Ford Sportsman's Convertible is combination of station wagon and convertible coupe. It is fitted with leather upholstery. Right, sleek Pontiac features new grille, relocated parking lamps and heavier bumper. Below, four-door Buick sedan has full airflow fender, restyled grille



WE NEED MORE SOOT



Continental Carbon Co. photos

Natural gas fuels carbon black plant above. Shaft moves iron plates in burner buildings. At right, feeding bags of soot into press before shipment. Carbon black in ink is studied below

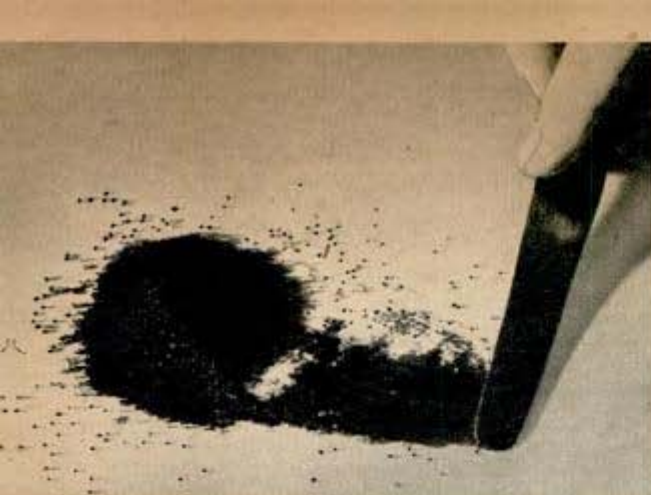


Binney & Smith Co. photo



ALL OF US are aware of the rubber industry's tremendous job both in war and peace. Everyone can see in photographs and newsreels the rubber pads that thrust powerful tanks forward to crush the enemy, and the rubber tires on which graceful B-29s thundered down an airstrip on another trip to Japan. But how many persons realize that the very backbone of rubber is carbon black—another name for soot!

Remember the white tires of 30 years ago? They were made of cotton fabric and rubber, the latter strengthened by a reinforcing pigment of zinc oxide. After about 3000 miles they fell apart. Then an English scientist discovered that carbon black, mixed into tire formulas in place of the pigment, made the rubber several times stronger. This process was perfected in America, and today's tires, with a strong



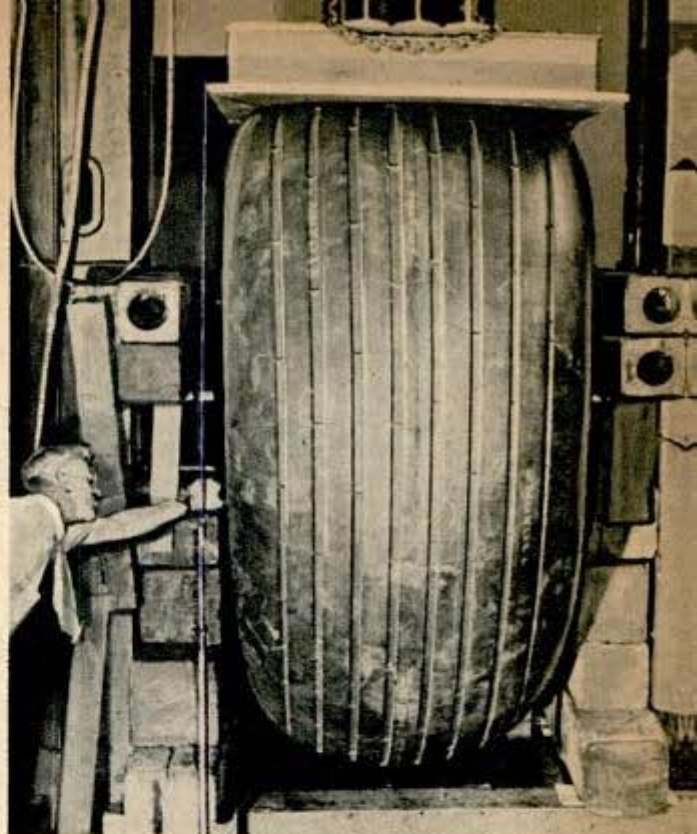
Binney & Smith Co. photo

Tiny beads of carbon black, above, made by special process. Right, testing biggest U. S. tire, built by Goodyear. It has overall diameter of 110 inches

fabric backbone, use rubber containing special grades of carbon black which gives them a strong, durable surface good for 20,000 miles or more. And if carbon black researchers continue to succeed, tomorrow's tires may even outlast the auto!

Research already has conquered serious problems. It was difficult at first to mix the carbon black particles in rubber batches. The process was done openly, raising great clouds of dust. Binney & Smith Company laboratories tackled the problem and came up with a machine that forms carbon black into small pellets, dust-free and easily transported. The toughest military tires are made with these pellets.

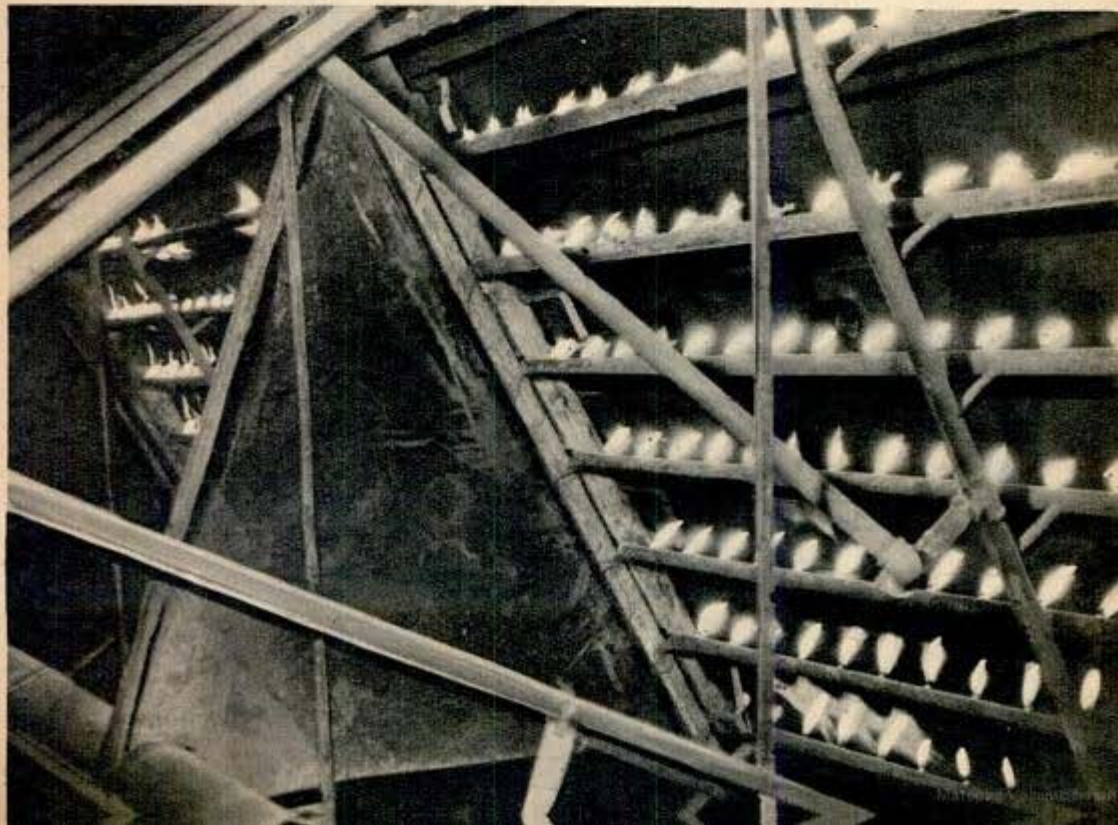
World War II brought a demand for rub-



ber that would conduct electricity. The technicians found that certain carbon black produced in furnaces is electrically conductive. Made with this carbon black, airplane tires grounded static electricity that might have ignited fuel tanks. Shoes soled with conductive rubber ground electricity that might cause munitions explosions.

(Continued to page 156)

Inside a burner building. Hundreds of burning jets leave soot on slow-moving iron plate; scraper removes it
Continental Carbon Co. photo



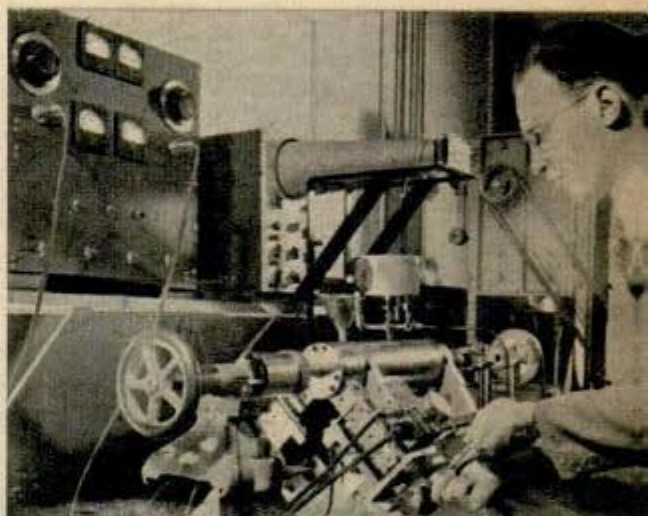


Gearless Cycle Does 70 Miles On One Gallon

Neither a motorcycle nor scooter, a streamlined speedster able to travel 70 miles per gallon of gasoline is ready for mass production. A centrifugal hydraulic transmission developed by the speedster's inventor eliminates gear shifting entirely. The speedster weighs 245 pounds, has aircraft-type wheels and a speed up to 56 miles per hour from a three or four-horsepower motor. It is fully cushioned, with an alloy steel tubular frame, and is equipped with roller bearings throughout.

Micrometer "Tunes In" on FM To Record 1/10-Millionth Inch

Rapid changes in position only one fifty-thousandth the thickness of newsprint can be measured with an electrical micrometer which records movements as small as one tenth of a millionth of an inch. The tool uses the principle of frequency modulation radio to measure position of moving objects without touching them. The wave length of light is the standard used in calibrating it. Minute errors in high precision lathe spindles were determined by the instrument. The micrometer also is the heart of an apparatus used to record changes in crystal structure when steel is heated rapidly, and in electric welding.



"Dunkproof" Radio for Marines

Radio headsets and lip microphones used by marines on invasion barges are built to withstand a ducking in sea water. A specially designed "gland" in the new microphone will pass air but exclude water. The microphone is one half inch thick and no larger than a half dollar. In tests, the "mike" and handset assembly have been soaked five times in water for a 25-minute period and then baked at 125 degrees Fahrenheit without damage to the equipment. The complete unit weighs only 20 ounces.

☐ A thin layer of nylon sandwiched into the rubber walls of aircraft fuel tanks developed by the Glenn L. Martin Company prevents leaking of high-octane gas fumes.

Amphibious vehicles by the thousand are lined up at marine supply center



One Step Short of Tokyo

the Leathernecks operated their largest supply base in the South Pacific — a production line on a coral beach

By S/Sgt. George E. McMillan

Photographs by T/Sgt. Arnold Johnson

HIS finger pointed to the speedometer reading. Two hundred miles. He waved his arm across the communications jeep. "Look at her," he said.

The torn and ragged edges of the fenders were corrugated with rust. The metal seat frames were twisted, and the seats themselves were water-logged and splotted with mold.

"If she had just gone 20 miles she would have done her duty—been worth what she cost the American people in dollars and sweat."

Marine supply men have hardened themselves to the high cost of amphibious warfare. What mattered to them was perfect functioning of equipment during those critical minutes when Leathernecks were clawing for a foothold on a Jap-defended beach.

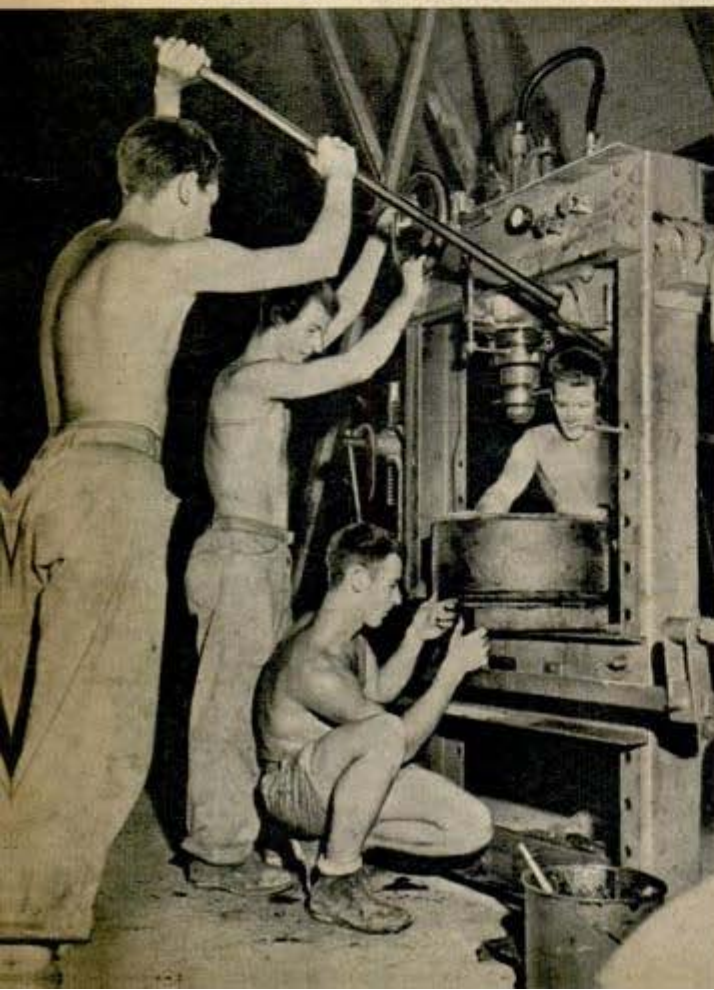
The jeep must hold together while being lifted in and out of cargo holds. She must withstand the tortuous trip over coral reef,

Up she goes! New tread is fitted on tractor which was brought in for repair after battle on Peleliu
Marine Corps photos





Ammunition storage hut at supply depot is inspected by Col. J. M. Pearce, commanding officer. Below, marines fitting new tire on bogie wheel for a tank



the lash of salt water, and must drive through sand and on into the mangrove swamp behind the beach.

Her radios must work, then and there. There is no time for fixing and no radio repair men with fancy testing equipment. They must work for marines, men who are fighters first and radio operators second.

So if this signal jeep had done nothing but send out the messages for the first few hours (and that's what she did at Guam), she was well worth the money and trouble it took to make sure she got there in good shape.

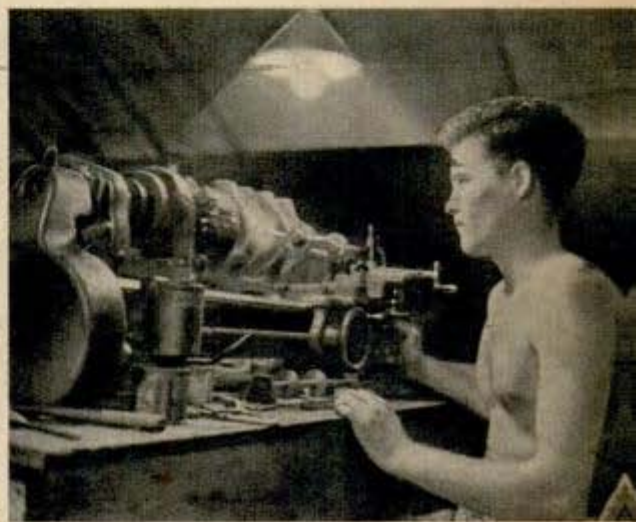
Nobody understands better, or practices more faithfully, this axiom than the 3400 men of the largest marine supply center in the South Pacific—men like Master Technical Sergeant Leslie R. Tinkler, in the corps eight years, who was an operator at Radio Shanghai in peacetime marine life and had overseen the fitting of the jeep before she left for Guam.

From the air this depot looks—except for the palm trees—like any large military base in the world. You see the patterns of quantity: long lines of warehouses, symmetric rows of artillery pieces, the squat squares of a tank park, the diagonals of a lumberyard, the molehills of tarpaulin-covered ammunition dumps.

The difference is in the job, and in the men. Here are the Tinklers, the high-ranking enlisted men and warrant officers, who have learned the traditional marine respect for weapons and equipment through years of service.

This is not a depot in the sense that its principal task is to receive, store and ship war materials. It is, rather, a series of shops and production lines where war equipment mass-produced in the United

Below, rewinding radio coil after it has been lacquered and covered with a fungicide for tropic use



States is modified to fit amphibious assault.

The Guam jeep will be refitted in such a production line, a line that begins at a long, broad plywood table where marines sit on high stools taking apart radio sets, sets with parts still shiny and the smell of newness about them.

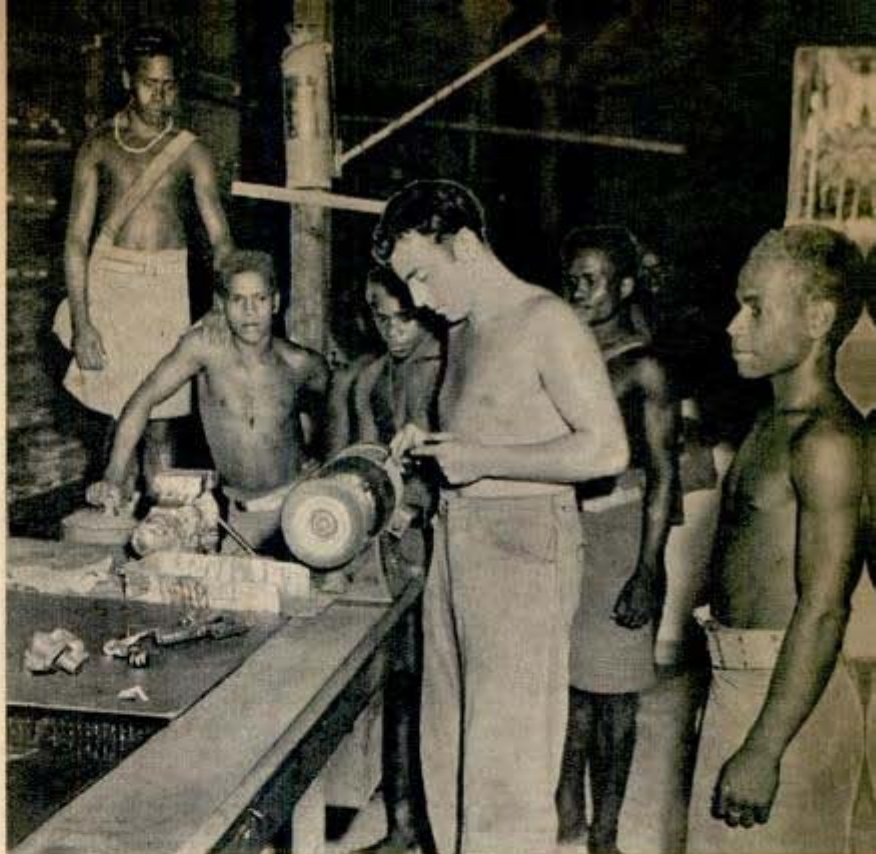
New or old, when the radio reaches this bench it is disassembled, soldered connections are broken, even the coils are unwound, and the whole jumble is put in a large vaultlike heating cabinet. When the parts are dry, they are laid on a revolving table and sprayed with a mix which includes lacquer and a fungicide. The coils are rewound, the set reassembled, new connections are soldered, and then the metal box is sealed and put in a heavy rubber case which is closed with a zipper.

Meanwhile the jeep chassis is going through another production line. New parts are put in where needed; loose joints are welded; new metal boxes to hold the radios and batteries are installed, and the whole jeep is painted. Then the vehicle is given an overall coat of a new preservative that is used by the men of this base as freely as a doctor uses sulfa in battle. Finally jeep

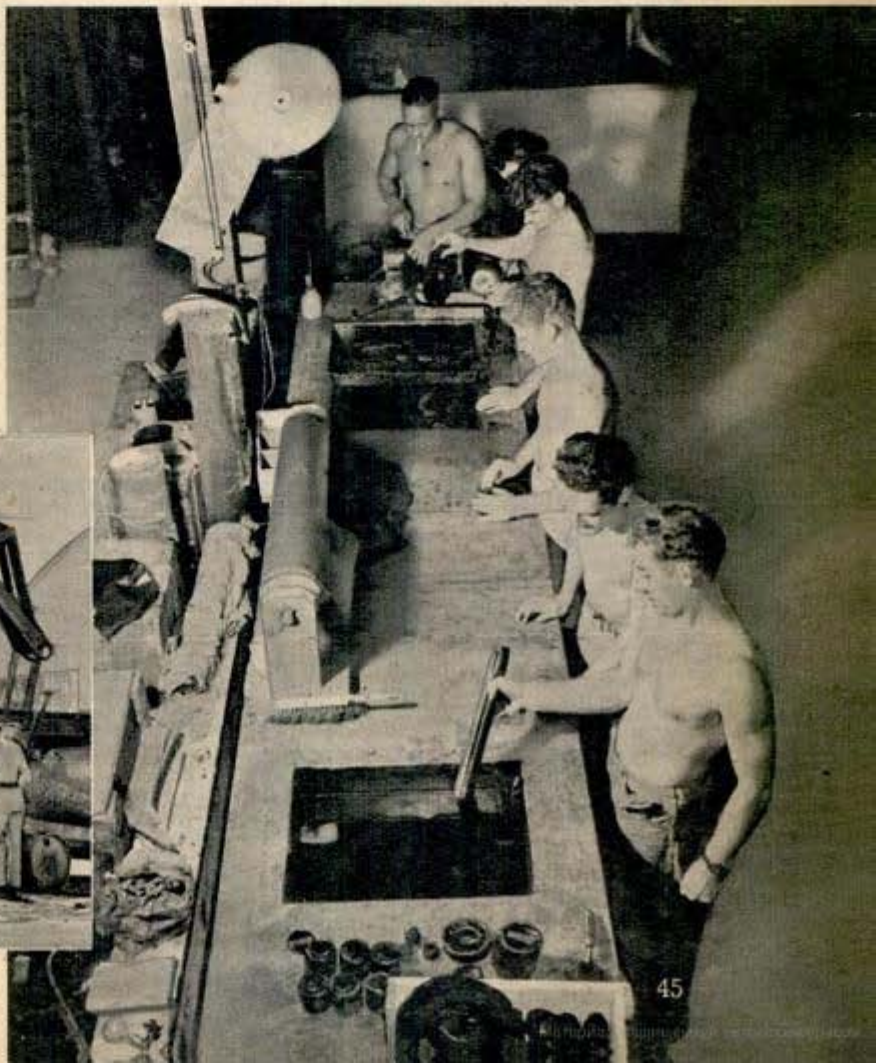
Giant crane moves vehicles at depot



NOVEMBER 1945



Natives stare in awe as sparks fly from knives they have brought in to be sharpened. Below, assembly line for cleaning and dipping parts



45



Chain belt carries rusted 155-mm. shells which are being repaired



Veteran jeep from Guam is sprayed with preservative after repair job. Below, setting lathe to make jig for fuse setter on shells



and radio meet, and together they are ready for another blitz.

The battle to get equipment in perfect working order goes on throughout the depot. At the engineering small parts warehouse, a group stands alongside a workbench into which sinks are built. All the parts in the warehouse, and there are thousands upon thousands—gears, sprockets, screws—pass along this table.

Each part is buffed with steel brushes, washed in preservative, wrapped in wax paper so heavy it folds like canvas, and finally the sealed package is dipped in wax. A gear at the end of the line looks like a huge candle.

In the instrument section, across the island, a marine stands at the kind of machine that makes your milkshake in the corner drugstore. In the metal cup are binocular lenses around which the shaker is throwing an ammonium compound. "They're new, or at least they just came from the States," he says above the whirr of the shaker. "Yet, we've got to take them apart and clean them and seal them up tighter than they were when we got them."

Up the road, in a coral-graveled lot where the dericks, graders and entrenchers are kept a group is fuming over the tread of a crane.

"Cleats are frozen," says a master technical sergeant. "You wouldn't think they'd rust that much. Tread won't work at all now. We've got to unlink, scrape, put preservative on, and reassemble it."

Back in the shade of a coconut grove, a crew loads bags of cement on pallets. Behind them stand long rows of the wooden platforms. These can be dragged along roads by bulldozers on the beachhead, saving three or four steps in loading and unloading from ship to

(Continued to page 152)



ILLUMINATED WIDE-FIELD MAGNIFIER, equipped with two 110-volt bulbs and a two or three-inch lens, throws a scientifically correct light on the object in the magnification field. The device may be turned to any angle by a universal clamping attachment, and may be raised and lowered quickly for numerous purposes such as machine parts inspections, examination of currency and signatures, or virtually any fine work requiring visual examination.



WHITE HOT STEEL is sucked up like lemonade in a straw with a glass tube fitted with a rubber bulb on one end. This procedure is used to obtain a sample of slag-free metal for carbon analysis. When the steel cools, the glass is broken and the test piece is weighed and placed in a high temperature furnace to determine carbon content. Before this method was introduced at U. S. Steel Corporation plants, samples were secured by drilling into slugs of cooled metal.



MAKESHIFT FLOATS made by tying empty water canteens together can be used to keep airmen afloat when they are forced down at sea. Use of the canteens is only one of many water safety measures that are taught at a six-day survival course for physical instructors of the 1st Air Force at Mitchel Field, N. Y. The men also are taught how to swim with weights and how to protect themselves from sharks.



SENSE-OF-TOUCH TOOL locates nuts, bolts or screws which must be fixed in invisible or remote positions. This compact tool, which is worn like a ring on the finger tip, also grips the nut or bolt to hold it in position, and enables a mechanic to use his sense of touch, which is almost impossible with a wrench or screwdriver. When not in use the tool is turned around out of the way, leaving the hand free.

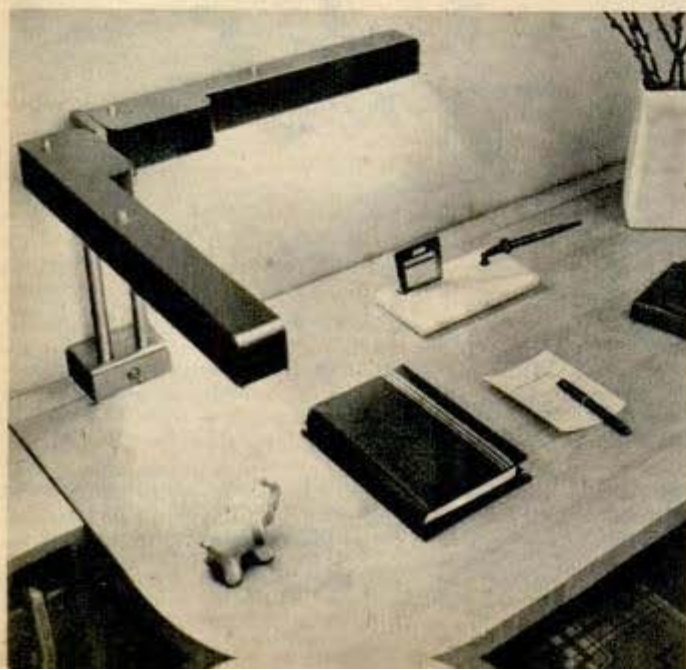


Pulp Mill Waste Yields Alcohol To Make Synthetic Rubber

Butyl alcohol, a prime ingredient in making a superior synthetic rubber, is produced from the sulphite liquor waste of pulp mills in the Northwest. Research chemists at the University of Washington obtain other valuable products from the waste that has menaced the fishing industry of Puget Sound. The sulphite liquor used in producing one ton of pulp yields 75 pounds of butyl alcohol, 40 pounds of acetone and about two gallons of ethyl alcohol. A solid fuel of pealike granules which burns like coal and a yeast fodder for livestock also are produced in the conversion process. The various products are made from the raw liquor by chemical precipitation, fermentation and distillation. The residue is pure water.

Berth Above Trailer Cab Built for Extra Driver

Perched on the forepeak and above the cab of large semitrailers, a berth for an extra driver is designed to provide better rest than conventional berths placed back of the regular driver in the cab. Invented by S. C. Thrasher, maintenance superintendent of Central Motor Lines, Charlotte, N. C., the berth furnishes more ventilation and greater freedom from road noises. Two sealed beam headlights under the covers provide heat in winter. The occupant can signal the driver at any time by a pushbutton which blows the horn.



Two Wings Swing Light Of Fluorescent Lamp

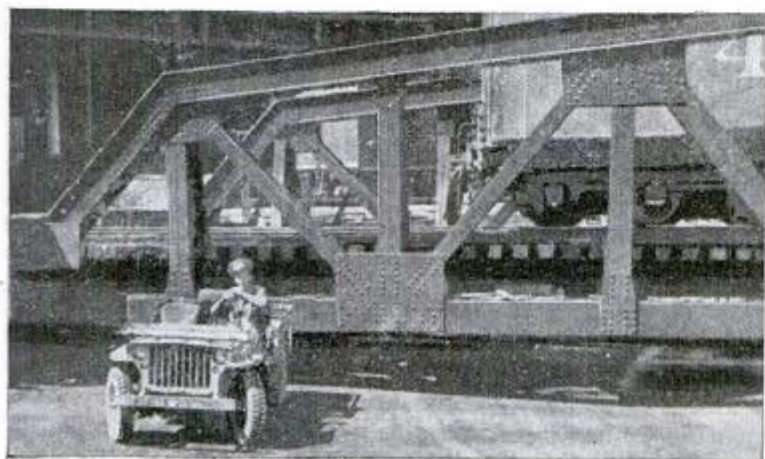
Two swinging wings of a two-tube fluorescent desk lamp can be adjusted to direct the light for best results. Each wing is adjustable through 90 degrees and can be set for either left or right-hand use. Both units can be flattened against a wall to conserve space and to light a wider area.

More than 45,000,000 pairs of rubber boots and shoes for troops were made during the war, according to the Rubber Manufacturers Association.



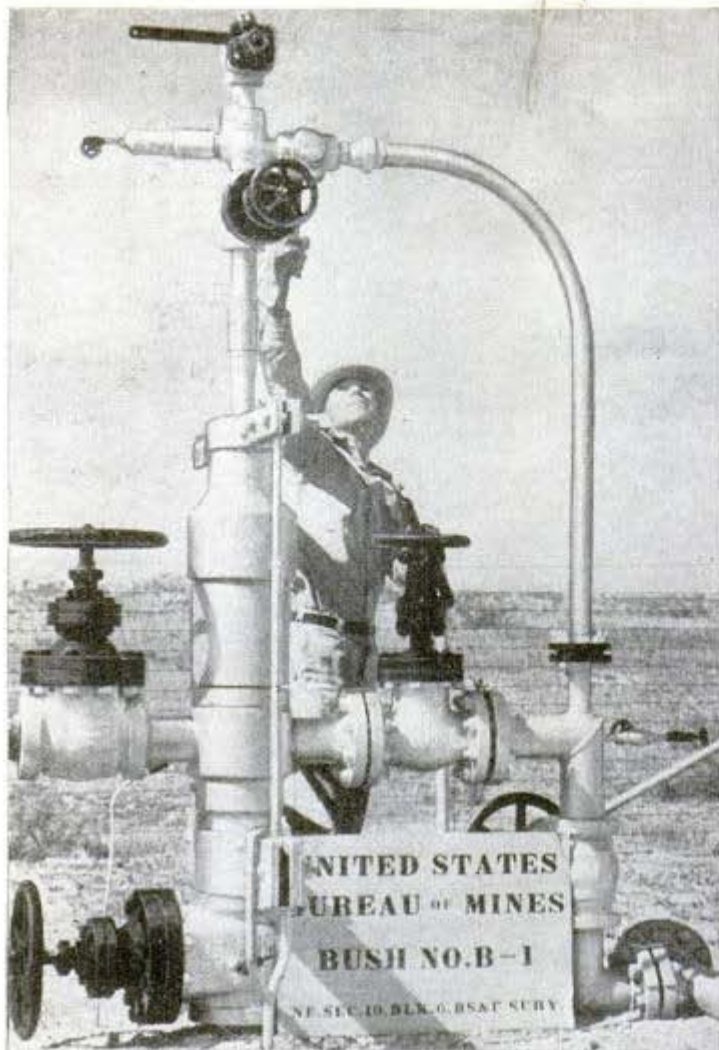
Navy's Helicopter For Land or Sea Has Twin Rotors

Forty-eight feet long and 13 feet high, the world's largest helicopter for Navy-Coast Guard air-sea rescue and special transport duty is undergoing tests. Power is provided by twin rotors, one at each end, and the craft can land within a 100-foot circle. The pilot's cabin is at the forward end, and space for 12 men or cargo is provided amidships. P-V Engineering Forum, Inc., of Sharon Hill, Pa., is the builder.



Jammed Turntable Moved by Jeep

If you ever have occasion to move a railroad turntable, don't try to push it. Just call for a jeep. That's what the Santa Fe Railroad did when an accident jammed its huge platform at Barstow, Calif. The Marine Quartermaster Depot obliged with a jeep which moved the turntable quickly into place.



Helium-bearing natural gas is piped back into underground reservoir for storage of surplus gas at 50,000-acre Cliffside field in Texas. Below, helium dilutes inflammable anesthetics in hospital



HELIUM IS A BUSY BACHELOR

By
Howard Stephenson

HELIUM, the buoyant gas that refuses to burn, sold at the rate of \$2500 a cubic foot in 1918. Today its price is under half a cent a cubic foot and will go lower.

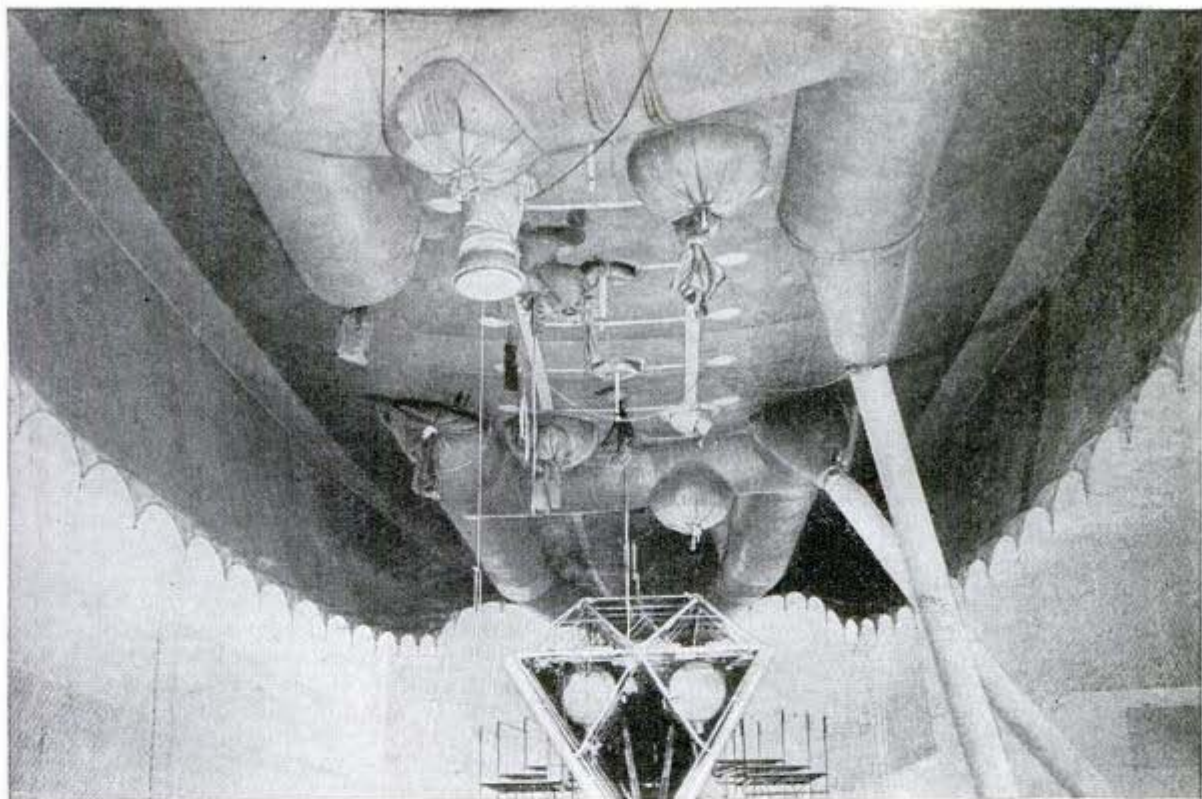
War uses for helium multiplied so fast that U. S. Bureau of Mines officials predict important new uses in peacetime. Five plants now make helium, compared with one before the war. Production in 1945 will be 25 times that of 1940.

For the first time there is now sufficient helium to supply every research laboratory interested in exploring new techniques. Postwar civilian supply is ample for present and new industries.

In metal working, aviation and medicine, spectacular results were obtained with helium during the war. The element, lightest of all gases except hydrogen, was really a "war baby" of 1918, but World War I ended before its value had been tested in practice.

All the world's helium supply is produced in the U.S.A. in plants owned and operated by the government. This means American control of lighter-than-air flight and strict licensing control of any foreign users of helium. A new U. S. transport industry, based on the helium-filled blimp, is being organized. Its managers are confident of taking a share of postwar air freight and passenger business on a world scale.

It takes 6,500,000 cubic feet of helium to inflate the largest blimps. But helium is cheap,



Goodyear Aircraft Corp. photo
Covered with weighted net, helium inflated envelope
for lighter-than-air ship awaits car installation

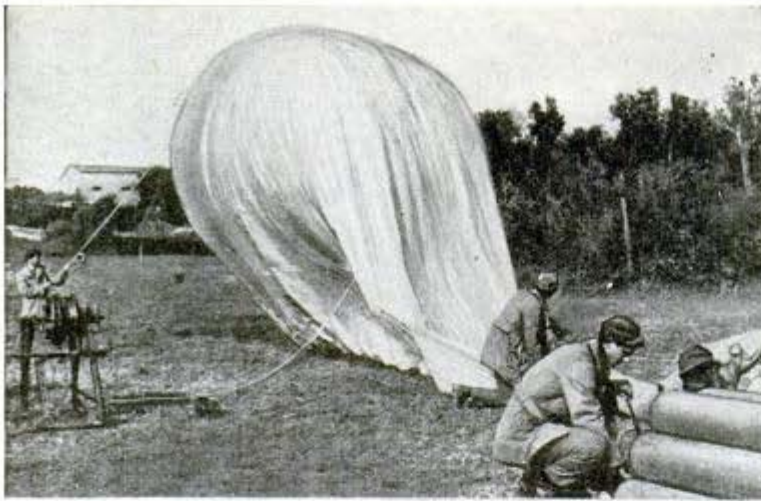
inert, and leakage losses are extremely small. Since 1940 more practical knowledge of helium-filled lighter-than-air ships has been acquired by actual operation than in the previous quarter century.

"Helium is the lifeblood of the airship," says Rear Admiral Charles E. Rosendahl, Chief of Naval Airship Training and Experimentation. "Blimps can fly slowly enough to accompany convoys at their slow speeds. Not a single one of the thousands

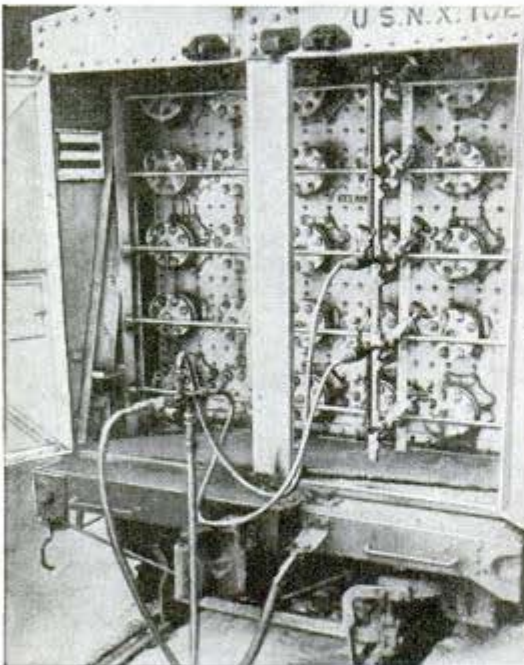


Helium prevents magnesium from bursting into flame during welding operation. Chain holds sheet of magnesium in place. Right, helium tank at air station

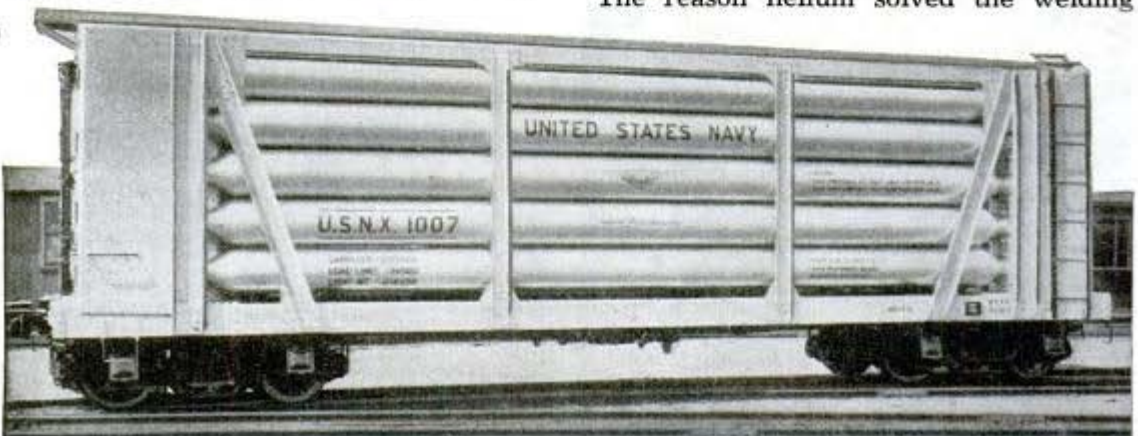




Helium was used to inflate thousands of barrage balloons. Cylinders in foreground supply the gas



Above, end view of latest helium tank car shown below. Gas is discharged into cylinders. It requires 6,500,000 cubic feet of helium to fill giant blimp



of ships which were escorted by blimps ever suffered a successful attack by a submarine."

Hydrogen was formerly used to inflate blimps but this came to a dramatic end when the German Hindenburg was destroyed in a few seconds of flames and terror in May 1937. The highly inflammable hydrogen ignited as the big zeppelin was descending at Lakehurst, N. J.

During the war, pleas of airframe makers for lighter, stronger metals

for plane parts received a superb answer when the wonder metal, magnesium, reached high enough production to begin to count in the war score. But magnesium, the stuff they put in flash bulbs, would burst into flame at the touch of the welder's torch. A special electric welding instrument was devised. It has a hollow handle and a nozzle through which a stream of invisible helium can be squirted over the magnesium surface. The helium forms a blanket in and around the welded joint, smothering any inclination to ignite, cooling the atmosphere and permitting better fusion.

It was thought other gases might be used and some were tried, nitrogen, for example. But nitrogen combined with particles of the metal and formed magnesium nitride. Contact with moisture would render such a joint worthless. No detrimental compound is formed in a helium-blanketed weld, which is as strong as the original material.

In metallurgy, the making of alloys can be conducted in an atmosphere of helium which permits strict control of the minute quantities of rare alloy metals. Aluminum may be welded to steel under a helium blanket—a major advancement in airplane construction.

The reason helium solved the welding

problem is that it is a "bachelor" gas, so called because it refuses to combine with any other element. It wouldn't combine with the magnesium and it wouldn't combine with the oxygen in the air. Bachelors are supposed to have their little peculiarities and helium is not lacking in these.

Its masculinity is attested to by its chemical symbol, He. Helium is the hardest gas to isolate. It can't be seen, tasted or smelled. It is the least soluble gas, the best gaseous conductor of electricity, except neon, and of heat, except hydrogen. It is also lightweight.

Helium may help reduce the weight of postwar air liners. Experiments conducted by Consolidated-Vultee Aircraft Corporation revealed a saving of 180 pounds when helium was used instead of air to fill the tires on the big Model 37 air liner. Punctureproof tubes are able to hold the light gas at the required pressure.

Helium possesses three cardinal virtues for use in medicine. It is light. It is inert. It is not toxic. For over 20 years, the Bureau of Mines, which produces and controls the world helium supply, has encouraged medical research with helium. Director R. R. Sayers, himself a physician, and many other Bureau scientists have conducted and supervised portions of this research.

Now that a plentiful supply of helium is in prospect, efforts of research scientists are being redoubled. The "chemical cop" already is on duty in scores of military and naval units and in some civilian hospitals.

It is used in the operating room to dilute highly inflammable anesthetics. Helium, next to carbon dioxide, is the best available fire preventer and carbon dioxide can't be administered with anesthetics.

For the treatment of asthma, substitution of helium for nitrogen content of the air provides relief in breathing. Helium is only one seventh as heavy as nitrogen and the muscular force needed to move it is only one third that for air; thus it makes an ideal oxygen carrier through obstructed passages. The proportion is usually 79 percent helium and 21 percent oxygen. Such treatment must be given under competent medical direction.

An adventuresome wartime medical role played by the invisible bachelor gas was in deep-sea diving and rescue work. It now enables men, breathing a mixture of helium and oxygen, to walk on the sea floor 400 feet below the surface. Some day, laboratory results indicate, this may be increased to 1200 feet. Before the use of helium, 200 feet was the limit of physical safety. Ships and cargo of almost incalculable total value lie strewn around the

(Continued to page 148)

'Speedometer' for Molasses



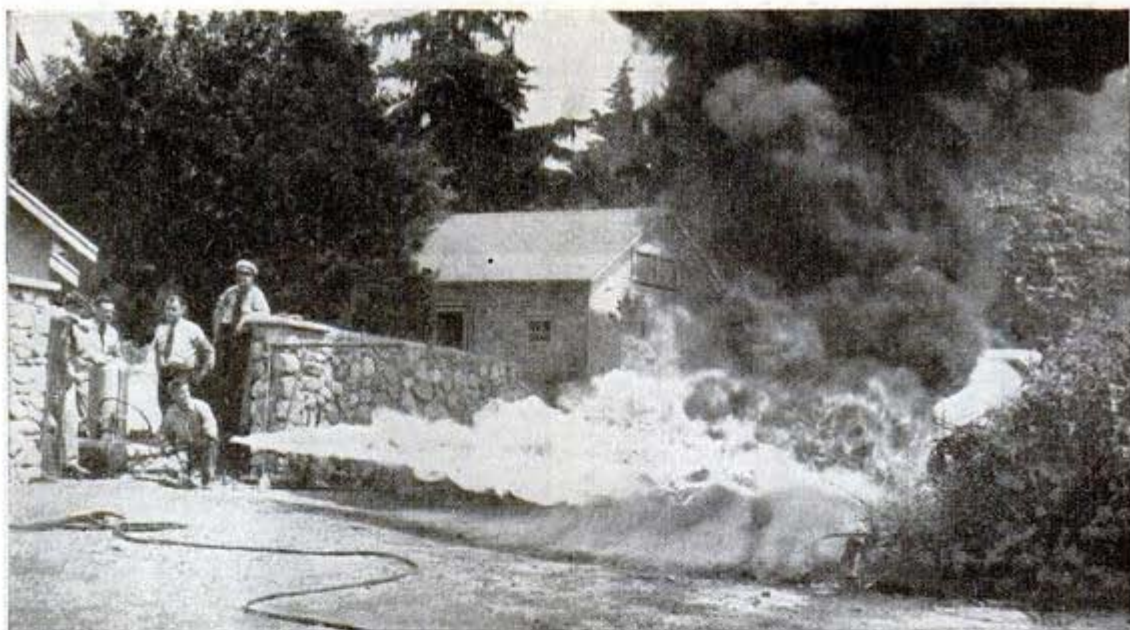
You can gauge the speed of "molasses in January" with a viscosimeter developed by the General Electric Company. This device consists of a metal cup of known capacity from which the liquid flows through a hole in the bottom. In a cold chamber test a cup of molasses drained out in three minutes and 41 seconds compared with four seconds for milk and kerosene. Even at summer temperatures molasses required 35 seconds to drain. Practical use of the viscosimeter, of course, is to measure the viscosity of various liquids—a prerequisite in making many mixtures.

Sealing Stick for Pipe Joints

Joint compound for pipe threads is now available in stick form. The handy stick, always ready for use, is unaffected by air, water, steam or acid. It lubricates and seals pipe joint threads, nuts, bolts, or gaskets.



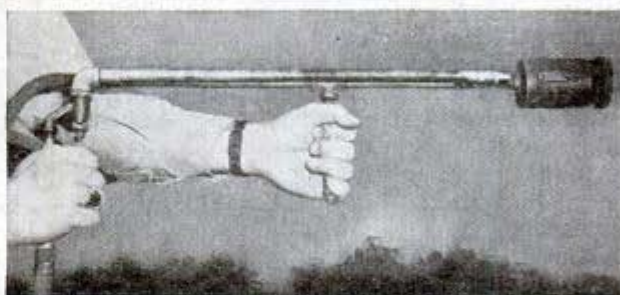
End of the war hasn't ended the need for saving your waste paper. Supplies still are short and will be for some time to come but paper must be found to package material for occupation forces. Save paper!



Rangers Use GI Torch To Fight Forest Fires

Green brush is quickly set on fire with a flame thrower designed to create firebreaks in fighting forest fires. This adaptation of the military flame thrower was built by forestry technicians of Los Angeles County, Calif. It consists of a 90-pound butane tank which supplies the pressure, a 35-gallon tank of Diesel fuel and 100 feet of hose with a special nozzle attached.

A pilot flame of butane, which can be used to set fire to dry, inflammable material, burns constantly in the nozzle. When the pressure is turned on, flames and oil are



Top, flame thrower sets fire to pile of green brush. Above, right hand releases pressure which projects flames and oil

thrown out from 30 to 60 feet. The first model was built for transport by truck, but portable units are planned for use in inaccessible mountain regions.



Music Is Played on "Typewriter" With Standard Keyboard

Resembling a portable typewriter, a newly patented musical instrument has a similarly lettered keyboard and produces 32 musical notes. A special music book enables a person without previous musical knowledge to play many tunes. Aside from its use as a musical instrument, the "Typatune" can be used to teach touch typing. Early production of these instruments was absorbed by the Red Cross and Veterans Administration for therapy programs, but they are expected to be on the market soon.

Names and addresses of makers or sellers of commercial products described in this magazine are listed in the Where-to-Buy-It Index, page 8-A. Write to them for additional information and be sure to say you saw it in Popular Mechanics.



"Jerkwater" Scoop Drinks at 80 m.p.h.

Marking its 75th anniversary this year, the system which permits locomotives to refill their boilers with water "on the fly" is so improved today that the job is done at 80-mile-an-hour speeds. Formerly locomotives had to slow down to 35 miles an hour at the track pans, from which, incidentally, the term "jerkwater" came into being. As the train passes over the eight-inch-deep track pan, a scoop is lowered from the tender by air pressure controlled from the engine cab. The scoop dips into the water a little more than four inches, and takes on about 2½ gallons per lineal foot, or 5000 gallons in 2000 feet. Damage from high-speed pressures was overcome by an iron pipe vent system for the tenders.

Sapphire Gauges for Precision Need No Wear Allowance

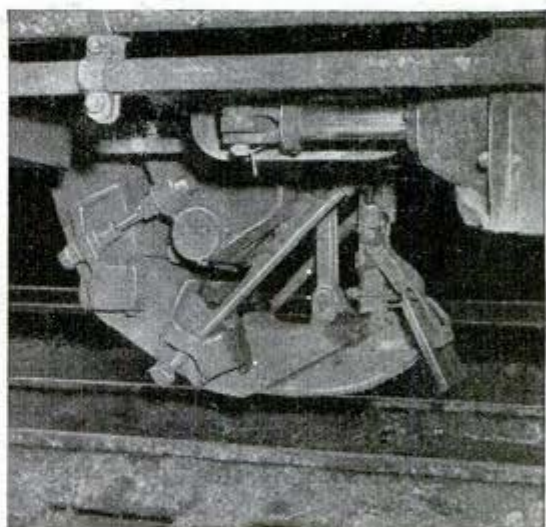
Sapphire plug and ring gauges for precision operations requiring interchangeable parts show an amazing resistance to wear and outlast hardest steel alloy and cemented carbide gauges, their manufacturer declares. Next to the diamond, the sapphire is the hardest substance known, and can be ordered in exact sizes needed



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Roaring over track pans, locomotives refill their boilers with scoops lowered from the tender by air



without allowance for wear. Being practically inert, sapphire reacts to few chemicals and is not subject to burring.

Diesel-Turbine as Truck Team

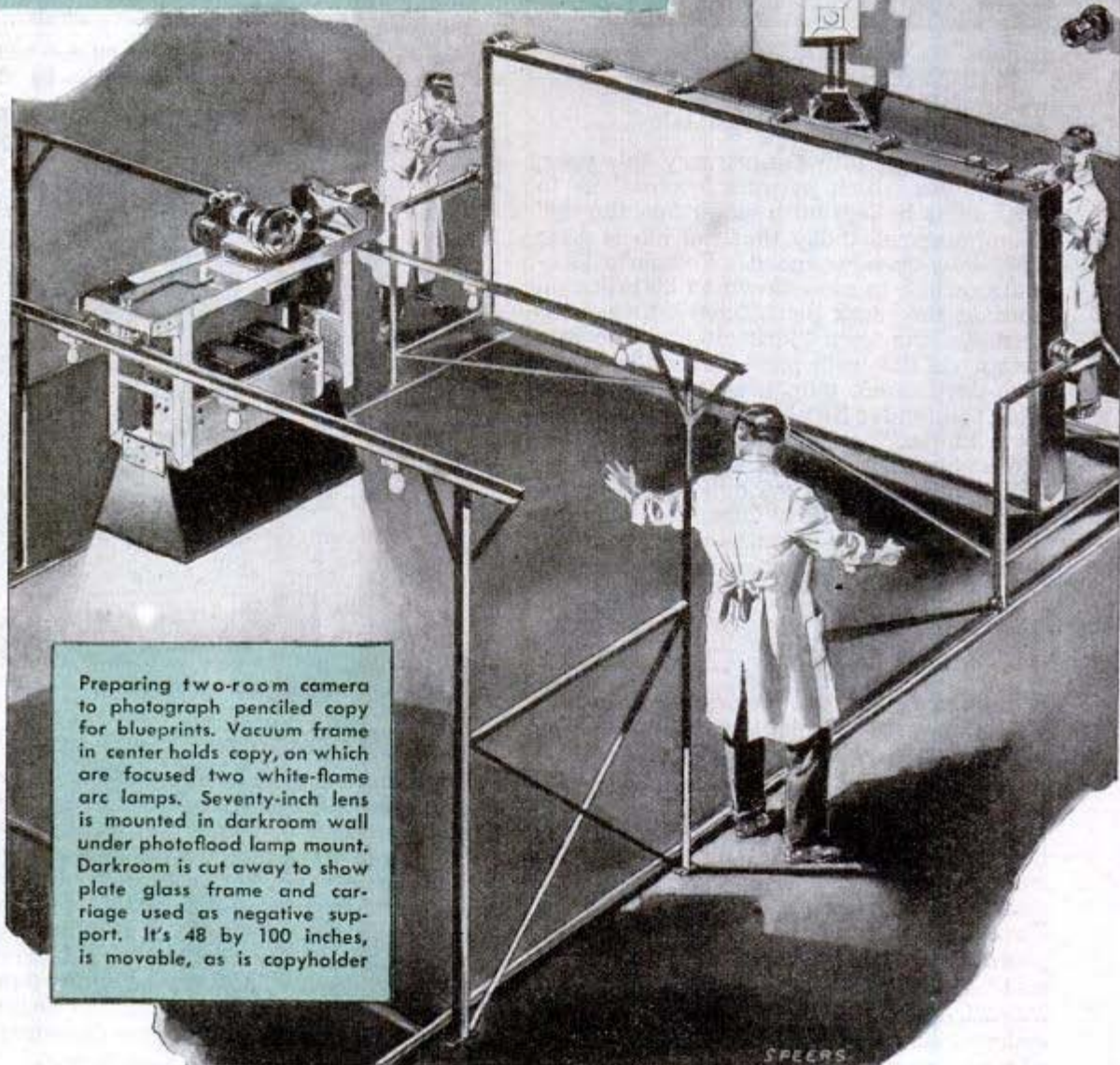
Combination of a Diesel engine, supercharger and turbine as the power plant for heavy trucks is foreseen for putting exhaust gas to work effectively. As outlined to the Society of Automotive Engineers, the supercharger would increase the Diesel engine's power output approximately 50 percent, and the turbine would drive the supercharger. The Diesel engine might be used later only as a combustion chamber for the turbine and to drive the supercharger, the turbine providing power.

55

TWO-ROOM



Retouchers at work on big negative from giant camera used in making blueprints. Negatives can be as large as 4 by 8 feet



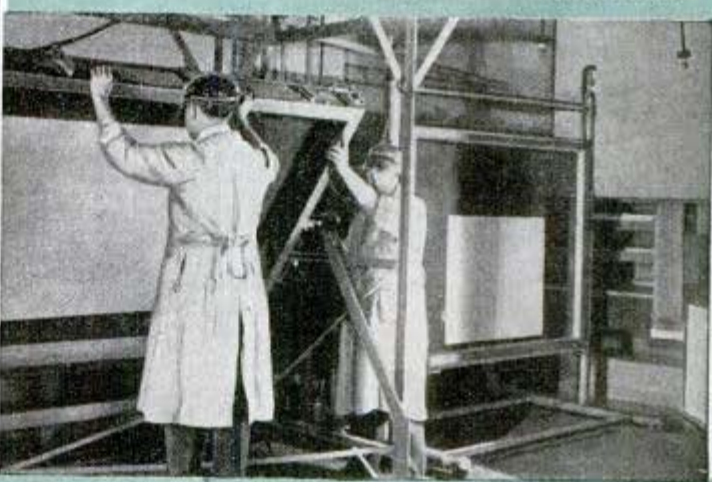
Preparing two-room camera to photograph penciled copy for blueprints. Vacuum frame in center holds copy, on which are focused two white-flame arc lamps. Seventy-inch lens is mounted in darkroom wall under photoflood lamp mount. Darkroom is cut away to show plate glass frame and carriage used as negative support. It's 48 by 100 inches, is movable, as is copyholder

SPEERS

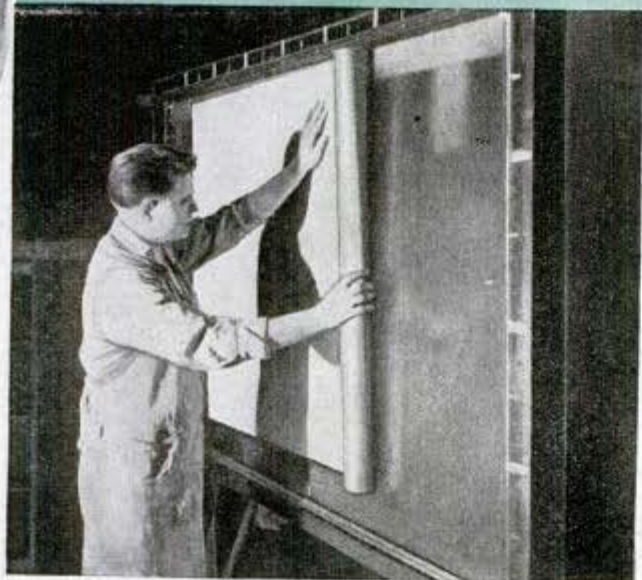
CAMERA ...



Adjusting diaphragm of specially constructed 70-inch lens in camera, entirely designed by photographic staff of GMC Truck & Coach Division. Below, unloading darkroom negative frame



Stayflat frame at back of camera interior is loaded with film, below left. Strong light is focused on frame holding subject matter and correct exposure given. Airbrushing corrects the cloth positive



Rider in P-38 Belly Tank Films Battle



Squeezed into the belly tank of an Army P-38 Lightning fighter, Marine Combat Correspondent David D. Duncan went on a picture-taking mission over Okinawa during some of the hottest fighting.

Wind Blows 3000 Miles an Hour Through Supersonic Tunnel

Vast peacetime applications are foreseen for two new Army wind tunnels, costing a total of \$2,000,000, that will produce speeds up to four times that of sound, about 3000 miles an hour. One of the supersonic tunnels is for bombs and the other for ballistics. Both tunnels are part of one closed circuit through which compressed air is forced by a five-unit power plant developing 14,000 horsepower. In the ballistics tunnel, a flexible throat nozzle can be opened or closed to change air speeds. The throat is made of long strips of quarter-inch steel plate, and the speed is changed by power-driven jacks which close it to a

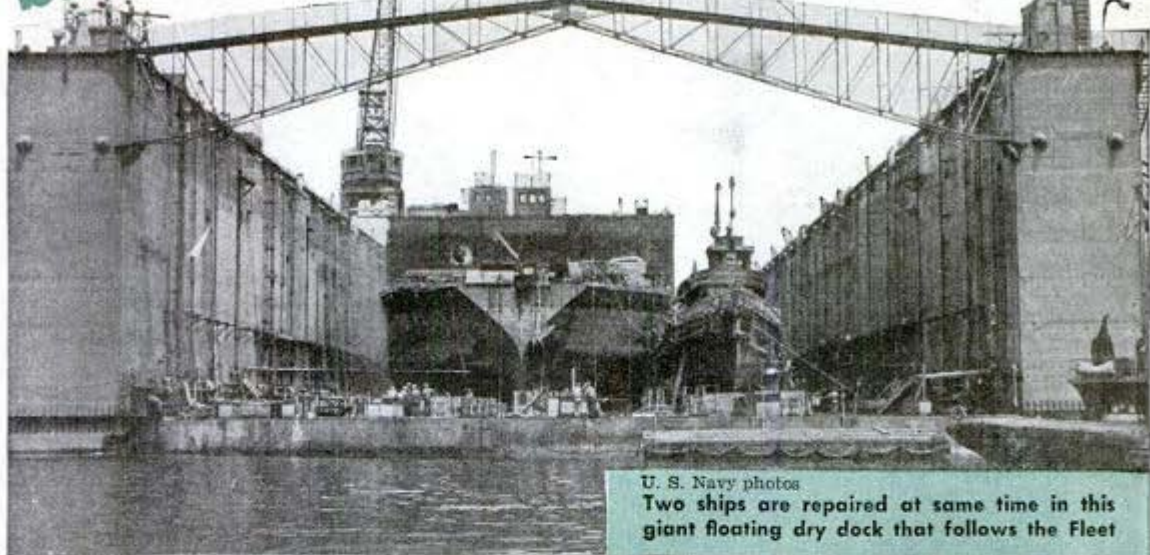
one-inch aperture or open it to 18 inches. Test sections of the tunnel are a little more than a foot wide and a trifle less than two feet tall. Scale test models of brass are placed in these sections on a special mounting rod. Observation ports of glass a foot and a half in diameter permit observation of the model at high speeds and photographing of the airflow pattern around it. Temperatures in the bomb tunnel during tests are about 100 degrees below zero.

Automatic Sextant For Navy Aviators Averages Readings

Driven by clockwork, a new sextant being used by the Naval Air Transport Service automatically continues to take sights of the object toward which it is pointed, and averages the readings to reduce errors to a minimum. The sextant can make up to 60 separate readings in two minutes. A mechanical brain in the instrument does the averaging and the results are read through a window.



SERVRON 10-FLOATING ARSENAL

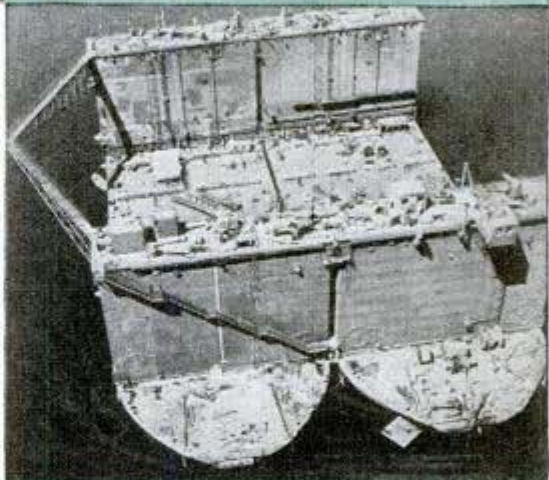


U. S. Navy photos

Two ships are repaired at same time in this giant floating dry dock that follows the Fleet

THE STORY of how the United States Navy is able to repair mighty men-of-war far out in the unindustrial wastes of an ocean is largely the story of Service Squadron 10—Admiral Nimitz's famed "secret weapon."

ServRon 10, as this industrial city afloat is called in Navy lingo, is credited by its commander, Commodore Worrall R. Carter, USN, as being the one factor in naval warfare that has decisively disproved the defeated Japs' cardinal faith—that the Pacific Ocean's tremendous distances would cancel out the American Navy's superior strength.



Dry dock is assembled in sections; here two are welded together. Ten sections (below) provide room for servicing a big battleship

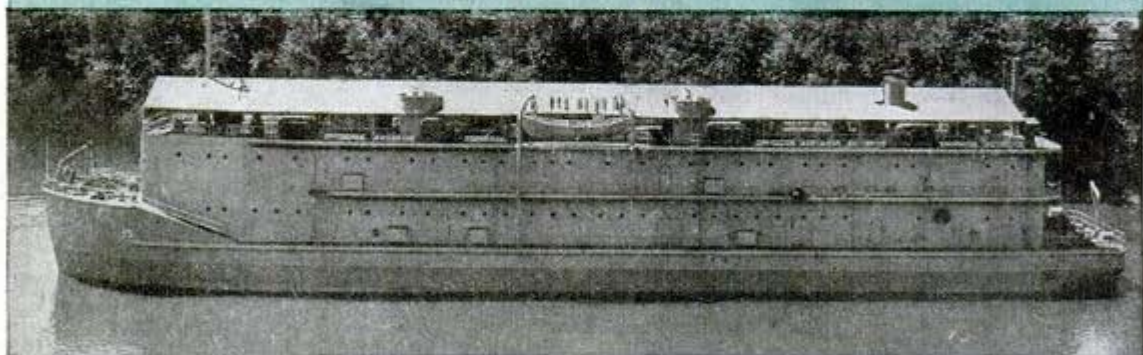




Repair ship of ServRon 10 is veteran USS Oglala, sunk at Pearl Harbor and now completely modernized



Navy tanker steams through rough sea after refueling flat-top in distance. Below, high-decked Navy barracks ship is typical of craft which serve as home in forward areas to bluejackets of ServRon 10



ServRon 10, with a greater population than many of America's factory cities, is equipped to keep a colossal naval task force in action by ministering to its needs for fuel, ammunition, food, fresh water, medical supplies, clothing, spare parts and even personnel. It has enabled many a seriously damaged ship to limp back to a U. S. Navy yard. Few cities of any size can accomplish the feats of this ocean-going metropolis with its 36 different types of vessels. Here, in one integrated force of several hundred ships and other craft, are joined every facility required to keep the combatant ships striking and striking again.

Backed up by this mobile "little Detroit,"

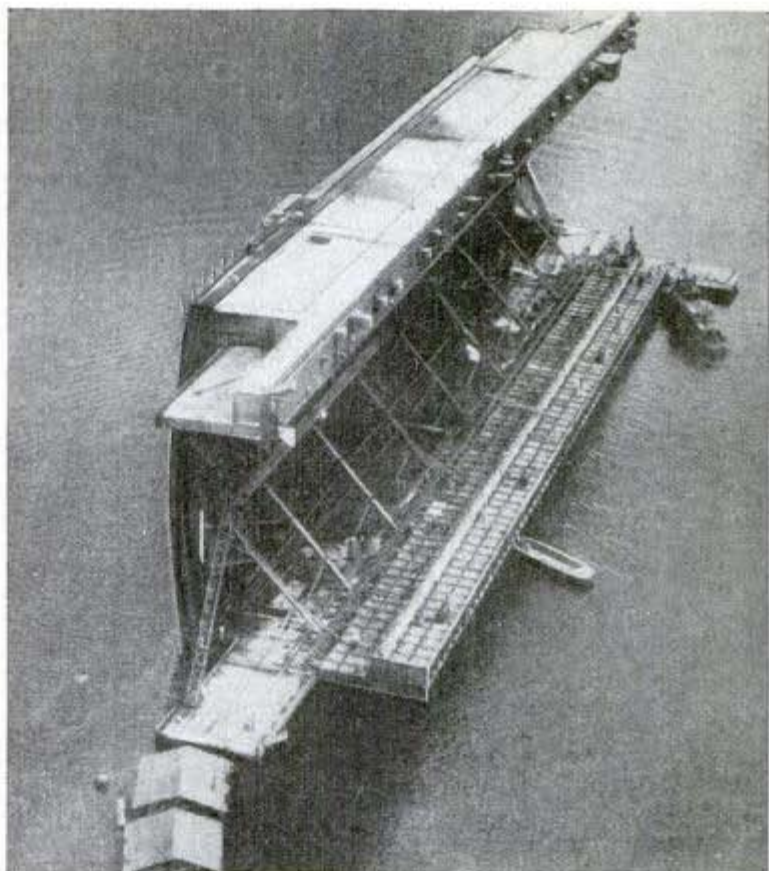
Task Force 58 was able to change the old "hit-and-run" tactics of carrier warfare to "hit and stay"—the slogan of 58's commander, Vice-Admiral Marc A. Mitscher, USN.

The more than 400 "factories afloat" include electrical equipment repair ships, tugboats, fresh-water tankers, a bakery ship, floating cranes, floating offices, floating refrigerated warehouses, floating dry docks; ships to tend destroyers, submarines, Diesel engines, landing craft, torpedo boats and aircraft. In the Iwo Jima operation ServRon 10 was stationed as far away from San Francisco as San Francisco is from London. Yet for that one operation

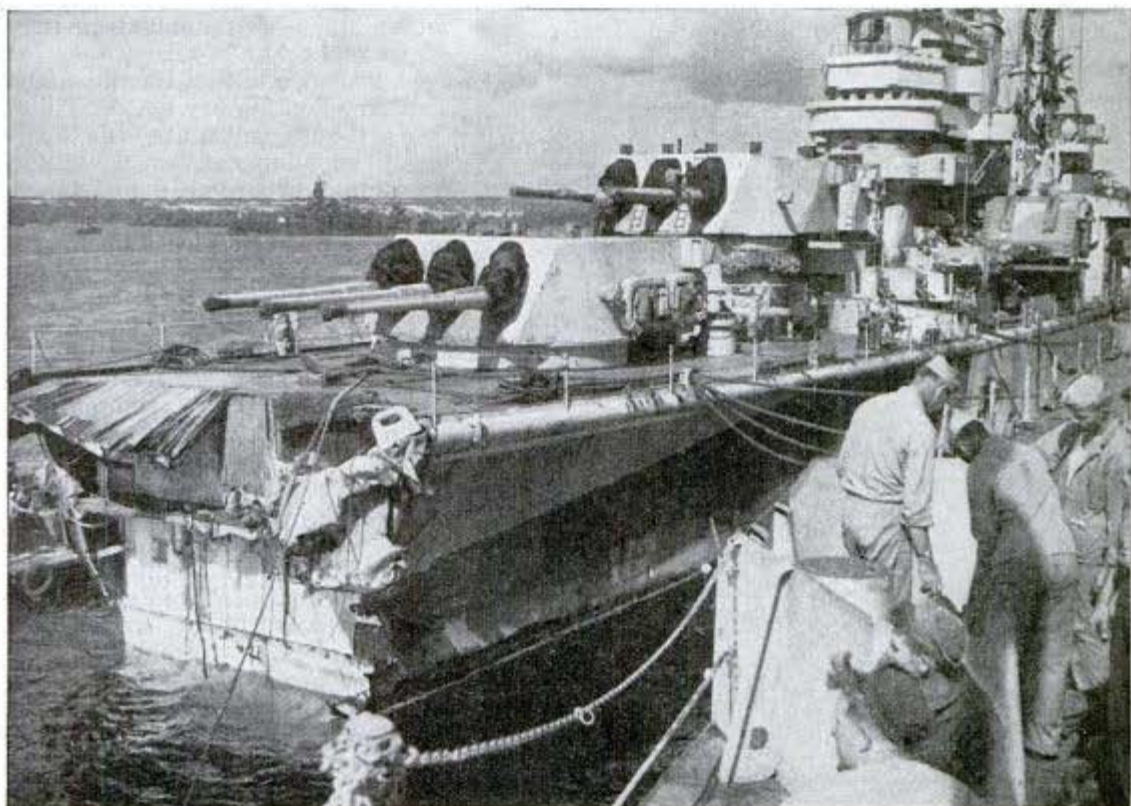
alone enough food was loaded on the task force vessels to feed Columbus, Ohio (a city of 300,000) for 30 days; enough spare clothing to clothe 1,500,000 persons, and enough candy, shaving cream, toothpaste and miscellaneous items to stock 6000 drug stores—including 100 million cigarettes.

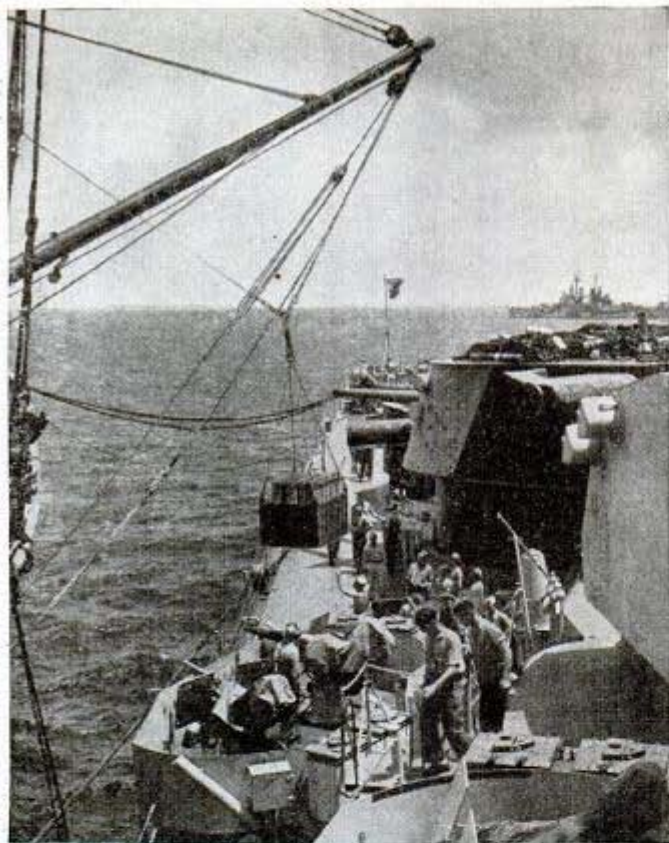
Those phenomenal figures give some idea of the size of the task of Serv-Ron 10, but they indicate its duties only in the line of supply; they tell nothing of the thousands of man-hours spent daily in sweating out repairs and routine servicings for ships coming in for everything from major hull repairs from Jap suicide bombing to a new power plant or a keel-scraping for removing barnacles.

For a glimpse of the workings of such floating machine shops, consider the internal combustion repair ship. It can maintain any Diesel engine,

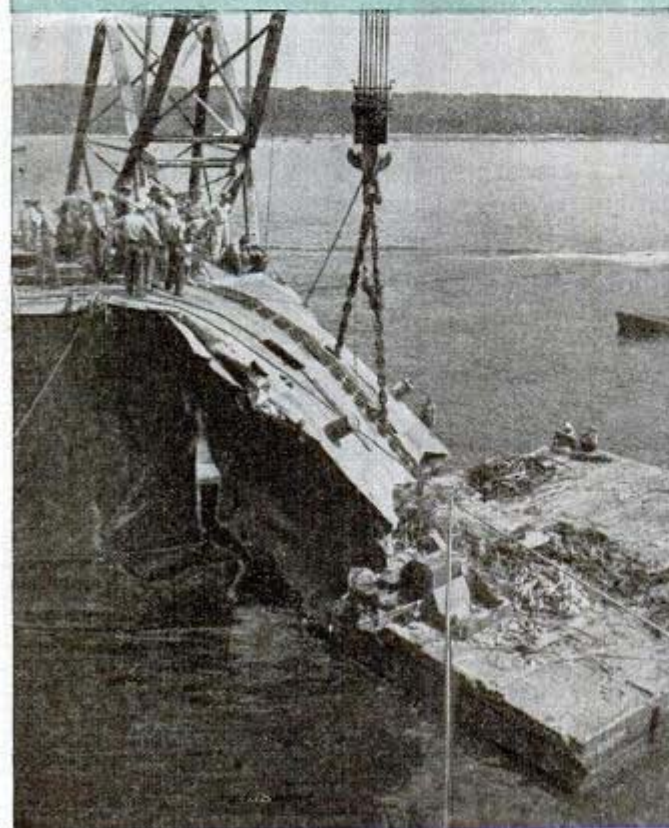


Too wide for Panama Canal locks, floating dry dock is tipped on side for passage. Below, typhoon ripped bow off Pittsburgh, but she made it to Guam





Steady, men! Cruiser takes load of ammunition from supply ship at sea. Below, repair crew removing the drooping bow of cruiser after torpedo collapsed forward deck



from the monsters that develop 6000 horsepower to little compressor motors of five horsepower or less. The Diesel engine is the heart of practically all our amphibious craft; therefore, the 215 men of the repair crew aboard must be able to keep any Diesel in tiptop operating condition, and also to instruct operating crews on how to keep their engines fit.

To speed the task of about 300 repair jobs a week, the ship includes a spare parts section, with shelf after shelf filled with Diesel spares — valves, springs, pistons, injectors; a machine shop, with the newest lathes, drill presses, milling machines and grinding equipment; and, because carrying thousands of blueprints to sea would be impracticable, the reference section contains a microfilm library, with negatives of blueprints for every type Diesel motor used in Navy ships. When blueprints are required, a specific negative is enlarged and, if necessary, new parts can be made from raw stock.

The barracks ship is actually a long way from its namesake, the Ritz-Carlton, in both distance and appearance; yet it enables crewmen of ServRon 10 to live in moderate comfort anywhere that the other ships of the squadron may drop anchor.

A recent addition has been the military floating dry docks. These are self-sufficient units, able to operate at advanced bases with a minimum of outside assistance. Though not self-powered, they can be moved by Fleet tugs at surprising speed. They vary in size from 1000-ton capacity AFDs (Auxiliary Floating Dock) to the giant 100,000-ton capacity ABSDs (Advanced Base Sectional Dock), composed of several sections with folding wing walls that can be assembled after arrival.

Through floating dry docks the Navy has mobile facilities able to dry-dock every type and size of vessel built or contemplated. They have enabled damaged combatant vessels to return to action in a matter of days, instead of the months previously required for the round trip to the States.

Even extensive repair of battle damage could be accomplished

(Continued to page 150)

Kindergarten Cadets Try Wings at Junior Flying School



To prove his contention that "even a child can fly a light plane," Alfred B. Bennett of Middletown, Ohio, assembled a class of boys and girls ranging from 5 to 12 years of age. In "ground school" they were taught the principles of flight. They learned about the action of air on the wings and



Top, teaching students principles of aerodynamics; above, boy at controls

tail surfaces by watching pieces of yarn that had been glued on. They made the acquaintance of ailerons, sticks, struts, rudders and fins. When they were taken aloft, the youngsters actually handled the controls of the plane. Reactions of the children and the plane were recorded by a movie camera on a wing strut.

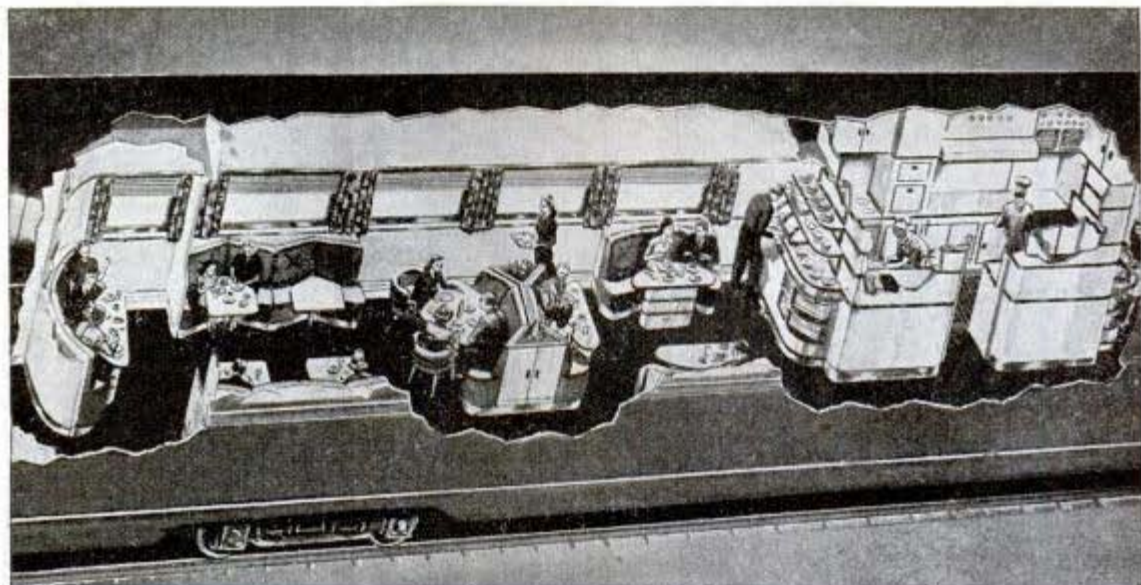
Flyers' Flexible Strato-Suit Sustains Life at 15-Mile Heights

Made of rubberized fabric, a new flexible, pressurized "Strato-Suit" for flyers may enable flyers to go farther than ever before into the stratosphere. Developed by the AAF Air Technical Service Command and B. F. Goodrich Company, the suit has proved practical in pressure-chamber tests equivalent to 80,000 feet, or 15 miles above the earth. When fully pressurized the suit surrounds the airman with four pounds of air pressure. It provides oxygen for breathing, microphone and earphones for communication, and electricity for heated underwear. All are "piped in" via a single junction assembly which can be disconnected in one quick movement. A transparent plastic bubble headpiece is removed in less than a second by a secret device. Donned in two minutes, the suit has airtight and watertight zipper closures.

Pulp Waste Found Good for Soil

Long regarded as the largest waste in industry, lignin, a by-product of pulp and paper mills, is now found useful with fertilizers to add humus and organic matter to poor soil. A potential 12,000,000 tons of this waste now discharged into streams and rivers can be used for soil improvement, research at Yale University has disclosed.





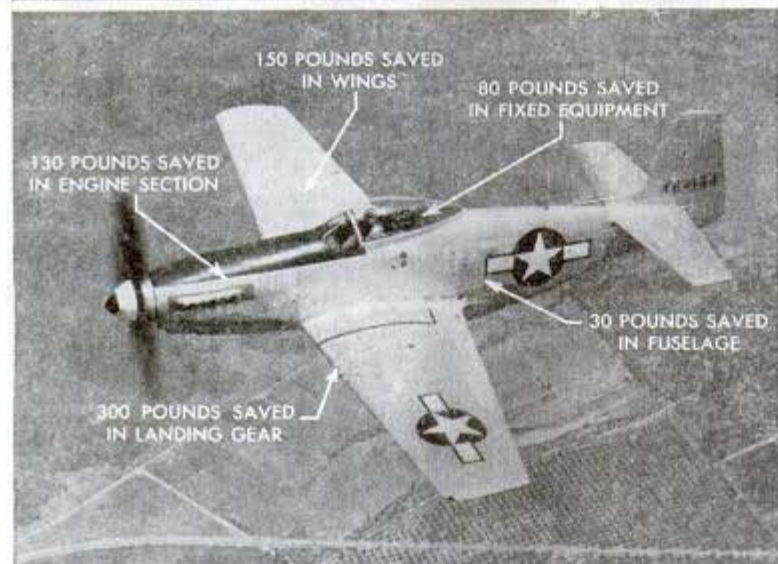
Cafeteria-Lounge for Trains

There will be no more last calls to dinner aboard postwar trains which have self-service grillroom cars. These cars, designed by Pullman-Standard Car Manufacturing Company, combine the practicality of a cafeteria with the luxury of a lounge car. The kitchen is placed in the center of the car with a food bar on either side. The car accommodates 50 patrons who may order anything from a sandwich to a full meal. Arrangement of tables and chairs is similar to that of a lounge car.

North American Aviation, Inc., photos

10 Rockets on P-51 Boost Armament Of New Model

With five rocket launchers under each wing, the new P-51H Mustang fighter can launch a destructive blast as potent as a full broadside from a destroyer. This airplane, which played an important part in the final phase of the war against Japan, also has six .50-caliber machine guns and racks to carry 1000-pound bombs or extra fuel tanks. The P-51H has a speed in excess of 460 miles an hour, a range of more than 1000 miles (an increase of 37 percent over the P-51D) and a ceiling of 42,000 feet. Powered by a 2000-horsepower engine, the plane is reported to have a rate of climb 26 percent faster than previous models. The new Mustang is 700 pounds lighter due to some 50 structural changes and the use of lighter alloys.





Soldiers don't have to be told to smile when the mail arrives

By Thomas E. Stimson, Jr.

NOW it can be told. Some of the letters that you mailed to soldiers in the Pacific during the war were put aboard ships that moved directly toward islands still in Jap hands when the mail left home. Postal schedules and fighting schedules were linked so closely that

sometimes your letters were delivered only a couple of hours after your soldier sighted the island and charged ashore to capture it. Perhaps your letters got there ahead of him, if he was in one of the last waves of men to hit the beach.

Fighting postmen of the Army Postal Service, carrying a mailbag in one hand

"GI Pony Express" carried the mail to some units in Europe





Machine at San Francisco APO puts V-mail in envelope, seals it. B-25 is loaded with mail to drop by chute

and a carbine in the other, often went ashore with the second or third wave in an amphibious assault. They dug their fox-holes, set up their equipment and went to work. There was mail to distribute, mail to collect and money orders to write.

At Leyte, 700 pounds of mail arrived just as the first waves were storming ashore. It was taken in at once for beachhead distribution at the next chow call.

At Kiska in the Aleutians, the postal unit lost its equipment when its boat was swamped in the heavy surf. Without a desk, the postal officer lay on his side in the mud to write out money orders. He had plenty of last-minute customers among the men who were just going into battle.

All through the war, soldier mail was a high priority item that ranked just below ammunition, hospital supplies and food. When the average soldier joined the Army he left home for the first time in his life and naturally was homesick after he was shipped abroad. Mail from home was of high importance to keep up his spirits.

Because of that, early in the war, the Army Postal Service turned the Pacific into a vast rural free delivery system. Each letter and package carried an invisible "special delivery" mark. Army letter carriers used aircraft, warships, transports, LSTs, jeeps and even parachutes to deliver their goods, and they kept the mail moving. One air mail letter traveled 26,682 miles in 23 days before it finally managed

to catch up with its traveling addressee.

A civilian is apt to live at the same address for a dozen years but a fighting soldier may have been moved a dozen times in 12 months. This postal headache was solved by providing each soldier with an Army Post Office number that represented the unit to which he was attached. In essence, the soldier always had the same address. The unit APO number followed him around.

Mail to all soldiers in the Pacific with the exception of those stationed in Alaska funnels through the Army Post Office of San Francisco. This enormous forwarding organization has its eye on the clock every minute to assure the best connections with planes and ships. It is at work 24 hours a day.

When you address a letter to a certain APO number, "c/o Postmaster, San Francisco," your letter first moves through a huge postal concentration center on the coast where civilian post office clerks break down the mail into V-mail, air mail and first class matter. The next breakdown splits each class into batches destined to the same APO numbers.

Then the Army takes over. The troop locator section determines from its files the geographical point at which the APO on your letter is now located. A routing is worked out to move your letter and the rest of the mail with the greatest speed. Possibly your letter will be put on a ship

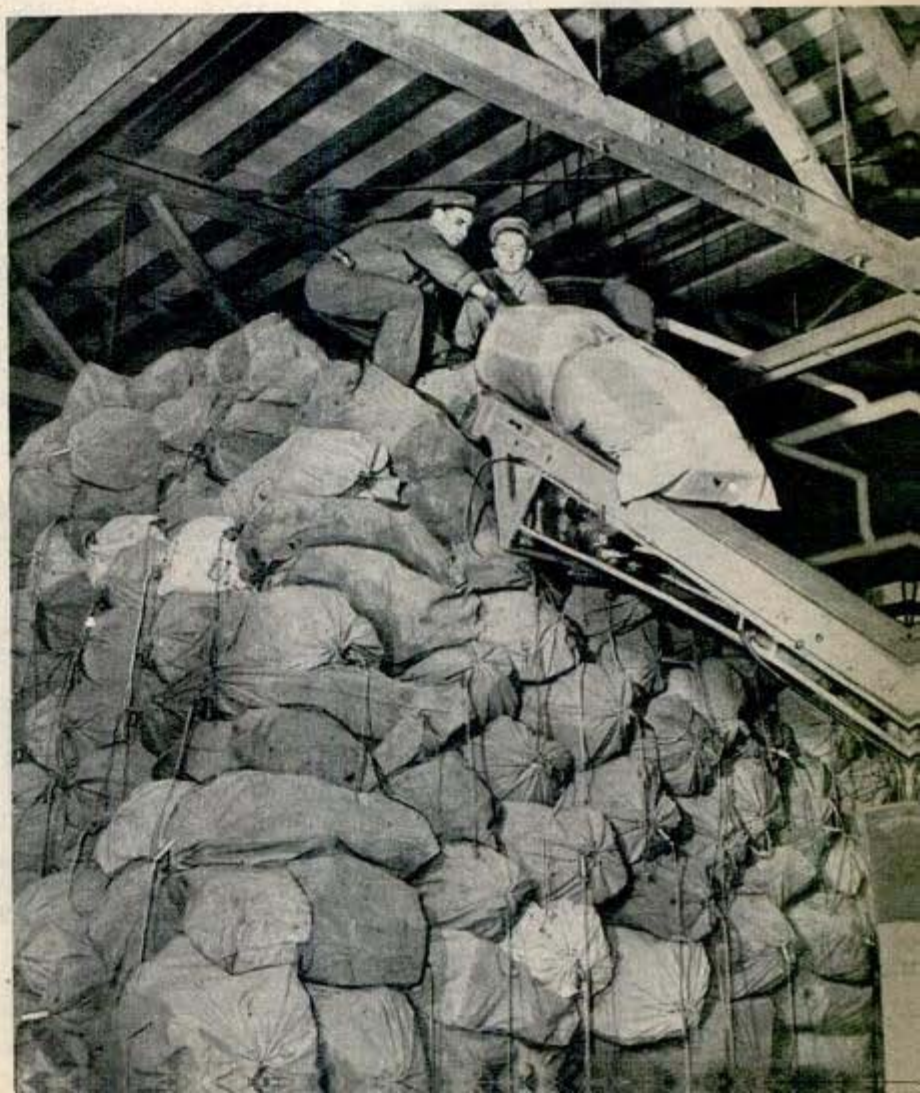


U. S. Signal Corps photo
Directory holds postal data on every soldier to move through San Francisco Post Conveyor below stacks mail

that day, possibly it will be rushed by train to Portland or San Diego in time to catch a ship that will make more direct connections.

Measured in millions of units per day, 100 carloads or more per day during the pre-Christmas rush, the San Francisco APO has put mail on as many as 27 different ships during a 24-hour period. Mail always gets top stowage under the last hatch to be sealed so that it will be the first item of cargo to be taken off at the ship's destination. When a troop unit makes several moves while mail is en route to it, the mail may be rerouted during its journey to reach the men without delay.

Part of the reason why military mail flows so smoothly is that the Army has put experienced postal men in charge. Lieut. Col. John H. Van Meter, commanding officer of the San Francisco APO, is a former United States Post



Office inspector. Major A. F. Reagan, his executive officer, was assistant postmaster at Natick, Mass. Men with post office experience helped to train the men who form the postal units in the field. The Army Postal Service is a portion of the Army Service Forces.

Aside from the routine work of assembling the mail and forwarding it to its destinations, the San Francisco APO performs a number of special services that have paid for themselves a thousand times over in gratitude and appreciation.

When Colonel Van Meter receives word that a certain outfit in a local staging area has been

Lightweight canceling machine used by APO units in the field



Part of package distribution line at San Francisco APO. This setup is for one particular overseas unit



alerted for sea he also learns the sailing hour and the ship on which the men will sail. This is continuing for reassignment and redeployment units. At once all incoming mail for that unit is diverted from its regular channel and this special collecting continues until just about the time the ship leaves its dock. While the ship is moving out toward the Golden Gate all of the last-minute mail for the men is put aboard a fast dispatch boat and delivered. Examination of postmarks shows that some of this mail, written locally, was posted only five hours before.

Service beyond the ordinary flow of the mails led to the idea of "mail call" on inbound hospital ships. When a man wounded in the Pacific had to be returned to the mainland for treatment, his name and transportation schedule were forwarded by air to San Francisco. Immediately, in San Francisco, all mail addressed to him at his APO number was intercepted and held out. At the same time any mail for him that reached his field APO was returned by air mail to San Francisco. Collections continued until the ship was several hours offshore, then a launch carried the mail for delivery at sea. As many as 12,000 pieces of mail have been delivered to an inbound hospital ship by this special service.

Except for V-mail, which it processes in each direction, the Army Post Office of San Francisco handles outbound mail only. Inbound mail from soldiers abroad is received by civilian post offices on the coast and distributed through regular channels.

The Navy maintains a comparable postal system through its Fleet Post Offices, the chief FPO for the Pacific also being in San Francisco. Mail for sailors and marines on ships and at shore stations in the Pacific moves the same as Army mail, on the fastest vehicles over the shortest routes.

There always was a chance that mail would be destroyed or damaged by enemy action but the principal reasons for slow delivery or nondelivery were improper addressing and poor packaging.

How would you go about delivering a pair of eyeglasses that were found unpackaged and unaddressed in a mail sack? How could you trace the destination of a good wrist watch that had been in a package that was bombed open by the Japanese? With the watch was a business card of a jeweler at

"7th & Park," on the back of which were a few words addressed to "Bill" and signed "Mother." There were no other clues.

In San Francisco, Major Reagan thought that there was a chance that the owners could be traced, so he turned detective. Puzzling over the "7th & Park" address that accompanied the wrist watch, he consulted the stack of classified telephone directories on file at the library. In Baltimore, he found, there was a jeweler at such an address, so he sent a description of the watch to the jeweler and asked who had bought it. The jeweler hadn't kept a record of the sale, so he passed the story on to the local newspapers. "Mother" read the story, furnished the APO with "Bill's" full name and address, and within a week the watch was on its way.

The eyeglasses were restored to their owner by similar deduction. Major Reagan observed that the frame contained an odd screw, suggesting that it had been repaired overseas. Australia, he reasoned, was the most likely place at which such a repair might have been made. He sent the glasses to an Army oculist who broke down their prescription and then he mailed copies of the prescription to a number of Australian firms. Sure enough, one of them had repaired the glasses and could furnish the name of the customer. The soldier was now in a hospital in Tennessee, it turned out, and Reagan forwarded the glasses to him.

But don't bank on getting special "directory" service of this kind for packages that you send overseas. Deliveries are most rapid when the addresses are plain and complete and when packaging is strong. Remember that your mail may be transhipped several times, it may receive un-

Sailors carry sacks of mail aboard ship for distribution

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Portable distribution case of canvas and plywood used for field sorting

avoidable rough handling, it may get wet at sea, and be exposed to humidity in the jungles. Wrap each package with several layers of strong paper. Use two lengths of twine lengthwise and two crosswise, with a knot at each crossing. Pack your parcel solidly. Weight is limited to five pounds and size to 15 inches long, 36 inches length and girth combined. List the contents, your name and the addressee's name, and place the list inside the package.





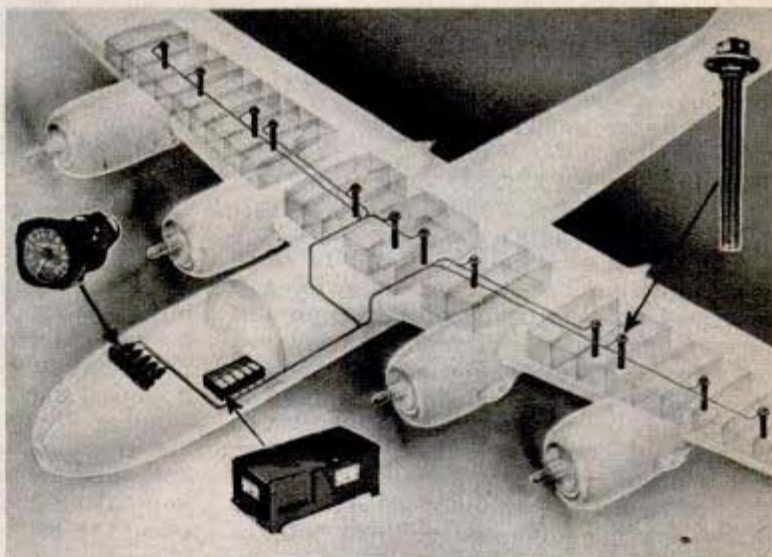
Flying "Bathtub" Carries Freight On 450-Mile Nonstop Trip

Designed by British engineers for carrying light freight or passengers, the Miles Aerovan has a cruising range of 450 miles. Its speed is about 115 miles an hour. The

plane has a single high wing and is powered by two engines. With a triple tail, somewhat resembling that of the Lockheed Constellation, and a tublike fuselage, the Aerovan presents an odd appearance. The rear compartment has a door large enough for a sedan to be taken aboard.

Electronic Gauge Measures Fuel

Gasoline in the fuel tanks of military aircraft is measured by weight with an electronic capacity type indicator that is unaffected by varying temperatures. Multiple pickup points compensate for wing tilt which causes as much as 20 percent error in conventional float gauges. In the electronic system, a long tube is mounted in the tank and an amplifier and meter in the fuselage. Resembling a section of pipe with two smaller pipes inside, the tube actually is an electrical condenser. Gasoline flows inside the tank unit between the two smaller pipes and a minute electrical current moves from one small pipe through the gasoline to the other tube. Changes in height of the liquid in



the tank unit cause a corresponding change in the electrical capacitance of the gasoline, which is measured electronically by the amplifier and registered in gallons on the meter. Expected postwar uses are in the refining industry, for storage vats, and for measuring moisture content of grains.



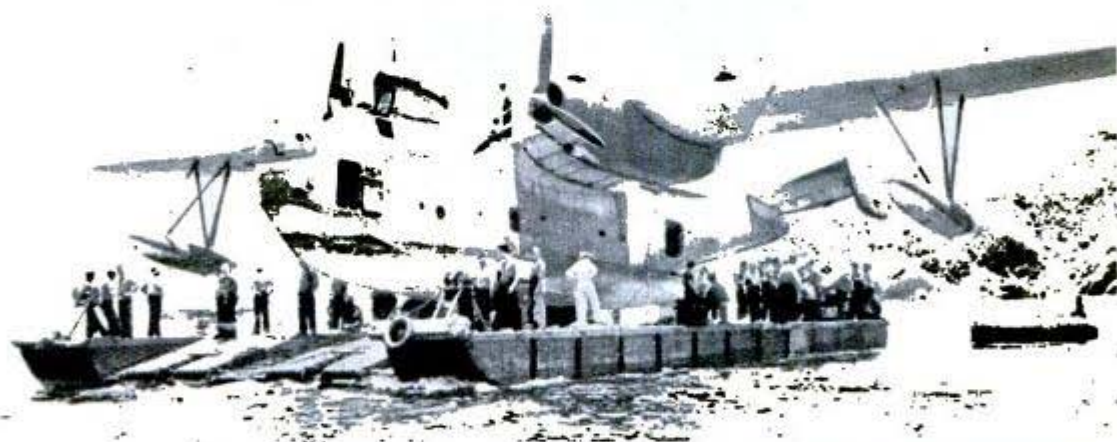
B-24 Camouflaged Into 4 Planes

Ingenious application of camouflage to a B-24 Liberator resulted in a plane which looked like four Liberators, with their nose turrets, engine nacelles and tail surfaces all in a row.

☞ The "twilight sleep" drug, scopolamine, a hypnotic and sedative, prevents seasickness in two out of three persons and in tests among servicemen has had no effect on their efficiency.

French 'Pocket' Car, Swedish 4-Seater

Sweden's postwar automobile, a streamlined four-seater two-door model featuring a rectangular hood somewhat reminiscent of the Cord, was a great attraction at the Swedish Fair, held recently at Gothenburg. Rectangular grillwork covering the radiator and parallel with the front bumper gives the car a modernistic appearance. Running boards are eliminated completely. French manufacturers meanwhile offered a miniature auto, of simple design, weighing 500 pounds and traveling about 60 miles on a gallon of gasoline. Its lines look as if they were taken from an amphibious tank.



Seaplanes Ride Pontoon Barges Propelled by Outboard Units

Pontoon barges were carried by LSTs beyond advanced bases in the Pacific to speed repair work on seaplanes. These barges are fastened to the sides of the big landing ships. They are launched by removing the turnbuckles and chains that hold them in position and then cutting a cable. The barge drops into the water. One landing ship can carry four barges. They can be joined together to form floating platforms of varied sizes which are equipped with outboard propulsion units.

PBM rests on barges, above, carried by LST as at right



TNT DIVERS



Training for underwater demolition work, Navy men tie explosives to rocky Hawaiian shoreline. Below, ready for action, they head for first target—Peleliu



Below, while U. S. bombers strafe Jap-held beaches at Balikpapan, Navy divers wait to plant undersea TNT



SWIMMING warriors, you might call them—those shockproof Navy men who dove under water and planted explosives to blast away natural and man-made obstructions from enemy beach approaches.

Losses among the underwater demolition teams were high—40 percent at Normandy—because the TNT divers hit the beaches days ahead of actual invasions.

Wearing only swimming trunks, tennis shoes fitted with fins, and goggles, they looked for mines, spikes and other enemy-installed invasion barriers. In Japanese waters, they were alert for hardwood posts wedged into reefs along with cribs of logs and netting packed with cement and coral. Often these guards were interwoven with barbed wire and interlaced with mines.

Once these landing obstacles were located, the underwater sailors tied cords of high explosives around the objects to be blown out. Then the swimmers got out of the area fast. With synchronized watches and in radio communication with their commanding officer, the men hopped into rubber boats on prearranged signals and hurried to their landing craft to escape the deluge of flying coral, concrete, steel and broken timbers from the explosions.

Underwater demolition teams, drawn from both the Navy and the Army, landed at H-hour on Normandy. Under fire from enemy-held strongholds, they helped clear the way to victory.

In Southern France, the undersea dy-



His explosives planted under water, a diver comes up



Underwater fighters tie cords of high explosives to mines, logs, coral deposits and other invasion obstacles

nameters knocked out large numbers of enemy obstructions with virtually no loss of life. At Okinawa, 3000 underwater barriers were blown to bits by the swimming sailors, and at Guam 1000 bull's-eyes were chalked up.

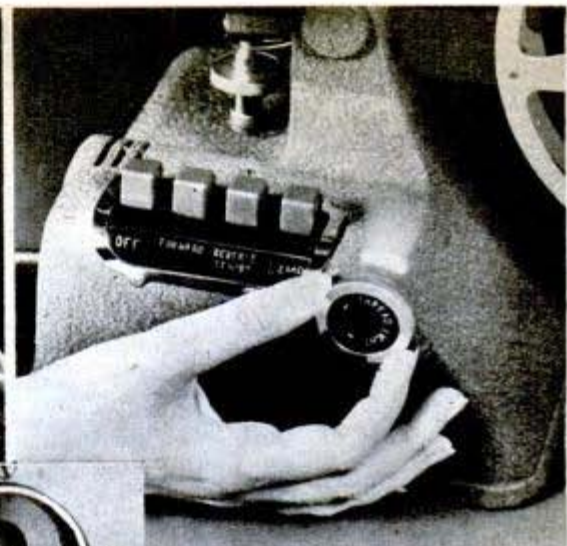
Teams of 87 enlisted men and 13 officers worked both day and night at two main

jobs: (1) to find mines and other obstacles in the way of invasions and get general hydrographic information and (2) to eliminate all obstructions where necessary.

While the TNT divers were bobbing along on the water's surface or probing down below, fighting ships and planes protected them by blasting the enemy's shore.



Left, his fin-equipped shoes pointing skyward, a Navy diver lands upside-down in his rubber boat. Right, 8000 pounds of tetrytol planted under water by Navy divers explode off the coast of Peleliu to aid invasion



Power Cord Winds Self On Movie Projector

Simplicity and ease of operation are emphasized in a new 16-millimeter motion picture projector already in limited production. The electrical cord is coiled on a spring-tensioned reel in the base of the projector and retracts automatically



Push-button control and self-winding power cord feature 16-mm. projector

when not in use. Film sprockets and film gate are illuminated by a separate thread light. Major projection controls are contained in a panel having four push buttons. A lever halts projection for enjoyment of single frames, and a threading knob makes adjustments easy during threading or still projection.



Brand 'Typed' on Tubing Helps Identify Wires

Flexible plastic tubing is branded for identification purposes with a machine that operates as simply as a typewriter. The branding machine, which applies indelible letters by heat each time a key is hit, not only resembles a typewriter in appearance but has a standard keyboard. The brand is "typed" on in various colors which are said to be as resistant to acids and oils as the plastic itself. Identification sleeves are used extensively on electrical wiring in airplanes and ships. Plastic tubing is also used for insulation. For either purpose the branding machine operates at 30 or more characters a minute.



62 Miles of Wire in Pound

One third the size of a human hair, delicate wire used by General Electric for tiny coils of electronic circuit measuring instruments measures 62 miles to the pound. Even with six coats of insulation it is as fine as a cobweb.

POPULAR MECHANICS



Submachine Gun Becomes Pistol By Detaching Butt

Australian soldiers have a strong fancy for most equipment of their American allies, but the reverse is true of the simple, rugged and lightweight Owen submachine gun invented by a young Australian. Weighing 10 pounds, the Owen gun uses 9-mm. ammunition, fires 725 rounds a minute. Each magazine will take 33 rounds, but usually is loaded with 28 to avoid jamming and to save the spring. The gun has a foregrip, carries the magazine on top, and is sighted with both eyes open. If dropped, it is designed to fall on its side, with mechanism clear of mud and dust. Both firing pin and extractor are part of the bolt, and the trigger mechanism, packed in grease, is water and dustproof. Made of oil-impregnated metal, the bolt never requires atten-

Spent magazine of Owen gun is removed with a flick of the wrist and a new one clicked home in a fraction of a second, above left. U. S. officers fire the gun from hip and lying down. Bayonet catches fasten the parts



tion. With a detachable butt, the gun may be used pistol-fashion. Although the gun hasn't the stopping power at close quarters of our heavy .44-caliber slugs, it was extremely popular for jungle fighting because of its lightness. It costs the Australian government less than \$30 to manufacture.



"Pin Ball" Tester for Metals Reveals Hardness

Metal can be tested for hardness "on location" with a portable testing unit. Requiring no special skill to operate, the tester consists of a spring-actuated hammer containing a striking ball. By resting the hammer on the metal to be tested and releasing the ball under impact of a spring, an impression is made on the test piece. The diameter of the impression is checked with a microscope; comparison of this diameter with data on a chart determines whether or not the metal comes within specified hardness.

IT'S OUR TURN AT THE POTTER'S WHEEL



Fashioning of chinaware and pottery has become an American art. Here a delicate object is sculptured for a master mold

CERAMICS, a lusty youngster in American industry, today holds undisputed world leadership in production and technical skill, thanks to typical Yankee ingenuity in exploiting the secrets of an ancient art. In attaining this pre-eminence the industry has exploded the fanciful and mesmeric charm of the word "imported."

The alchemy of our potter's art belongs to the 20th century—largely to the 1930s and early '40s, when the greatest strides were made. In the early 30s, more than a third of all the chinaware sold in this country was imported; of those imports, Germany and Japan together sent 87 percent. By 1940 the total of all imports had declined to 11.8 percent.

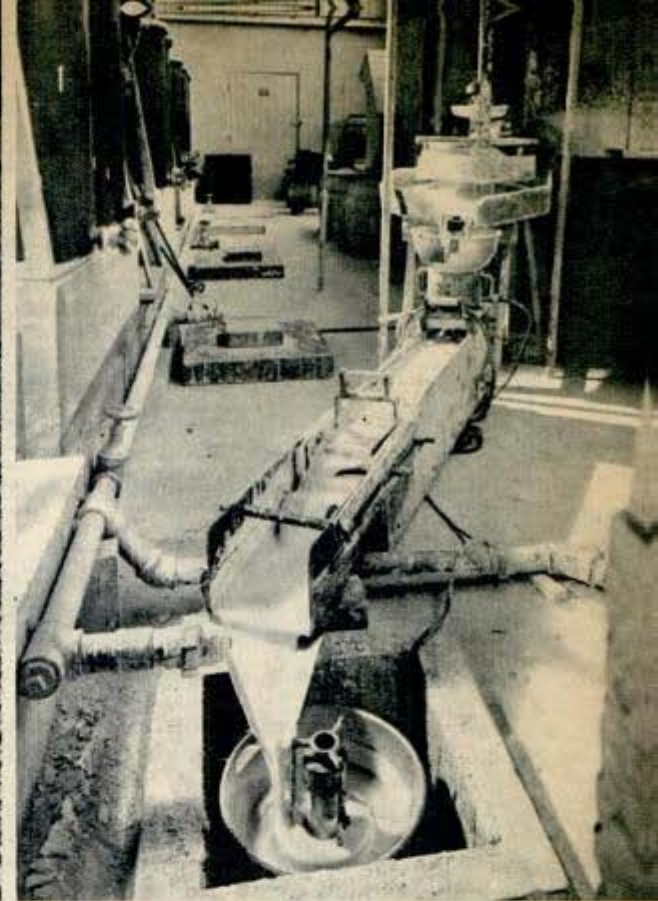
Before the war, Japan maintained a sort of trade espionage in this country so that

her 45,000 ceramic workers and 2106 pottery chimneys might be kept busy. Time was when "Dresden," "Tokyo" and other foreign imprints were the despair and envy of domestic potters.

The production of pottery in this country furnishes a study in anachronism. Side by side with the potter's wheel and other crude implements of the distant past are the latest in labor and timesaving devices. But the ceramic art has not lost affinity with the ancients. Inert clay, whether by hand or machine, still takes shape, grace and symmetry, much as it did centuries ago in the Nile valley or the pagodas of China.

Early in the 18th century, European potters learned the secret of porcelain from China, whence it derives its name. In 1769 the first true china appeared in this coun-

Handwritten note:
Hart, Inc.
Boston 5, 79



Clay is mixed with feldspar and flint, water is added. Electro-magnetic slip trough takes iron bits from mix

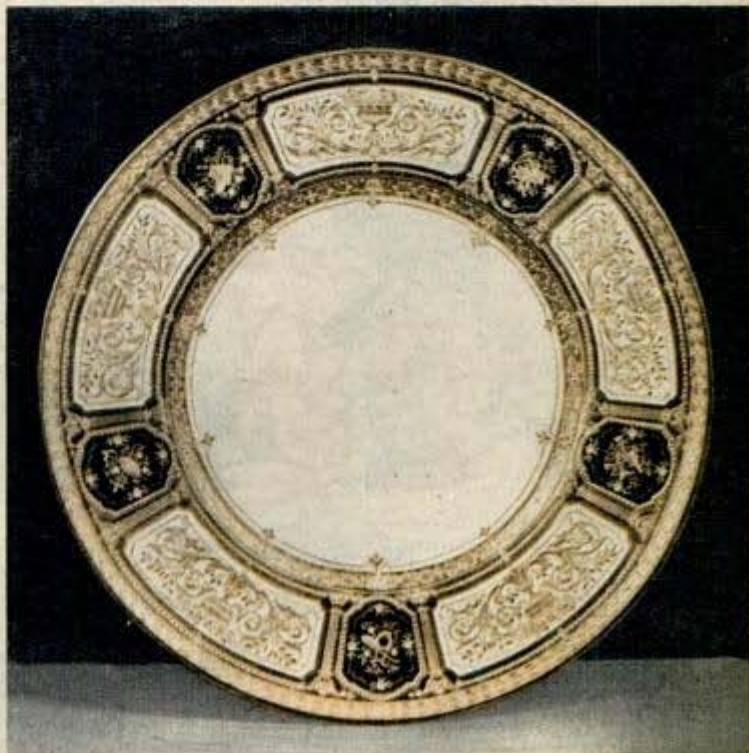
try—in Philadelphia. Failure after failure marked the early American endeavor, however, and the industry didn't get off to a successful start until 1882, when workmen were brought here from the famous pottery in Belleek, Ireland, to duplicate the thin eggshell ware made there that is noted for its luster glaze.

Much accomplished since then stems from the early influence of Irish Belleek. The American ware, however, has eliminated the high glassy and mother-of-pearl effect that characterizes Belleek. Because the Irish local clay is 75 percent feldspar, it differs from the bone china process common in English ware.

Bone ash comes from animal bones that have been calcined. Feldspar, generally in use here, is a glistening white powder, the product of crushed rock formations. Neither adds anything to the strength of china but acts as a flux or solidifying element.

French china, as typified by the Theodore Haviland ware

of Limoges, France, is distinguished by its low temperature bisque fire and high temperature glaze. Haviland began his career in America as an importer of English china, later went to Limoges where he set up his kilns and won fame for his ware. In 1937, manufacture of the American Theodore



Nellie Melba plate, given to her by Victor when diva retired, is example of fine china. Value is \$6000 a dozen



Modern potter's wheel, jiggering machine makes simple shapes. Green ware is fired in bisque kiln, above right

Haviland china was begun in Newcastle, Pa., from the original molds and designs created in Limoges.

Pottery, in common English usage, applies to all opaque ware as distinguished from porcelain, or its synonym, china. Porcelain, as found today in fine table sets, is vitreous and highly translucent. It is non-absorbent and when struck has a clear, bell-like sound.

There are two types of porcelain, the

natural or hard paste type and the artificial or soft paste porcelain. Feldspathic china is a hard paste type while bone china is the soft paste or artificial porcelain.

Semiporcelain is generally found in hotel ware and in bathroom fixtures and accessories. It is semivitreous because it is not so high-fired as pure porcelain. Earthenware, or common pottery, represents all that the ancients knew about the ceramic art, until the technique was learned from the Chinese.

Gold printing is transferred from steel etching by press and tissue paper

Rich deposits of potter's clay, flint and feldspar abound in this country. As a rule, the clay is mined from several different areas, washed and stored in bins. These clays are creamy white in color and very fine in texture. When ready for the pottery, the clay is mixed with feldspar and flint and placed in a large revolving cylinder containing water and flint pebbles. By this process of "pebble grinding," the minerals are ground into uniform density.

After 50 hours, the mixture attains a thick, creamlike consistency. It then is forced through a fine wire screen by air pressure for two hours to remove larger particles. What is left is a fine-textured fluid called "slip." Some pot-





Glazing, or dipping in liquid glass, must be done deftly. Translucence over light discloses glazing flaws

teries, instead of using slip, employ a soft pliable clay mixture from which moisture has been pressed. It is then thrown with great force into the molds.

The slip is forced over an electro-magnetic trough to remove all metallic iron particles before it is ready for "aging." Why this aging is necessary no one seems quite sure, yet it is done according to the oldest of principles known in the art.

Properly aged for several days, the slip is ready for casting in plaster of Paris molds. These molds are placed upon a "jiggering" machine, a flat, revolving disk that is the modern prototype of the ancient potter's wheel. Slip is poured into the mold and allowed to thicken until semiplastic when it is ready to "work."

Only simple shapes are produced on the wheel or "jigger." Elaborate or intricate shapes such as handles, spouts and knobs are cast in molds and attached separately to pitchers, pots and similar objects by hand. Slip is used as an adhesive.



Cylinders made of steatite test penicillin. Below, hand-painting a design





Photographed at Marshall Field & Co., Chicago
Woodrow Wilson set was first presidential
service designed and manufactured in America



Quaint teapot and dinner plate of Crinoline
pattern by Gladding McBean of Los Angeles



Castleton china in Gloria motif, above, made
by Shenango (Pa.) Pottery. Gold-rimmed cup,
golden handle mark Haviland's Kenmore china



Frances Poe, Chicago artist, molds, fires, glazes and
paints models of animals such as this prong buck

Next comes the drying process which ordinarily requires 24 hours. One pottery in Buffalo uses a technique new to the industry—drying by infrared process, which cuts drying time for hotel chinaware from two hours to only 15 minutes.

For fine china, however, the green ware must lose all its moisture by slow evaporation. Then the pieces are ready for the firing (at 2200 degrees F.) that gives them a vitreous and translucent quality. Because the forms cannot be exposed to direct heat without discoloration or cracking, they are placed in coarse clay containers called "saggers."

After 30 hours in this inferno, the ware is in a white, vitrified state called "biscuit ware." The pieces that survive warping or any other imperfection undergo a blast of fine sand which scours every trace of a ridge or bubble. Clinging particles of sand are removed by compressed air.

In a few seconds, the biscuit ware is glazed by an expert craftsman who dips it in liquid glass, accurately and delicately so that the finish is even and uniform. Another step is glaze firing at 2100 degrees F. In the glaze kiln the liquid glass is fused with the body of the ware, giving it a rich, ivory-cream tint.

(Continued to page 154)

*North American Aviation, Inc.
 Longwood, Calif.*



Two Power Packages Drive 77-Foot Trailer

Measuring 77 feet from bumper to bumper, and nine and a half feet wide, eight Army super truck-trailers carry 34 complete tail-cone assemblies each between California and Texas plants of North American Aviation, Inc. Two V-8 Mercury engines, on a removable mount which pulls out from under the hood for repair or replacement, power each truck. Cargoes are light and bulky rather than heavy. The vehicles are said to be the largest now in operation.

☐ Fish wardens in Quebec have captured fish for study by electrocuting them with a 400-volt, 60-ampere shock administered by a 25-kilowatt generator applied to a pool five feet deep, 250 feet long and 15 feet wide.

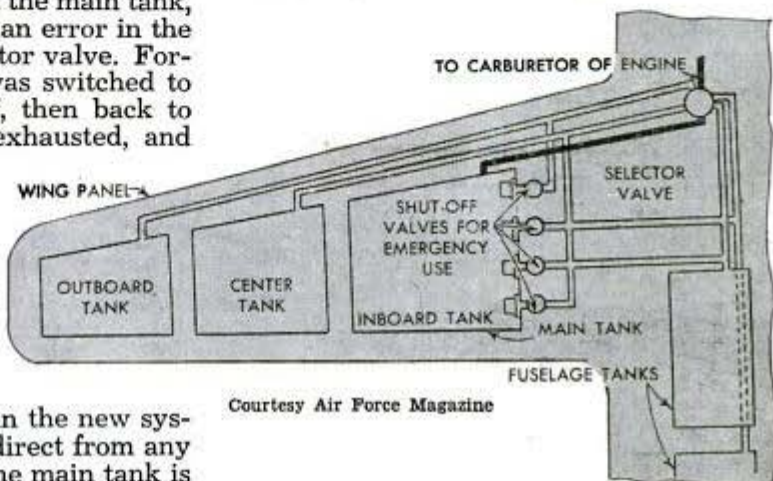
Twin V-8 engines on removable mount which pulls out from beneath hood can be replaced quickly in supertrailer operation



Foolproof Fuel System on Plane Uses Last Drop of Gas

Aircraft engines are assured of a continuous supply of gasoline as long as there is a drop in the principal tanks with an improved fuel system. The new system, which pipes all fuel through the main tank, reduces the chance for human error in the manipulation of a fuel selector valve. Formerly, the selector valve was switched to the main tanks for takeoff, then back to the auxiliary tanks until exhausted, and then to main tanks again. With the new system, fuel level valves in the main tank automatically open when the gasoline drops below a certain level. This keeps the main tank filled from the auxiliaries until they are empty. The selector valve in the new system permits piping of fuel direct from any tank to the engine in case the main tank is

damaged. This system was first installed in P-47 fighters, but it has been adapted to the A-26 and other two-engine models by using one unit for each engine.



A BRIDGE FOR EVERY MILE

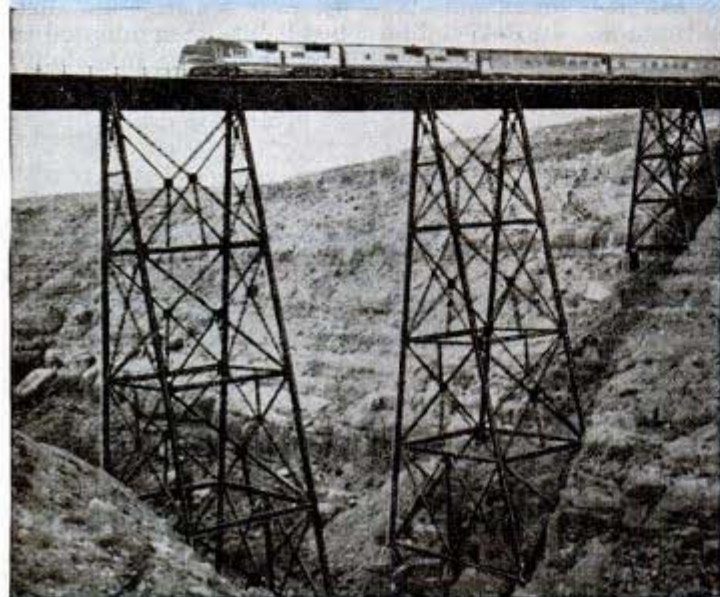


112-year-old stone bridge at Relay, Md., carries heaviest B & O rolling stock. Engineers say it will last for centuries



Portland Cement Association photo

Reinforcement assembly moves over gantry to steel form in construction of 3½-mile concrete trestle. Below, Santa Fe's Super Chief speeds across steel trestle over canyon in Arizona

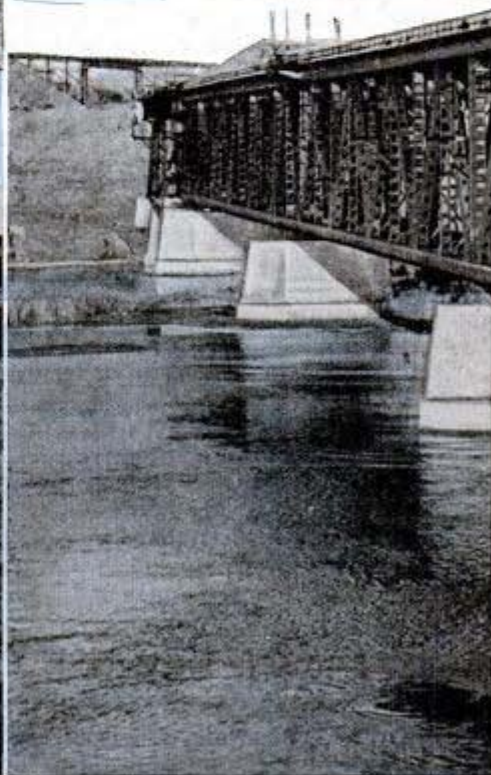


IF ALL the railroad bridges in the United States were placed end to end their 4000 miles of length would reach from Newfoundland to beyond San Diego. There is a bridge for every mile of railroad track in the country.

These structures cost more than two and a half billion dollars to build and require 40 million dollars a year for maintenance. Present schedules are possible only because of the structures that carry the roadbeds across rivers and valleys, saving minutes and hours of detouring.

Back in the 80s the surveyors of the Southern Pacific ran their lines west to the Pecos River in Texas and then found themselves face to face with a chasm 300 feet deep and 2100 feet across. There was no safe way to span the river gorge and so they diverted the line to the south, to an easier crossing.

But a decade later, as soon as metallurgists and bridge designers were confident that





Diesel locomotive slows pace across old cantilever bridge which was a bottleneck until replaced with modern span. Below, new double-track bridge at Needles, Calif. Santa Fe photo

it could be done, a bridge was put across the Pecos at the original site. This one bridge shortened the line by 11 miles, eliminated 14 smaller metal spans, two quarter-mile tunnels and 3000 feet of wooden trestle, and reduced track curvature from 10 to five degrees. In its 50 years of life the Pecos bridge has saved many hundreds of thousands of hours of train operation. Since it was first built it has been strengthened to carry the heavier loads that are hauled today.

Bridges rarely wear out. Frequent inspections, followed by maintenance and renewal work when necessary, keep them up to their original strength. But bridges do become obsolete. Entirely satisfactory for the loads and speeds that prevailed when it was built, such a bridge becomes out of date when heavier rolling stock is used, heavier loads are carried and faster speeds are scheduled. Often it can be strengthened to support modern traffic; sometimes it must be entirely replaced.





To guard against rust, old paint is seared with multiple-burner torch and removed with a power-driven brush that leaves surface clean for fresh coating
Oxweld Railroad Service Co. photos

Early this year the Santa Fe completed a new double-track bridge across the Colorado near Topock, Ariz., to replace just such a bottleneck. The old structure had a 10-mile-per-hour speed limit and carried a gauntlet track that permitted only one train at a time to cross over it. The new no-speed-limit bridge saves from five to 10

minutes of operating time per train, a saving important enough to warrant its construction as a wartime measure.

Far less imposing in appearance than the cantilever structure that it replaces, Santa Fe's new span is a good example of modern bridge construction. Of deck truss design, the bridge is built under the roadbed, so to speak, instead of being built around and over the roadbed. There are no bridge members to interfere with the carrying of extra-wide loads. The rails are on wooden ties that are laid in a ballasted roadbed, giving a smooth ride and eliminating the usual bridge rumble.

In designing the new bridge the engineers planned for loads that might be imposed upon it by extraordinary circumstances. They used as a basis the effect that two doubleheaded locomotives would have if they were moving side by side in the same direction at high speed over the bridge, at the same time that a 100-mile-per-hour side wind was blowing. Such a situation, of course, is highly improbable.

The bridge is designed to support a load of 7200 pounds per lineal foot, nearly twice the weight of a heavily loaded freight, and this strength is multiplied six times by safety factor allowances. As is the case with all metal structures, the Topock bridge is designed to flex under a load. The center of the lower chord of each span is one inch higher than its ends and under a heavy load the center deflects to one inch below the horizontal, then arches upward again when the load is removed.

One of the forces that must be considered

Hell Gate Bridge in New York looks like a toy from plane, but it is 305 feet high and carries four tracks



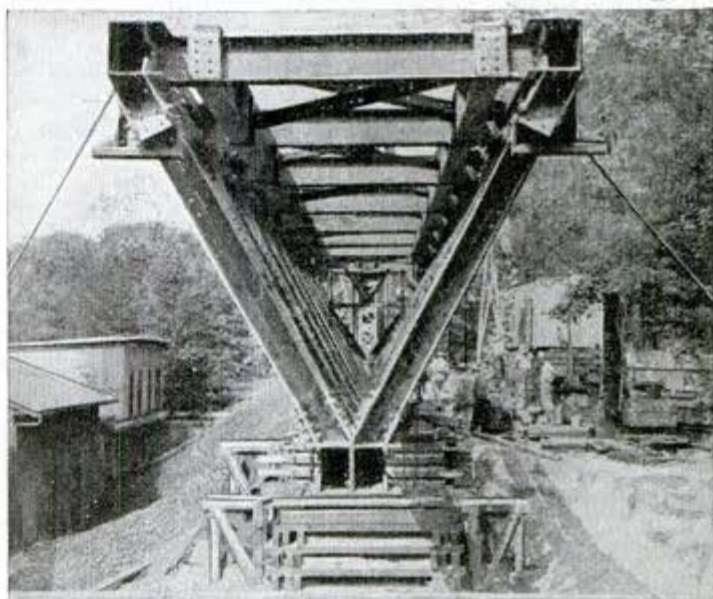
in designing a bridge is the thrust that will be imparted to it when a train sets its brakes while crossing the structure. Transmitted to the foundations, this force would tend to cause movement of the foundation piers. This is avoided in the Topock bridge by anchoring one end of each span to a concrete foundation pier and by resting the other end of the span on the next pier by means of big steel rollers. Thus a span simply stretches on its rollers without affecting the foundations when it receives a lengthwise thrust. The rollers also absorb contraction and expansion movements caused by temperature changes.

The Colorado is a shallow river in the vicinity of Topock and yet the engineers had to bridge a deep chasm. The concrete foundation piers go down through layers of sand and gravel to bedrock. Each pier was built in the form of two side-by-side concrete cylinders that were sunk by the pneumatic process. The midstream pier is among the deepest ever built by this method, its bottom being 121 feet below river level.

The caisson crews that were employed inside the cylinders, removing the river gravels so that the cylinders would sink, worked in air pressures of up to 50 pounds per square inch. High pressures were necessary to prevent water in the gravels from rising up inside the cylinders while the excavation was being done. Two hours under this pressure constituted a full working day and the men went through a gradual compression in an air lock before descending to work, and a gradual decompression upon completing their shift. Excavated material was removed by means of buckets that were hoisted through air locks at the tops of the cylinders and also by means of a "blow pipe" that exhausted into the open atmosphere. This tube swept up sand and gravel just like a vacuum cleaner when its

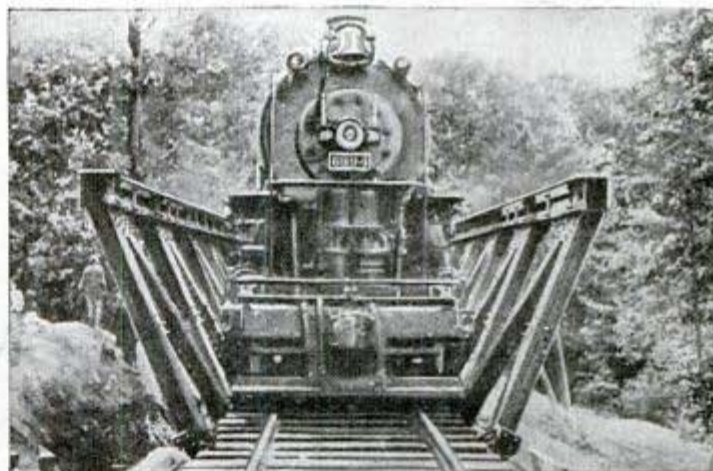


British soldiers test section of unit construction bridge which helped patch the bombed railroads in Europe as Allied troops advanced



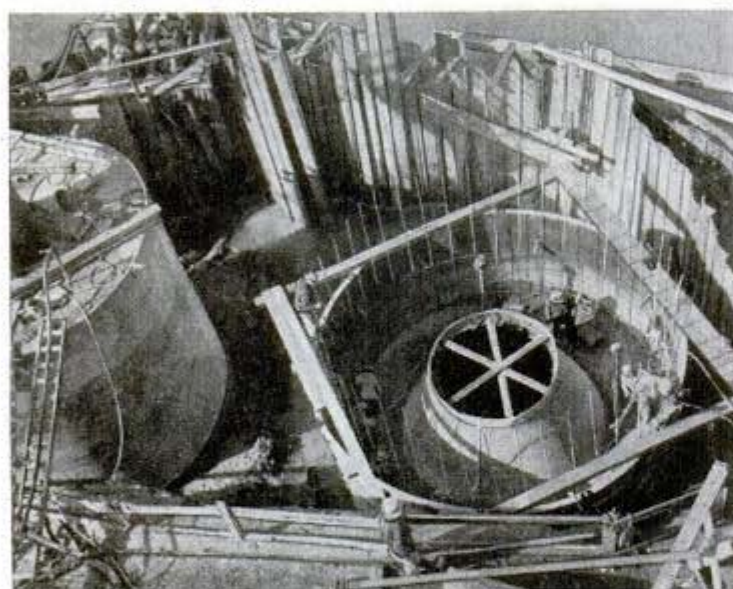
Fort Pitt Bridge Works photos

Above, demountable V-type deck bridge during assembly; rails are laid on top of bridge. Finished V bridge below is a through type. Bolted as a temporary structure, it can be riveted for permanence





U. S. Army engineers built this bridge across the Rhine at Wesel, Germany, in just 10 days. Below, looking into steel piling cofferdam as concrete is placed for pier of Santa Fe's new Colorado River bridge



Below, Illinois Central train crossing dam at Gilbertsville, Ky.



valve was opened. Each pair of cylinders was filled with concrete upon completion and then joined at the top by a concrete cap, forming a finished pier.

Recently the Pennsylvania Railroad was confronted with a similar bridge replacement problem but in its case there was no possibility of building a new bridge on a new alignment. Its 2529-foot Long Bridge across the Potomac at Washington, D. C., was 40 years old and was carrying as many as 260 trains per day, some of which were limited to 15 miles per hour over the structure. A stronger bridge would allow this traffic to speed up and so, with no other location available, the engineers built their new bridge outside of the old one and then transferred the load from the old bridge to the new structure without once interfering with train traffic.

They built 11 new piers midway between the existing piers to reduce the length of each span, placed the girders of the new bridge in

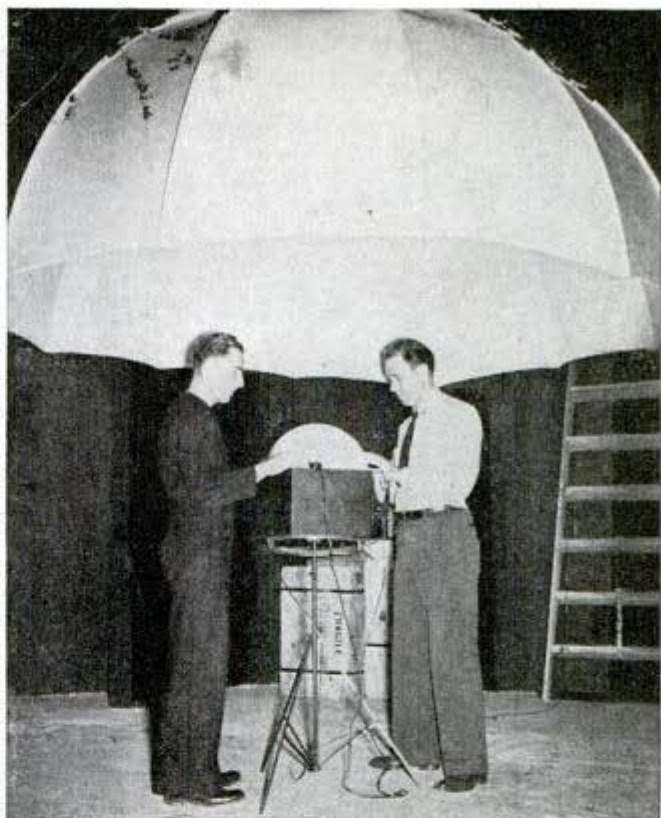
position on all the piers outside the trusses of the old bridge, supported the existing floor system on temporary floor beams hung from the new girders, and then introduced new floor beams to support permanently the load on the new girders. After that the old bridge structure could be dismantled piece by piece.

The necessity for creating sturdy railroad bridges that could span long gaps is the chief reason bridge engineering has developed to its present high point. The oldest and possibly the best railroad bridges in the world are built of stone. Such a viaduct is the Baltimore & Ohio's stone bridge at Relay, Md., now 112 years old. It carries today's heaviest rolling stock with ease and probably will last for additional centuries.

Stone arch bridges have tremendous strength but they are expensive and are not suitable for long spans. Brick or concrete arches have similar objections. Modern bridge design had to wait for the development of steels that possess extreme strength in relation to their weight. Steel makes possible the long truss spans and girder spans that are common in bridge design today, as well as cantilever, steel arch and suspension bridges. Each bridge is custom designed for its site and it often happens that a single long bridge may actually consist of a number of short spans of different design, attached end to end.

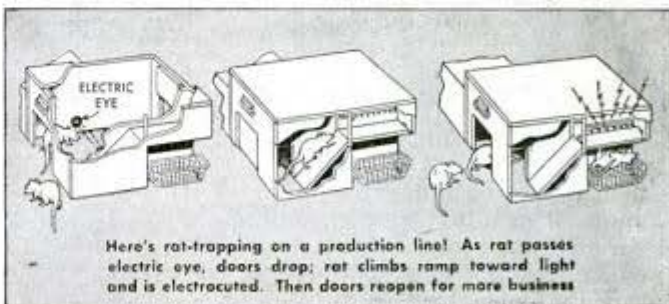
During the war engineers designed for military use a demountable V-type bridge which is easily assembled or dismantled. In peacetime it can be used as a temporary replacement for bridges that have been destroyed by floods or tornadoes. The bridge can be made into a permanent structure by replacing connection bolts with rivets.

Another bridge of special design is said to be earthquake proof. It was built by the Southern Pacific Railroad across the Pajara River between Gilroy and Watsonville Junction, Calif. The bridge is mounted on rockers with one end anchored and the other riding free in a recessed abutment. An electrical recording device stops trains if the piers move more than three-quarters of an inch.



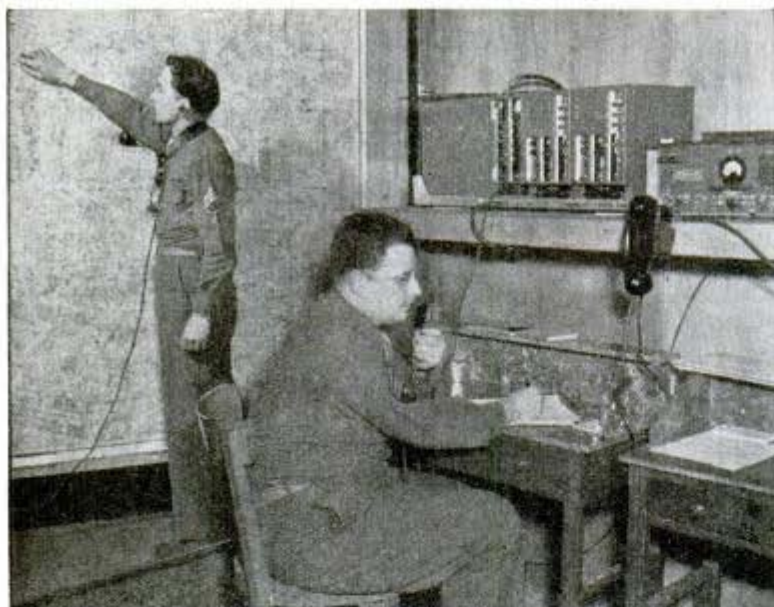
Umbrella Planetarium

Students at the Alameda Naval Air Station in California learn to recognize constellations and stars used in celestial navigation from the inside of a big white canvas umbrella. This rudimentary planetarium is placed over a stellar globe. A light inside the globe projects beams through holes to form dots of light on the umbrella in the exact pattern of the stars. By rotating the globe, the umbrella reflects the appearance of the sky at any hour of the night, any season.



Electric Rattrap A boxlike trap built like a tunnel has doors at each end that drop when the rat breaks an electric eye beam. An inside door admits the rat to a ramp leading to the "execution room," where his weight closes the door and electrodes send a killing shock through his body. Then the floor of the death chamber drops and the dead rat is deposited in a basket. The trap automatically resets itself and can be plugged into an ordinary electrical outlet.

Two-Way FM Radio on Jeeps for MPs Snags Lawbreakers Overseas



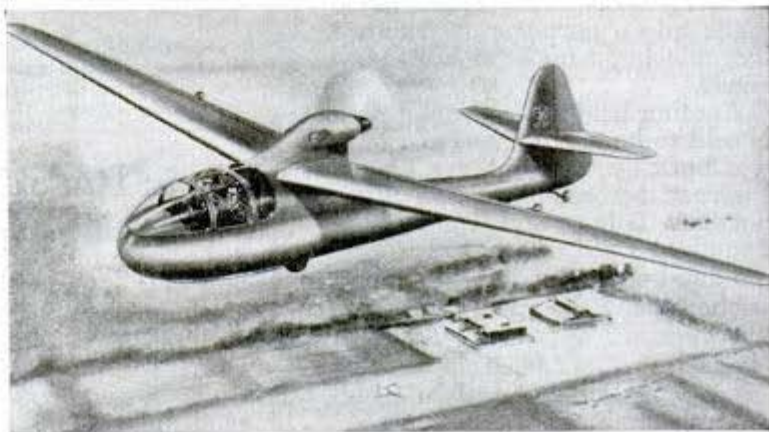
Jeeps operated by American military police in Paris and other European cities are equipped with two-way FM (frequency modulation) broadcasting equipment. This radio network is modeled after the police system in a number of large U. S. cities. In Paris, the nerve center of the network is on top of a former department store. No building in the French city was found tall

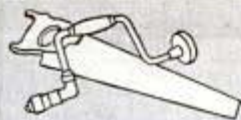
enough for signals to reach all roving patrols, so a relay station was built on the Eiffel Tower. The radio-jeep patrol has enabled alert military police to track down black market operators, hijackers of military vehicles, AWOL soldiers and other lawbreakers.

Top, in control room of Paris station calls are relayed to cars. Below, MPs await call

Pusher-Type Plane For Private Pilot Lands Like Glider

With an engine mounted on top of the wings and the propeller behind them, a pusher-type light plane will cruise 110 miles an hour on 65 horsepower. It has a top speed of 135 miles an hour and a cruising range of 400 miles. This two-place business and pleasure craft, being tested by the Jarvis Manufacturing Company, Glendale, Cal., is built to land safely at 40 miles an hour on a rough field. It has a single main landing wheel, similar to that used for gliders, and a three-inch steel nose skid. A tail wheel and two retractable wing wheels are used in taxiing. The plane cannot ground loop, according to the designer, Volmer S. Jensen. It is expected to sell for less than \$2000.





The Craftsman

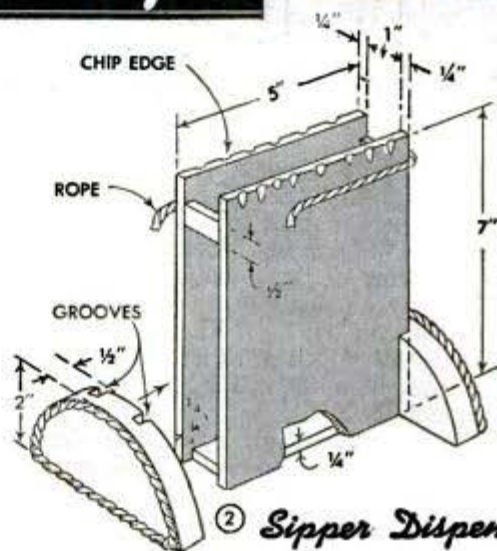


Serve It Western Style

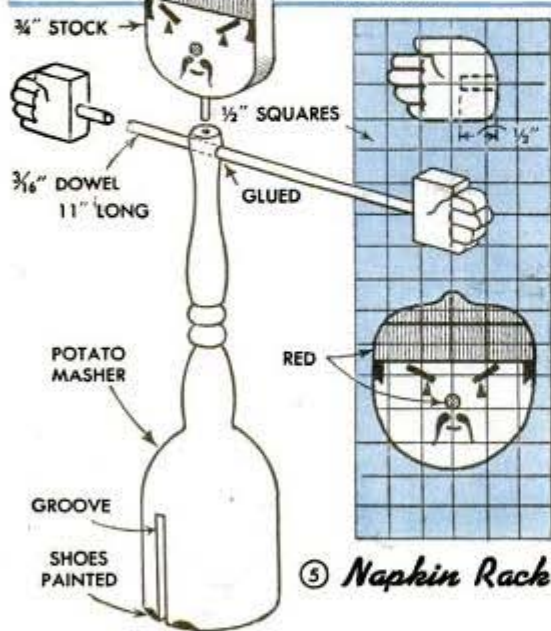
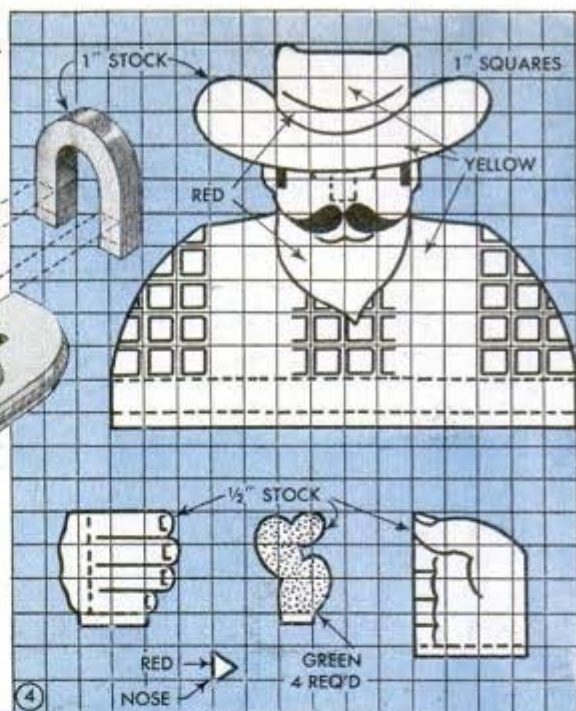
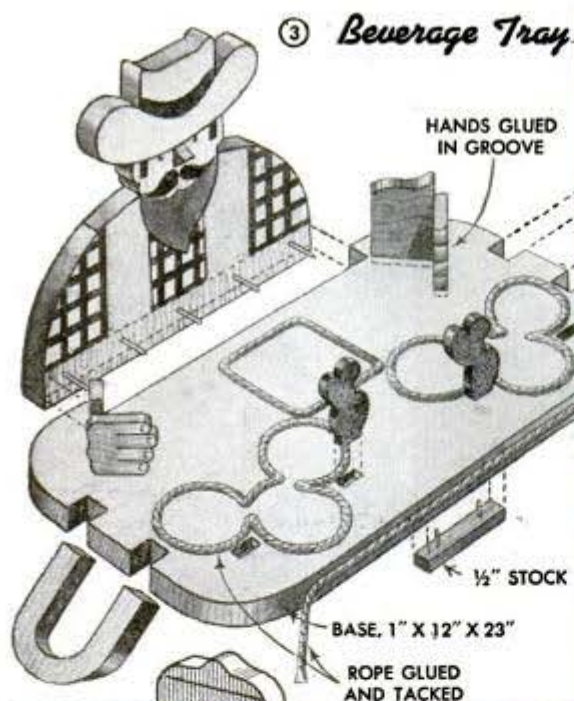
By Roberta L. Fairall

IF YOU want something different for your informal luncheons and buffet dinners, try a set of western-styled table accessories such as pictured in Fig. 1. Your guests will enjoy these comic reminders of the Old West.

Beverage tray: This is the heart of the set and is shown in Fig. 3. It holds two bottles, six glasses and a refrigerator jar for ice. A jigsawed figure at the back and U-shaped handles at the ends are notched into the tray so that they project $\frac{1}{2}$ in. below it to serve as feet or supports. A cleat at the front provides the fourth support. Jigsawed hands are mortised into the upper surface to hold the bottles, each hand



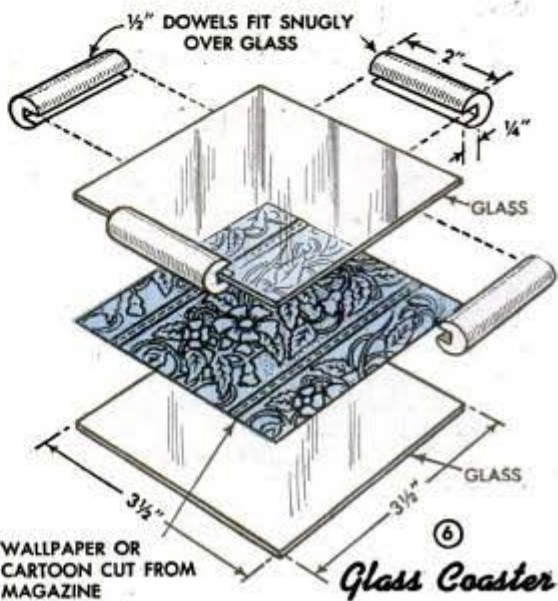
② Sipper Dispenser



supports. Chipping the top edges and binding the sides and upper part with rope carries out the western atmosphere.

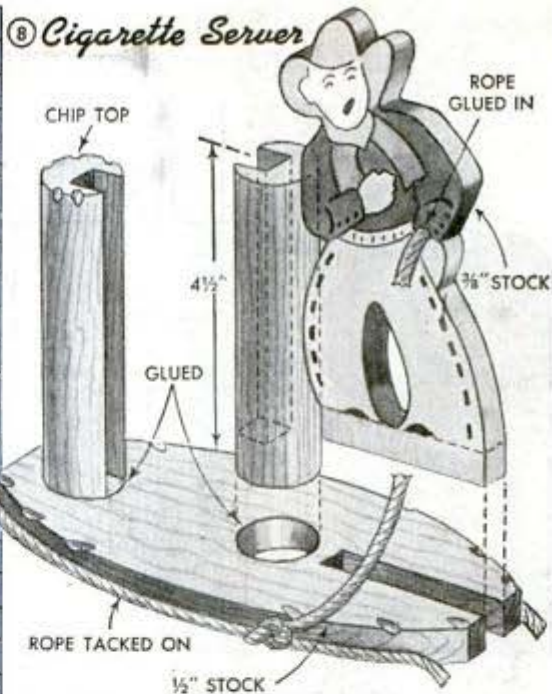
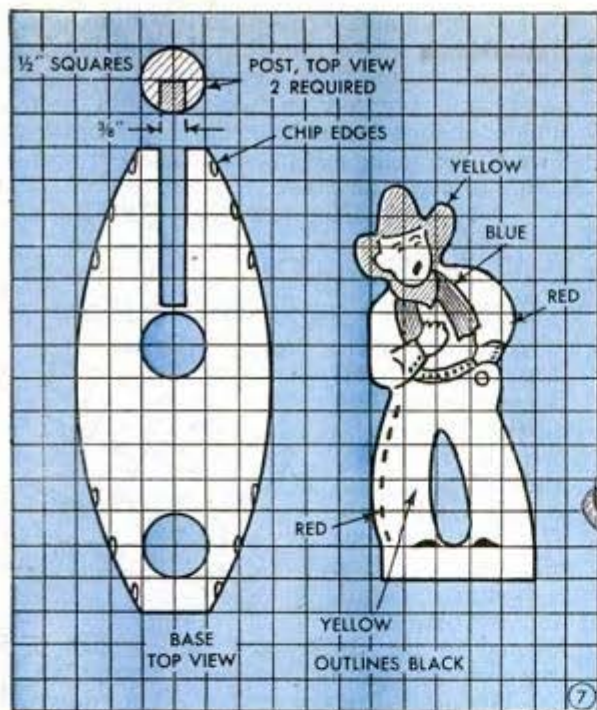
Napkin rack: Paper napkins are appropriate with this set, and the little ranch cook in Fig. 5 will keep them on his outstretched arms ready for use. A wooden potato masher serves as his body, which is grooved at the bottom to simulate legs with toes of shoes painted on. A jigsawed head is doweled to the upper end of the body, the latter being drilled horizontally for a dowel carrying two jigsawed hands.

Coasters: These are a "must" to protect polished surfaces, and good ones can be



being made in two parts according to the patterns in Fig. 4. Small rope glued and tacked in place is used to bind the edge of the tray and to form holders for glasses and ice jar. A row of jigsawed cacti mortised into the tray adds a western touch.

Sipper dispenser: For the convenience of your guests, you'll want a holder for sipping straws. The one in Fig. 2 matches the tray, especially if you put a "wanted" poster of the figure on the tray on one side of the dispenser. The front and back are assembled with a bottom and two spacer strips, after which the unit is glued into grooves cut in two half circular sides or



made by sandwiching wallpaper or magazine cartoons between two pieces of glass as in Fig. 6. Four pieces of dowel grooved to fit tightly over the two thicknesses of glass hold the assembly together. A little adhesive may be needed on the dowels.

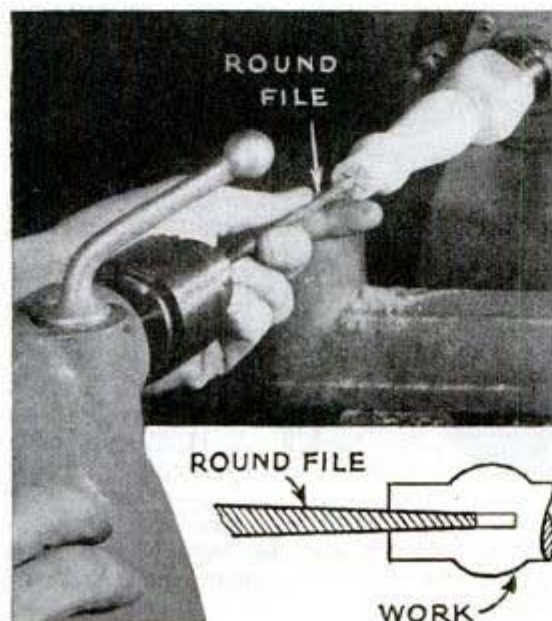
Cigarette server: This is pictured in Fig. 8, and completes the set. It consists of a base, a cowboy cutout, and two vertical

dowels which are channeled to take the ends of the cigarettes, the base and cowboy being cut according to the patterns in Fig. 7. When the dispenser is filled, the cigarettes and dowels simulate a panel of a pole fence against which the cowboy is leaning. Both the base and dowels are chipped and the base is bound with rope, which extends up to the cowboy's hand.

Round File Tapers Drilled Hole to Take Tang of Chisel

The next time you fit a small chisel or file into a wood handle, use this method to get a snug fit. Drill the tang hole to nom-

inal size, then chuck a round file in the tailstock and use the file to enlarge the hole to proper size. The file preferably should be coarse-cut, and should be withdrawn repeatedly, the file being stationary while the wood handle rotates. If a hole larger than the file is needed, press lightly with a wood block against the end of the turning as it spins in the lathe.



Rubber Bands From Finger Cot

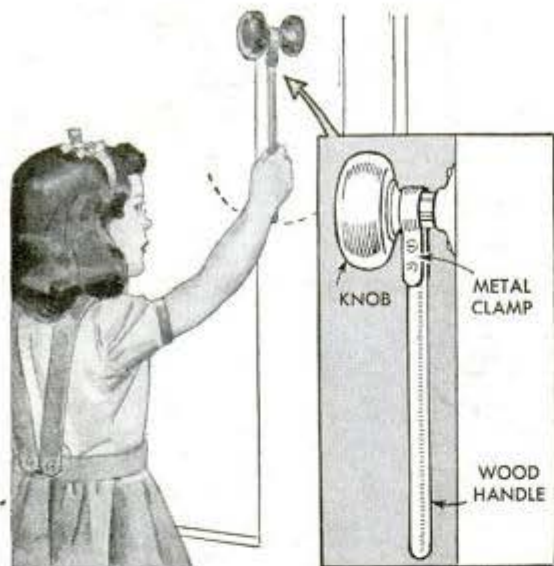
A rubber finger cot cut into strips will form elastic bands of any desired width. Length of the bands may be varied by cutting the cot diagonally. To facilitate cutting, a strip of thin cardboard can be rolled and inserted in the cot.



Joseph Jay Gould, Brooklyn, N. Y.

☞ To remove iodine stains from linens rub the stained area with a slice of lemon.

Extension Handle Enables Child To Turn Latch on Door



You can save yourself many steps in opening and closing a door for a child who is too small to reach the doorknob, if you use an extension handle on the knob. It consists of a suitable length of broomstick or large dowel clamped to the knob shank with a piece of sheet metal folded tightly around the shank and screwed to the handle. The clamp must be tight enough to turn the knob when the handle is moved.

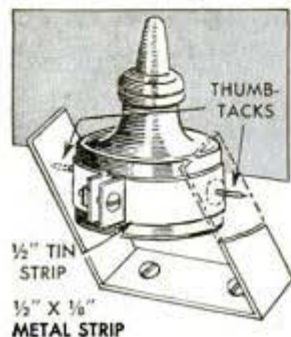
A. Armstrong, Missoula, Mont.

Sprayer Aids in Dressing Leather

The usual messy job of applying neats-foot oil or other liquid compounds to leather garments is a much cleaner task if the oil is applied with a household sprayer, preferably of the continuous spray type, although others will do. Mildew spots that are not too deep can be removed by spraying them heavily, letting the oil soak a few minutes, then rubbing lightly with a cloth.

E. F. Brandt, St. Augustine, Fla.

Stand Holds Ink Bottle Level On Sloping Table



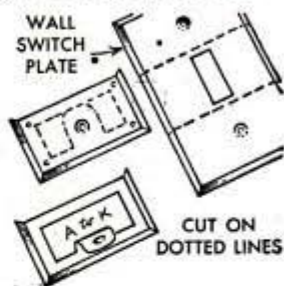
With a stand like this one, draftsmen will be able to keep their ink bottles level even when they are placed on a tilted table. The stand is made from two strips of light sheet metal. One strip is bent

to a U-shape and screwed to the table, and the other is formed around the ink bottle, the ends being bent outward at a right angle and pierced to take a small bolt, which clamps the strip around the bottle. Two thumbtacks are pressed through both strips to serve as pivots.

A. Giandomenico, New York.

Pulls for Filing-Cabinet Drawers Cut From Toggle-Switch Plate

Drawer pulls that will take index cards for filing cabinets can be made from the ends of a toggle-switch wall plate. The ends are cut off as shown in the right-hand detail, and a tongue is formed in the center portion of each of these pieces as indicated in the upper left-hand detail. After the tongue is bent down, holes are drilled in the corners for screws to attach the pull, and the index card is slipped behind it.



Lewis B. Rogers, Redlands, Calif.

Fruit Jar and Tape Trap Roaches

An effective trap for roaches can be improvised from a fruit jar and adhesive tape. Stick the tape on the jar, running from top to bottom, and place jelly or other sweets inside the jar. The tape makes it possible for the insects to get into the jar, since they are not able to climb the smooth sides of a jar without some assistance.

John D. Mitchell, Chandler, Ariz.

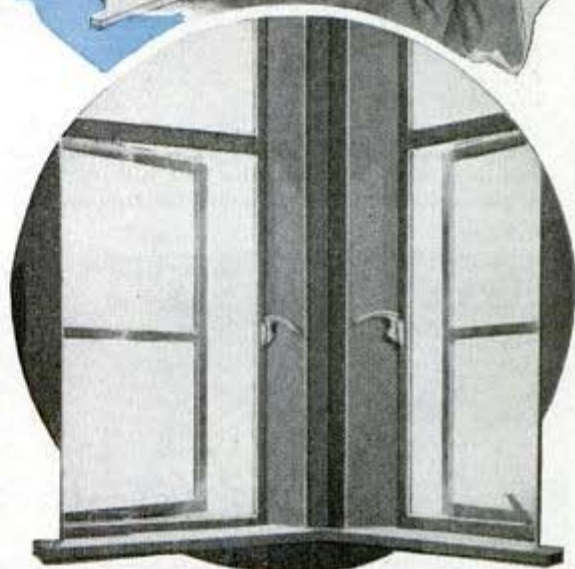
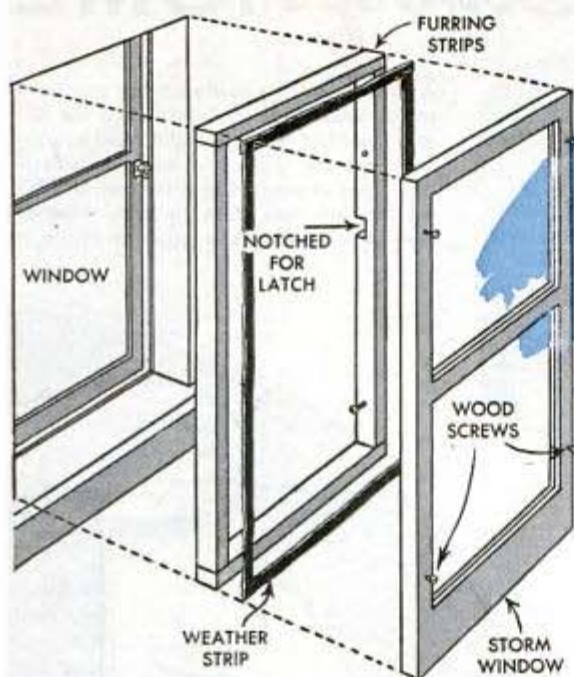
Small-Mouthed Bottles Refilled With Aid of Oil Can



Dispensing bottles of the type used for lotions ordinarily cannot easily be refilled because the mouth is too small. By filling an oil can with the fluid to be used and inserting the spout in the bottle, the latter can be refilled.—A. H. Waychoff, Phoenix, Ariz.

Greasy accumulations on kitchen walls and woodwork can be removed before painting by washing the surfaces with a solution of trisodium phosphate.

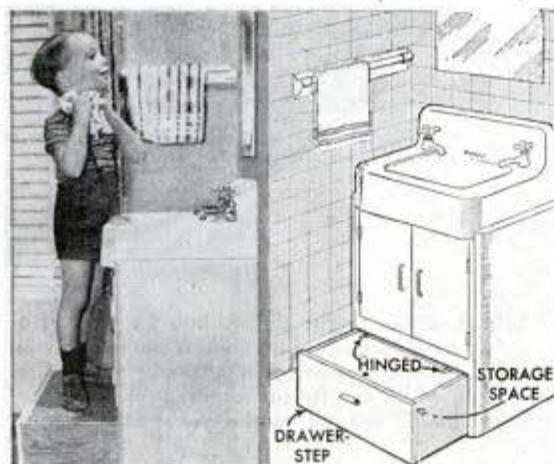
Wooden Storm Sash Fit Inside Steel Windows



To avoid excessive condensation on his steel casement windows that opened outward, as indicated in the circular detail, one homeowner installed ordinary wooden storm sash on the inner sides of the windows. To do this, first close and lock the windows and remove any hardware that will interfere with installing a wooden frame on the inner side of the casing. Then build the frame of 1 by 2-in. furring strips to fit the window frame, screwing the wide sides of the strips against the sides of the window openings. On some types of windows notches may have to be cut in the frame to clear fittings and allow it to set against the steel casement. Place 1-in. felt weather stripping around the frame before

mounting the storm sash, which is drawn tightly against the frame with wood screws, and paint the assembly to harmonize with the room.—Arthur Mobbs, Dumont, N. J.

Child Reaches Faucets by Standing on Covered Drawer



As a means of teaching my young son to help himself rather than depend on others, I added a hinged cover to the drawer in a cabinet under the lavatory. Now the boy can reach the faucets by standing on the cover, which can be raised to get at the contents.—A. T. Eyman, Rochester, N. Y.

Tobacco Pouch Serves as Case For Electric Shaver

When the carrying case of your electric shaver wears out, you will find that a tobacco pouch will serve just about as well. A pouch having a slide fastener to close it is preferable to the roll-type pouch.

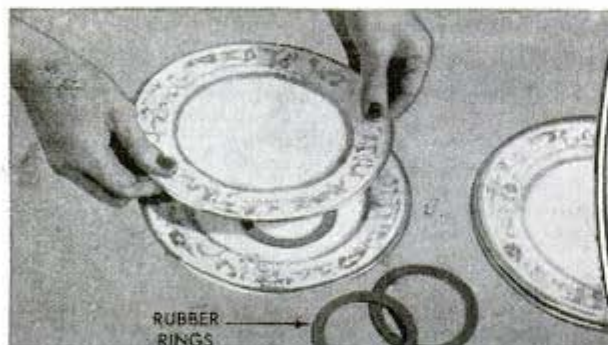
D. E. Horn, River Forest, Ill.

Solving HOME

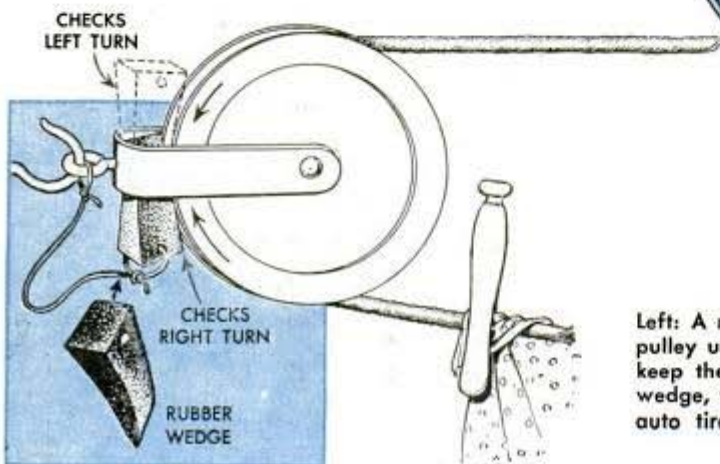


A shield made by cutting away part of a metal cake cover as indicated at the left will keep hot fat in a skillet from splashing over the stove and wall. Below: If you store waste fat in a tin can, a folded strip of tape stuck to both sides of the lid will provide a grip for lifting it

Right center: To stiffen a limp tape measure, lay it between sheets of waxed paper and press with a moderately hot iron. The heat will soften the wax sufficiently to impregnate the tape measure



Fruit-jar rings placed between hand-painted china dishes as shown above will help prevent scratches when the dishes are stacked. Right: The bases of thin candles can be enlarged to fit holders snugly by wrapping them with strips of corrugated paper



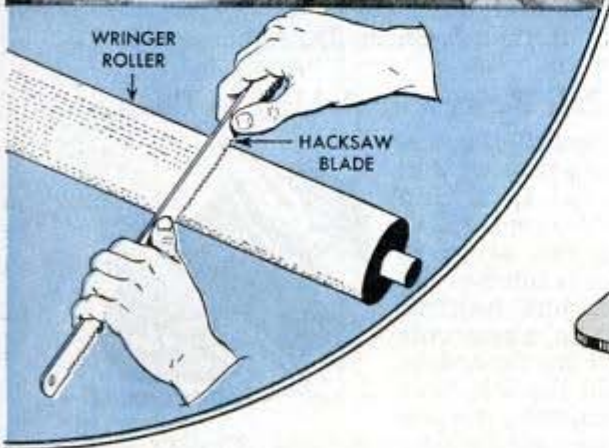
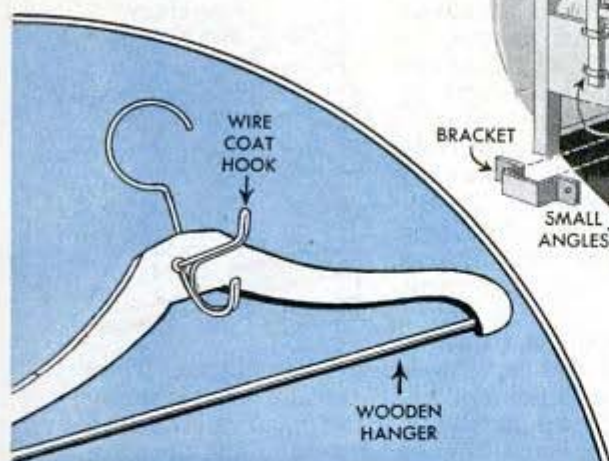
Left: A rubber wedge slipped into the yoke of a pulley used to support an endless clothesline will keep the line stationary in a strong wind. The wedge, which can be cut from a rubber heel or auto tire, is secured to the yoke with a cord

PROBLEMS

Removable panels on a full-size bed keep a baby from falling out. They are held in brackets, the uprights being cut away to fit into them as indicated at right. Below: You can hang your hat with your coat on a wire hook screwed to the hanger

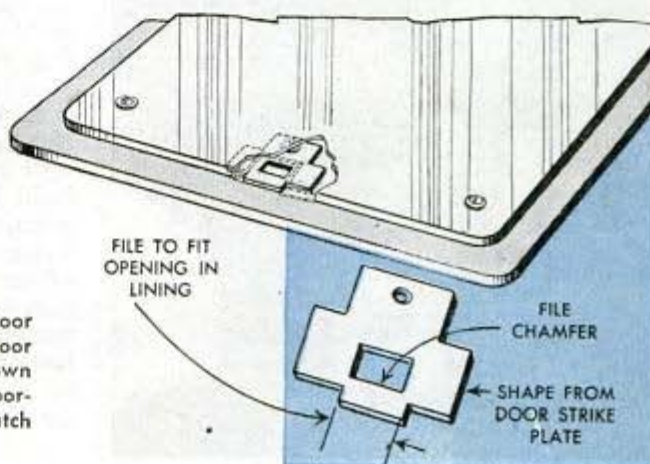


Left center: If your cupboard shelves are deep, you will save time in selecting spices and extracts by keeping them on a sheet-metal tray. This can be pulled out to expose articles placed at the end

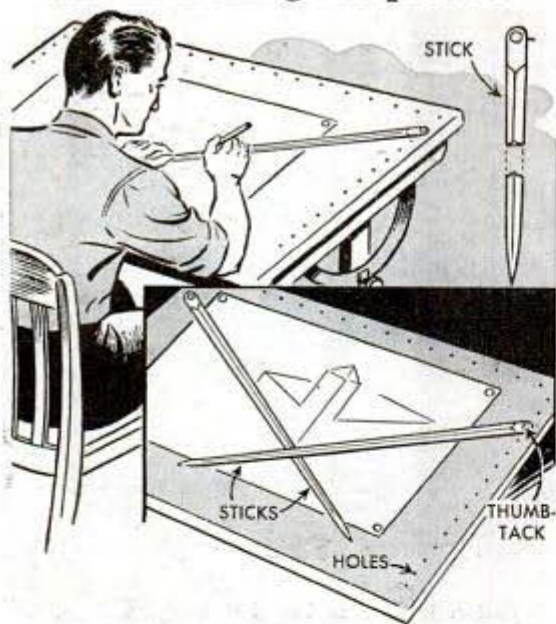


Above: If a measuring cup is coated with flour, molasses can be poured from it without adhering to the sides. Left: When rollers on a clothes wringer become smooth and fail to grip soapy clothes, roughen them with a hacksaw blade

When part of the friction catch on an oven door wears so that it will not hold, substitute a door strike plate. After being cut and filed as shown at the right, the plate is slipped under the porcelain facing on the door to engage the catch



Sticks Pivoted to Drawing Board Aid in Making Perspectives

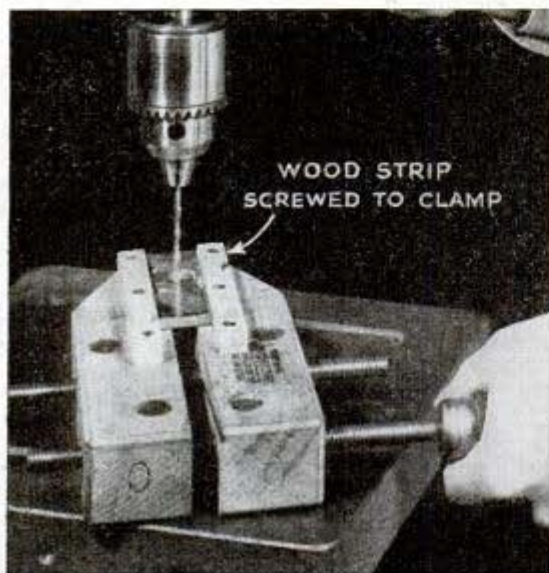


Two sticks shaped as indicated will be found an aid in making perspective drawings. They are pointed at one end and flattened at the other end to take thumbtacks, which serve as pivots. The tacks are inserted in holes drilled at equal intervals along the sides and top of the drawing board to get the desired angles.

Robert J. Dierkes, Milwaukee, Wis.

Wood Strips on Handscrew Jaws Hold Work in Drill Press

An excellent drill-press vise, especially suitable for holding thin metal for drilling, can be made by screwing wood strips to the jaws of an ordinary handscrew. An adjustable-type handscrew is preferable,



as this style will grip wedge-shaped pieces as well as rectangular and square work. The strips are $\frac{3}{8}$ by $\frac{1}{2}$ by $4\frac{1}{2}$ in., and are fitted $\frac{1}{4}$ in. in from the inner edge of the jaws. They do not interfere with normal use of the handscrew. The handscrew handle should be gripped by hand to prevent rotation.

Hand-Grinder Sanding Drum Made From Abrasive Cloth

Small sanding drums for use on hand grinders can be improvised by attaching abrasive cloth to steel rods, which serve as mandrels. To attach the cloth, first wind several turns of adhesive tape, sticky side down, on the rod, cutting off the tape to leave a small tab. Then attach the tape to the tab and wind it sticky side up until the drum is of the desired diameter. Now cut a strip of the abrasive cloth to a size that will produce exactly one turn around the drum and press it firmly in place.—S. Muns, Hemstead, L. I.



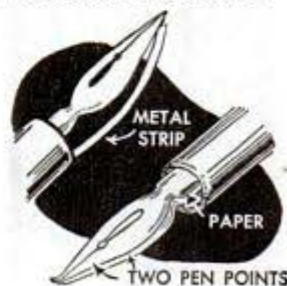
Strike Plate Plugged With Screw Prevents Locking Door

To prevent his small son from locking himself in a room, one man drove a screw into the bolt opening of the strike plate flush with the plate. The screw prevented the bolt from entering the plate, yet could be removed quickly.

Arthur F. Short, Jr., Apopka, R. I.

Ink Reservoir Added to Pens

By fitting a narrow strip of thin metal in a pen holder and curving the strip so that it touches the pen just behind the tip, a reservoir will be formed to hold the ink, thus permitting the pen

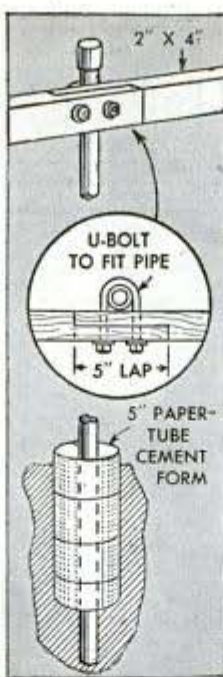


to be used for longer periods. Another way of creating an ink reservoir is to lay one pen over another with a piece of paper between them for a spacer. The tip of the under pen should be bent upward slightly to touch the other, care being taken to avoid scratching the tip when this is done.

Henri C. Holgate, Florence, Ariz.

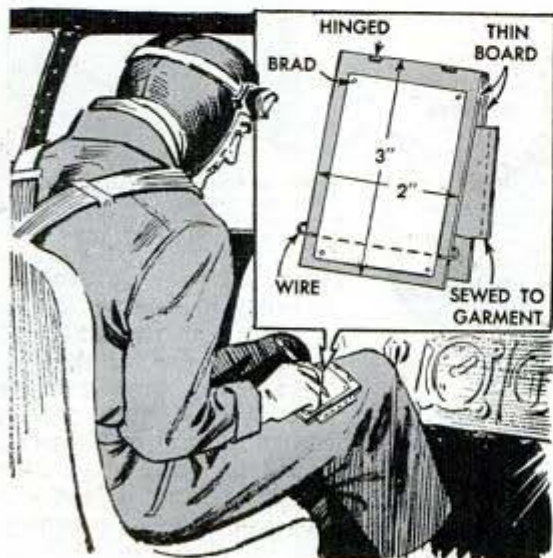
Pipes Set in Cement Make Durable Fence Posts

This neat looking fence with iron pipe for posts will outlast a wooden-post fence many times. Pipes of approximately 2 in. in diameter are given a coat of red-lead paint and driven about 3 ft. into the ground, spacing them 5 or 6 ft. between centers. Then a hole is dug around each pipe for a 20-in. length of heavy paper or cardboard tubing which serves as a concrete form. These forms should project about 1 in. above the ground level as shown in the lower left-hand detail. The tops of the posts may be plugged with cement or threaded and capped. For the top and bottom rails, 12 or 14-ft. lengths of 2 by 4-in. stock are lap-jointed at every other post. These joints should be given a heavy coat of white lead before securing them to the posts with U-bolts as illustrated in the upper and center details. If U-bolts of the size needed can-



not be purchased, they can be made from 3/8-in. iron rods threaded on the ends and bent around the posts. Wire fencing is stapled to the rails and the completed fence painted.—Otto Merker, Chicago.

Student Pilot's Flight-Record Pad Is Held on Trouser Leg



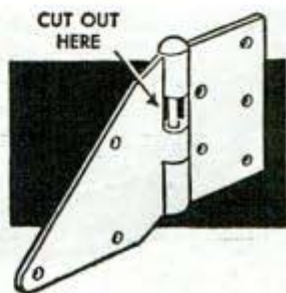
For recording take-off and landing times, student airplane pilots will find this knee memo pad superior to the patch of adhesive tape sometimes applied to a leg of their flying suits. The pad is made by hinging two pieces of thin board at one end and bradding to one of them a writing pad consisting of a sheet of celluloid fastened over

a carbon back. Such a pad can be bought at most novelty stores. When written on with a stylus, the celluloid sheet is pressed into the carbon back to form legible inscriptions, which disappear when the celluloid is lifted from the back. A length of wire bent to fit loosely around the board can be moved along under the celluloid to raise it and remove inscriptions. The pad can be inserted and held conveniently in a cloth tab sewed on the trouser leg.

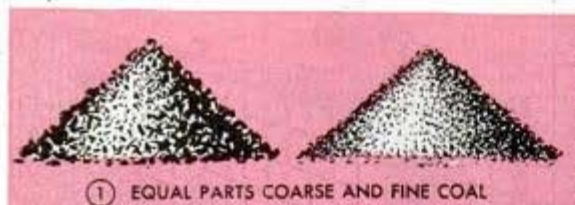
Ted Bryan, Kingsport, Tenn.

Altered Hinges Permit Door To Clear High Pavement

In cold weather the concrete pavement under garage doors sometimes heaves so much the doors cannot be opened. To solve the problem, cut away a small portion of each hinge, as shown, so that the doors can be raised vertically to clear the obstruction, then swung open.



"READING" YOUR STOKER FIRE



IN ONE respect the attention required by the stoker-fired heating plant is similar to that of the hand-fired plant—all details are important. When the stoker is installed in a heating system of adequate capacity the fire largely takes care of itself, and it is true that the less it is disturbed the better. Suppliers of standard stoker coals say that from a combustion standpoint a rather "dirty" fuel bed is better than a scrupulously clean one. Once the fire has been properly started and the correct cycle of operation established for the season, until some other development makes a change necessary there are only a few simple details that require careful attention at regular intervals.

Figs. 1 and 2 suggest two precautions that can save a lot of trouble if followed regularly. Although stoker coals usually are supplied in uniform sizes a certain amount of breakage occurs in handling. This means that in each season's supply you will



(Parts of text and certain illustrations by courtesy of Bituminous Coal Institute and Appalachian Coals, Inc.)

have at least a small quantity of fine particles of coal. The important thing when filling the stoker with varying sizes of coal is to mix equal

parts of fine and coarse fuel in the hopper. This will assure uniform feeding of the fine and coarse particles into the retort. Where the coal varies in size this precaution should always be observed. When filling the hopper, wear gloves and inspect each shovelful. It takes more time, of course, but by this process you are almost certain to discover a chance spike, bolt, or other foreign object before it can get into the mechanism and cause delay or breakage at a critical time.

Before firing the stoker for the first time in the fall, be sure that the furnace is clean.

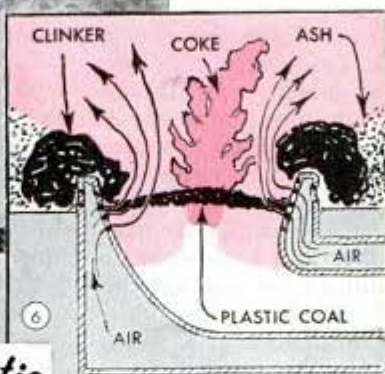




speed control for coal feeds. A correct air adjustment is one that will maintain a maximum depth of fuel bed without objectionable soot formation in the firebox and gas passages, or smoke discharge from the chimney. Avoid mixing different kinds or grades of coals. Once the stoker has been adjusted for a satisfactory grade and size of fuel it's best to continue with that size and grade.

Although one of the most common errors in household stoker operation is the use of too much air, too little air will cause a smoky fire. Also, if too much coal is being fed, the fire will be sluggish and smoky, Fig. 5, and soot deposits will build up on the heating surfaces. The fuel bed will form a heavy coke tree as in Fig. 12, and the clinker "ring" will be thin and

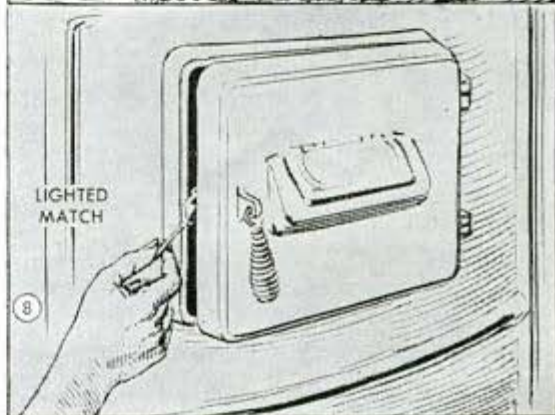
irregular, and may not form in the normal length of time. Large pieces of the coke tree will break away from the central mass and die out, resulting in an accumulation of unburned fuel around the sides of the firebox. On the other hand, if the fuel bed is supplied with too much air the fire will become steadily thinner and



Fuel and air ratio

If you have a steam or hot-water system, always check the water level. See that the stoker is properly serviced and lubricated, and be sure that the feed screw, windbox and tuyere openings are free of ashes, clinker or other obstructions. If the hopper is fitted with smokepipe, check to see that it is clear. Fill the hopper to about one fourth its depth, start the stoker and allow it to run until the retort fills level with the top. Then stop it and check all the controls, both manually operated and automatic, to see that they are in working order. Place several small pieces of dry kindling and twisted newspapers on top of the coal in the retort, sprinkle a scoopful of coal over this as in Fig. 3, ignite the kindling, Fig. 4, and immediately start the stoker again. Don't forget to fill the hopper after making the necessary adjustments.

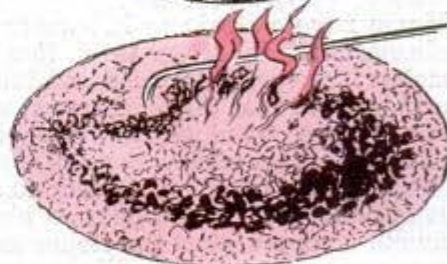
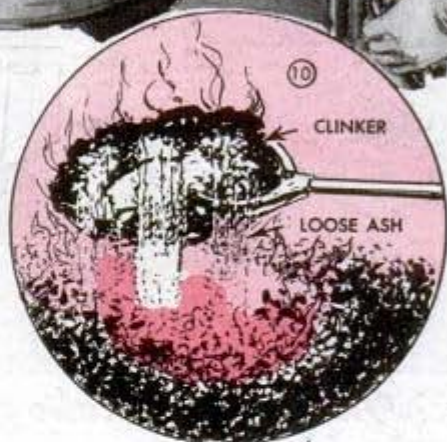
Proper depth of fuel bed to maintain will vary according to the coking properties of the coal used. Coals that form hard, strong coke usually require a deep fuel bed, while those that form soft coke generally burn best in a shallow fuel bed. In the average household stoker a fuel-bed depth ranging from 6 to 10 in. gives best results. Most late model stokers are equipped with automatic air-control devices and variable-



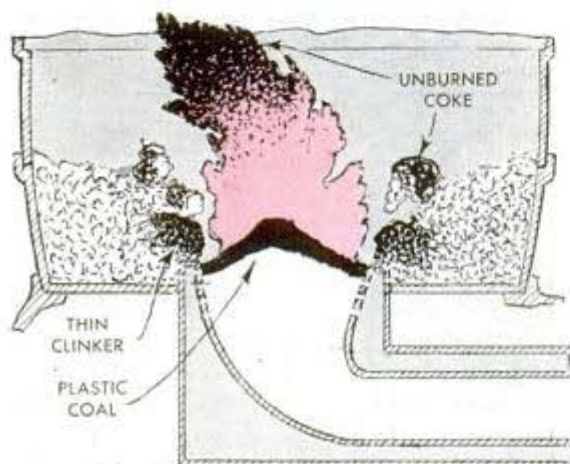
ash will be blown clear of the fuel bed to settle on the heating surfaces. A thin coke tree, Fig. 6, will appear at the center of the fuel bed, the tree sometimes being surrounded by dead, burned-out areas adjacent to the edges which act as passages for the excess air. If the fire door is opened while the stoker is running likely you will see streamers of sparks in the firebox, Fig. 7, and perhaps even in the smokepipe or chimney.

Another reliable and perhaps more sensitive indicator with most stoker coals is the nature and shape of the clinker formed by fusion of the ash and residues. With even a comparatively small amount of air in excess of requirements, the clinker tends to form deep in the fire bed and sometimes so low that it will partially obstruct the tuyere openings. The remedy for any of these troubles is to cut down the excess air or coal, as the case may be. Generally, it is best to adjust one or the other, then observe results before making other changes. If too much air is indicated, cut down the air and note results before increasing the coal feed. Proceed in the same way where too much coal is indicated.

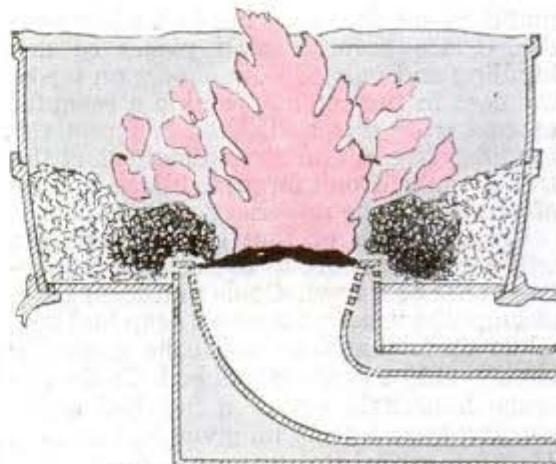
The amount of "free" or natural draft in the firebox is very important when burning high-volatile coals. As a general rule it should be kept at the minimum. In most heating plants this will be indicated by the simple check pictured in Fig. 8. With the stoker running and the smokepipe and chimney heated to normal operating temperatures open the fire door about 1 in., then strike a match and hold it in the position shown. The natural draft should be just strong enough to draw in the flame gently toward the firebox. If the draft is excessively strong, set the smokepipe dampers to produce the correct draft as indicated by the match flame. However, if the installation is equipped with an automatic damper, the check damper should not be used. Instead adjust the automatic damper. It should be kept in mind, too, that there are many other conditions, both inside and outside the building, that will affect the natural draft.



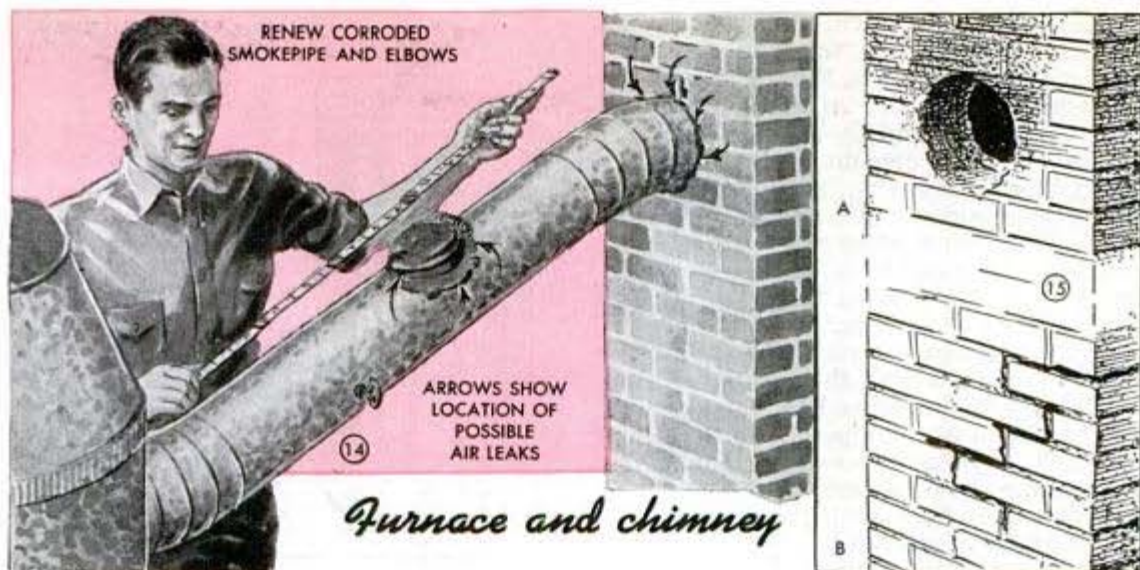
11 LEVEL FIRE BED



12 HEAVY COKE TREE



13 PROPER COMBUSTION



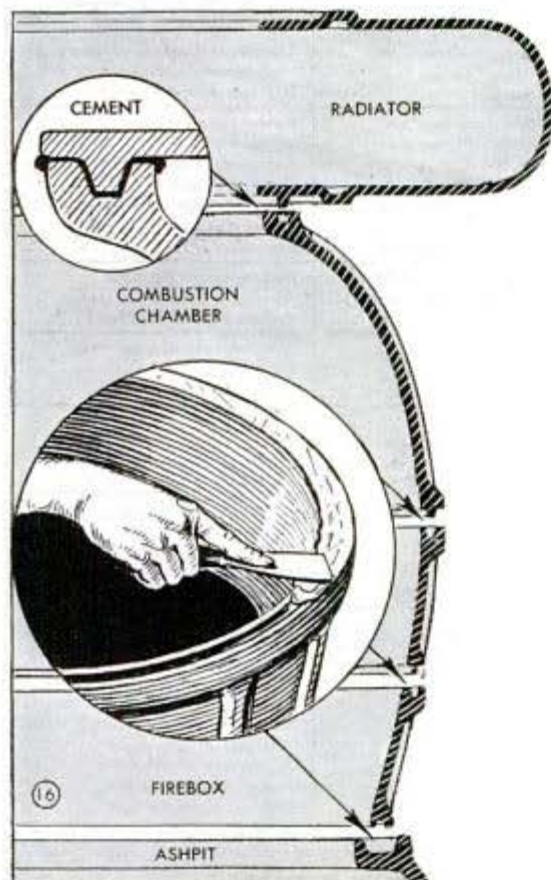
Furnace and chimney

Remove the clinker at regular intervals as in Fig. 9, using special clinker tongs. Be careful to disturb the fire bed as little as possible. Before withdrawing the clinker from the firebox turn it over as in Fig. 10 and shake off the loose ash and live coals. Then with a curved poker rake the surrounding loose ash into the cavity and level the fuel bed as in Fig. 11. In mild weather it's a good idea to run the stoker for a short

interval to recondition the fire after removal of the clinker. The frequency of cleaning the fire depends on the ash content of the coal and the amount of fuel consumed.

Most late model stokers are equipped with an electric clock type of hold-fire control, the purpose of the device obviously being to keep the fire from going out during long intervals in mild weather when there is no demand for heat. It serves the dual purpose of promoting good combustion, Fig. 13, and of converting ash into clinker. For this reason its proper adjustment is important. In adjusting for a given kind and size of coal, carefully follow the directions of the stoker manufacturer. Some older model stokers are fitted with a stack thermostat to control hold-fire. This device is, of course, set to operate the stoker for short intervals during the "off" period when stack temperature drops below a certain point. Due to variations in heating plant installations proper adjustment of any hold-fire control device is often a matter of "cut and try" until you attain the cycle or time interval of operation which gives best results. General practice favors the longer cycle; that is, it will be found that 4 min. operation once every hour is better than 2 min. twice every hour.

In any home installation it's well to check the chimney and smokepipe at the start of each season. Unused stovepipe openings into the chimney, detail A, Fig. 15, should be closed permanently, and the brick should be examined for cracks, detail B. A corroded smokepipe should be replaced, and care must be taken that there are no air leaks at the check damper or where the pipe enters the chimney, Fig. 14. Any of these openings, even though quite small, will act as miniature check dampers. If the

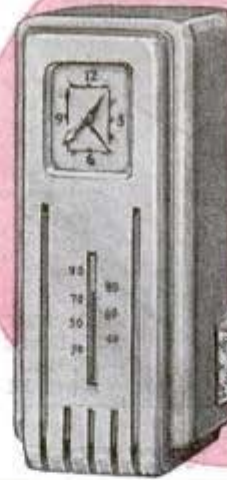


furnace is of the warm-air type and of cast-iron construction, then the condition of the cemented joints, Fig. 16, should be checked periodically. Any leaks in these will permit gas and fly ash to enter the house. When recementing these joints, clean them thoroughly, and be sure that the new cement is spread to a uniform thickness so that when the parts are set together there will be no openings or thin spots where the cement is likely to crack out within a short time.

In the average home it is almost impossible to locate a wall thermostat so that it will not be influenced to some extent by drafts and wall temperatures that may vary. For these reasons a comfortable room temperature should be the guide in setting rather than the actual thermometer reading. Much can be done toward more uniform heat distribution by adjusting register shutters. In addition, the best practice has shown that there is little, if any economy in a variation of more than 5 to 7 degrees between the day and night setting of the thermostat, Fig. 17. Wider variations throw a heavy load on the heating plant during the early morning warm-up period, and after a night at the low thermostat setting, the fire will not be in the best condition to deliver peak efficiency just when needed most. It is better to remove the clinker and condition the fire in the morning before setting up the thermostat, as the clinker then has had time to cool and harden and will be easy to handle.

The table in Fig. 18 explains common stoker troubles, their causes and remedies. This does not in any way supplant the specific instructions furnished by the manufacturer of your stoker. If there is any variation, follow the maker's instructions. However, close study of the causes and remedies given will enable you to cope with most of the ordinary difficulties which usually are quite simple to remedy.

Thermostat setting



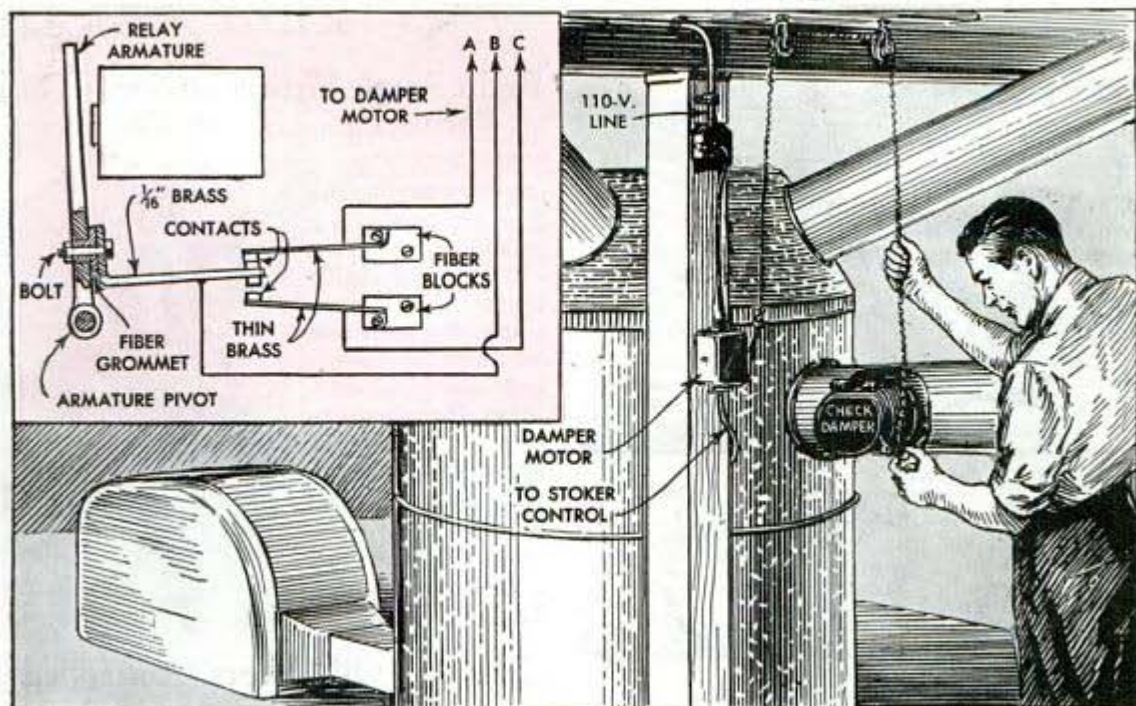
(17) NOT MORE THAN 7° MARGIN BETWEEN DAY AND NIGHT

(18) SUGGESTIONS FOR OVERCOMING OPERATION DIFFICULTIES *		
TROUBLE	CAUSE	REMEDY
Hopper gas	Excessively dirty fuel bed Clinker in retort Fuel bed too thick Hopper lid not sealed Hopper smokepipe plugged	Clean the bed thoroughly Remove the clinker Reduce thickness of bed Refit lid and gasket Remove cap and clean pipe
Smoke (chimney) (Either during "on" or "off" period, or both)	Fuel bed too thick Not enough air Poor draft Coarse coal Faulty chimney or smokepipe	**Reduce coal feed **Increase air Adjust smokepipe damper Mix fine and coarse coal Repair chimney and pipe
Smoke (basement) "on" period	Firebox draft too weak Too much air	Adjust smokepipe damper Decrease air by fan adjustment
Cake trees	Heavy trees—feed too fast Thin trees—too much air Coal too fine	**Increase air, or reduce feed **Increase feed, or decrease air, or maintain thicker fuel bed Mix coarse and fine coal
Not enough heat	Coal feed rate too low Air supply rate too low Poor draft Dirty fuel bed Heating surfaces dirty Coal too fine Limit switch set too low	Increase feed Increase air Adjust smokepipe damper Clean fuel bed Clean castings thoroughly Mix coarse and fine coal See stoker instructions
Too much heat	Wrong setting of hold-fire control (in mild weather) Coal feed rate too high	Reduce operating time Reduce rate of coal feed
Fly ash	Fuel bed too thin Too much air Dirty fuel bed	Increase rate of coal feed Decrease air Clean fuel bed
Soot	Fuel bed too thick Air supply rate too low Hold-fire control set incorrectly	**Decrease coal feed Increase air supply Increase operating periods of hold-fire control
Not enough air	Fan adjustment too low Siftings in windbox Water in air duct Retort openings blocked Basement too air-tight	Increase fan opening Clean windbox Remove the water Remove foreign material Admit more air
Fire goes out	Switch off, or fuses blown Hold-fire set improperly Clutch out, or pin sheared Coal arched in hopper Fuel-air ratio wrong Excessive draft Drive belt slipping	Rebuild fire Close switch or renew fuses Change setting Throw in clutch, or renew shear pin, or remove obstruction Break arch and push coal down to warm Adjust one or the other Reduce firebox draft Tighten, or renew belt

* It is assumed that the stoker has been properly installed and that heating plant is of adequate capacity

** Always do one then observe results before proceeding.

Automatic Check Damper for Use With Stoker



On older types of stokers that are not equipped with an air control for limiting the amount of natural draft through the firebox, a reasonably close control can be provided by automatically operating a check damper in the smokepipe as indicated. The damper closes when the stoker starts to operate and opens when it stops, thus checking the draft.

The check damper is operated by a motor unit of the type used with a wall thermostat for automatic damper control in hand firing. For use with a stoker, the unit is wired to a double-contact switch instead of a thermostat, the switch having connections for three wires the same as the thermostat and being actuated by the armature relay of the stoker control.

The particular type of relay in the stoker control will determine the method of making and mounting the switch. In the switch shown, an arm with double contacts at one end was mounted on the relay armature so that when the armature moved in starting or stopping the stoker it also moved the arm slightly to make or break the circuit between two spring contacts. The arm was insulated from the armature by a fiber grommet and the two brass contacts were insulated by being mounted in fiber blocks.

Most damper motor units have two electrical circuits, one of 110 volts to operate the motor and one of low voltage which flows through the thermostat to control the motor. The low-voltage circuit consists of the three wires that were formerly con-

nected to the room thermostat. These wires are now connected to the switch you installed in the stoker control in the same way as they were connected to the thermostat. The common wire, or wire B in the detail, which was connected to the blade or movable arm of the thermostat, is soldered to the arm of the switch, and the two remaining wires A and C are soldered to the two spring-brass contacts in the switch.

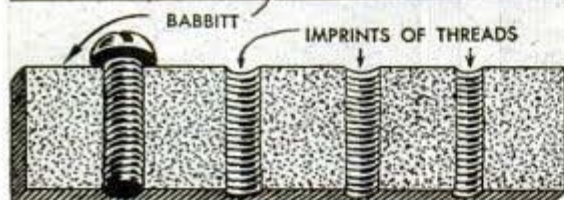
Mount the motor unit on a post, wall or other convenient place and connect one of its arms to the check damper by means of a small chain passed over pulleys as indicated. Plug the motor into the 110-volt circuit and check its operation by starting and stopping the stoker. If the damper closes when it should open, reverse the connections of wires A and C, or change the position of the arm on the motor unit.

Check Radiator-Cap Gasket On Sealed Cooling System

Antifreeze solutions sometimes cause deterioration of the gasket on the radiator cap of a car having a sealed cooling system. For this reason, when putting in your antifreeze, check this gasket and replace it when necessary to assure a perfect seal for the system.

☛ To move a stove, refrigerator or other heavy piece across a floor easily without marring it, place a piece of waxed paper under the legs or casters.

Thread Molds Aid When Sorting Machine Screws and Bolts



The difficult job of accurately sorting a number of machine screws or bolts of various sizes is simplified by using a mold like the one shown. This is a piece of lead, babbitt or other soft metal imprinted with the threads of the various sizes of screws to be sorted. The imprints can be made by driving the screws sideways against the metal, or by heating the screws and melting the imprints into the metal. The screws are sorted by placing them in the imprints to see if their threads correspond with those of the print.

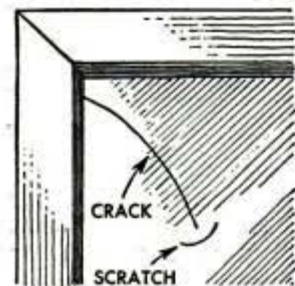
E. P. Barnhart, Whittier, Calif.

Cleaning Kerosene-Stove Wicks

To clean the wick of a kerosene stove or heater, first wipe the charred end with a cloth and then rub it over a piece of screen tacked to a wooden frame. Before replacing the wick, wipe the shield enclosing it.

Don C. Higbee, Downey, Calif.

Crack in Window Pane Checked By Arcs Scored at End



If a short crack appears in a window or door pane, you can prevent it from eventually extending across the glass by scoring short arcs on both sides of the crack near the end

of the crack. Use a glass cutter to make the arcs and scribe them carefully, making them not over $\frac{1}{2}$ in. in length.

M. L. Piatt, Alameda, Calif.

Right-Angle Fitting on Spray Gun Permits Its Use on Ceilings

By attaching a spray gun to the fluid cup by means of a street elbow or a right-angle brass coupling, the gun can be used for painting overhead surfaces that ordinarily cannot be sprayed. Thus fitted, the gun can be pointed up without tilting the fluid cup.—Sam Brown, Marion, Ohio.



Flow of Oil Colors Controlled By Notching End of Tube

When spreading small amounts of oil colors from a tube you will be able to control the flow more easily if you cut a small notch in the threaded end of the tube. The notch should be shallow so that the cap



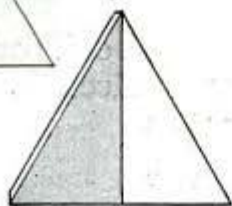
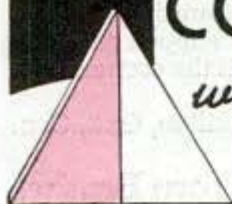
will cover it to prevent drying out the contents. In use, the tube is held vertically so that the color will flow through the notch. The same method can be used for controlling the flow of adhesives or other fluids contained in tubes.

Rubber Disk Used as a Glove For Handling Glass

Large sheets of glass will be less likely to slip out of your grasp or to cut your hands if you use a rubber disk in the manner of a glove. The disk, which can be cut from an inner tube, is provided with a thumbhole at one side to help keep it in place.—H. R. Wallin, Washington, D. C.

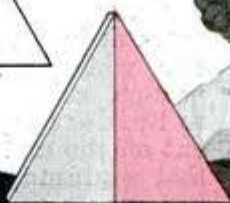


COLOR DESIGNS with Triangle Blocks

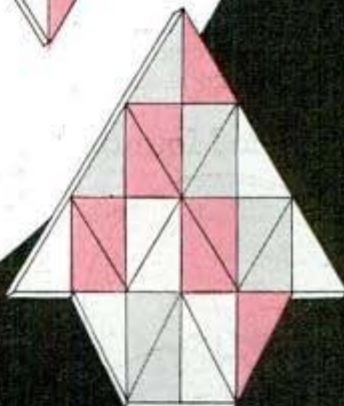
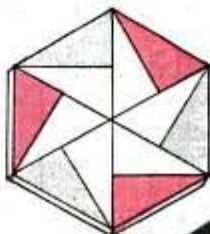
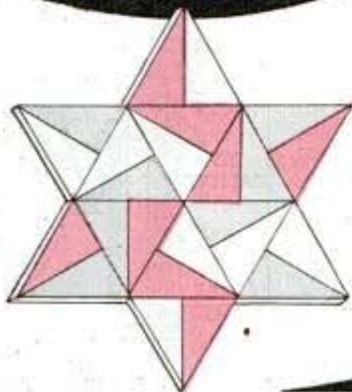
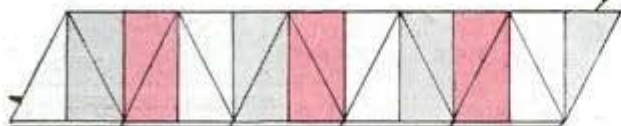
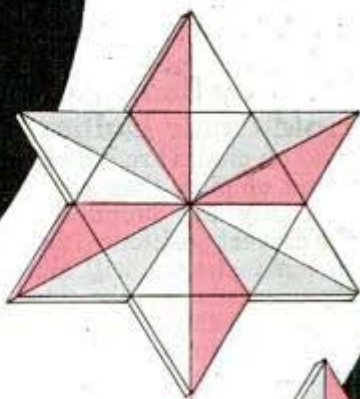
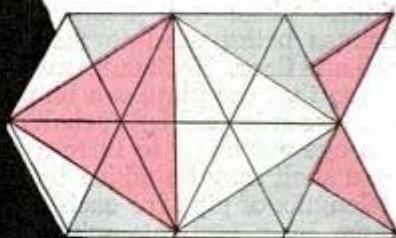


By

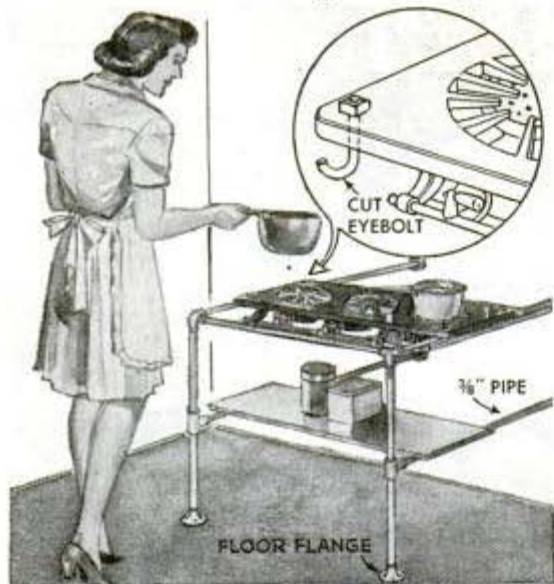
Ralph L. Ralston



TRIANGULAR blocks cut from fiber board or plywood and colored as shown in the upper detail can be used in many ways for practical purposes and for entertainment. As a toy, the blocks will keep children engrossed for hours because the pieces may be combined into stars, arrows, strips and other shapes, the colored portions forming designs within the shapes as illustrated. Mother can use the triangles as suggestions for quilting and Dad may find the blocks a new "wit challenger" not merely as a puzzle but as a pattern for setting tile or in decorating chests and cabinets with inlays. Any number of triangles may be used, although 12 pieces are generally enough for most purposes. The blocks may be of any size, each one being divided by a line running through the apex and perpendicular to the base. Each block is painted red and white, blue and white, or blue and red. Four blocks of each color combination were used in most of the patterns shown here, but any other colors may be substituted.



Gas Hot Plate Mounted on Stand Made From Pipe Fittings



When no stand is available for supporting a hot plate, one can be formed from pipe fittings. These are assembled as shown, flanges being used to fasten the pipe to wall and floor. Horizontal members are spaced so that the plate can be placed on them, where it is held by eyebolts with part of the eye cut away to form a hook. If desired, a shelf may be added by using two short lengths of pipe for each leg and joining them by a tee, into which cross members are screwed.

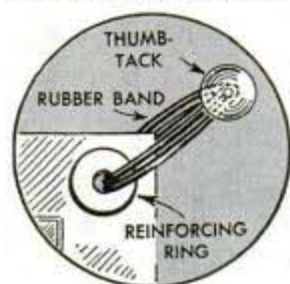
R. E. Murray, Fremont, Ohio.

Pins Replaced by Snap Fasteners To Hold Chair Doilies

If doilies used on chairs are held by snap fasteners instead of pins, they can be removed more easily for laundering and replaced in the correct position without difficulty. Also, the fasteners will eliminate the possibility of scratching the fingers of children who play on the chairs. One part of a fastener is sewed to each corner of the doily and the other part is sewed in position on the chair.

Beatrice E. Reese, St. Petersburg, Fla.

Flexible Mounting for Wall Maps



Large maps or plans tacked to a wall expand during humid weather and become limp. Tightening and retacking them when in this condition does not effect permanent

improvement as the contraction on drying enlarges the tack holes. Mounting the map with short rubber bands slipped through gummed reinforcements at the corners will keep it taut and smooth.

D. H. Matheson, Hamilton, Ont., Can.

Cutting Off End of Worn Brushes Exposes Serviceable Bristles

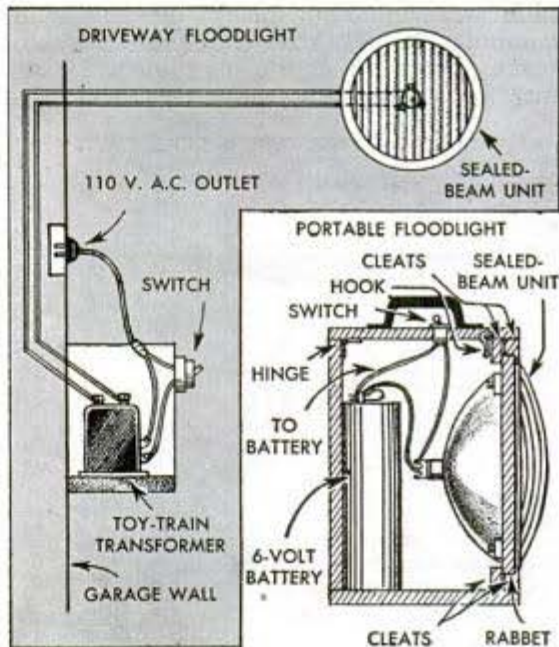
When wire brushes become worn at the outer end, which is the portion subjected to hardest wear, cut off the end so that undamaged bristles are exposed. The end of the wooden back should be sized with glue or several coats of shellac to prevent moisture absorption.



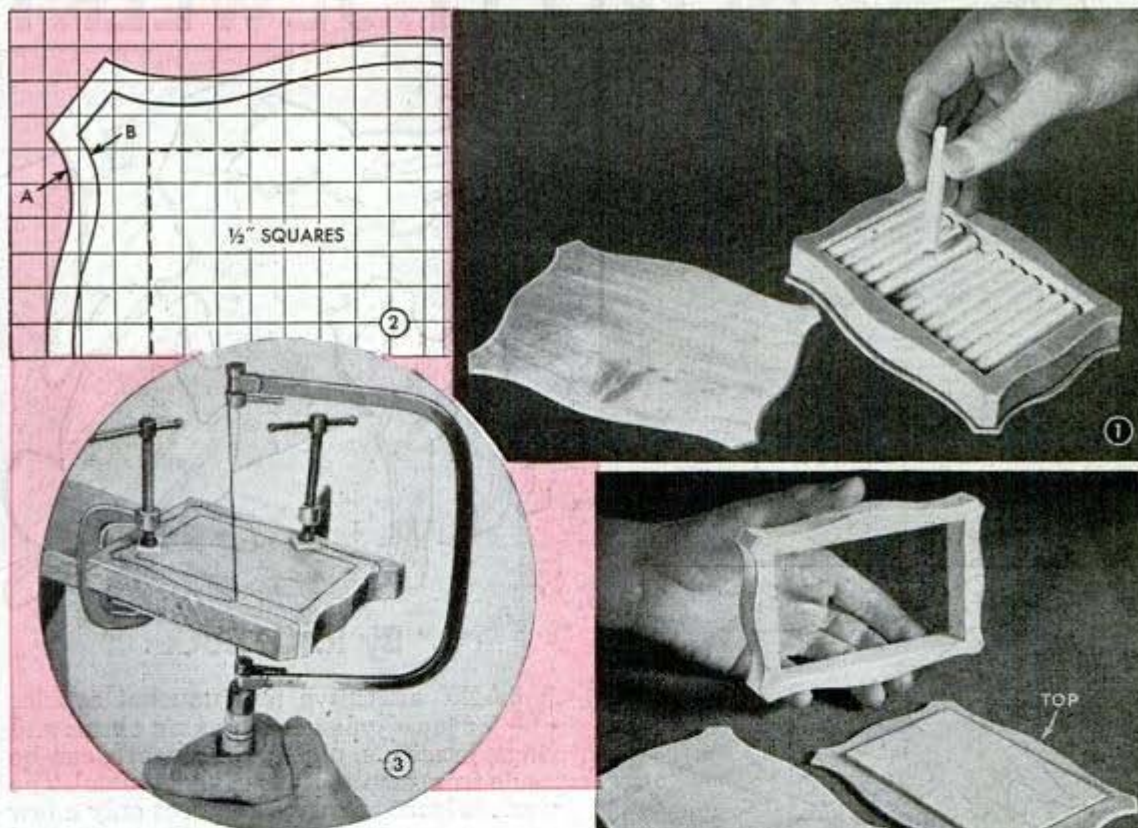
Old Sealed-Beam Lights Used As 6-Volt Floodlamps

Instead of discarding sealed-beam auto headlights when one of the filaments burns out, you can use them to make a driveway floodlight and a portable lamp. For the former, a transformer is used. This is connected as shown, and the light is attached to a garage wall or a conveniently located post. The portable lamp unit is enclosed in a plywood or scrap-wood box with a hinged lid held by a hook. The lamp is battery-operated and is controlled by a toggle switch, which can be located under a handle taken from an old suitcase.

O. Kelly, East Greenbush, N. Y.



Three-Piece Cigarette Box Is Sawed to Shape



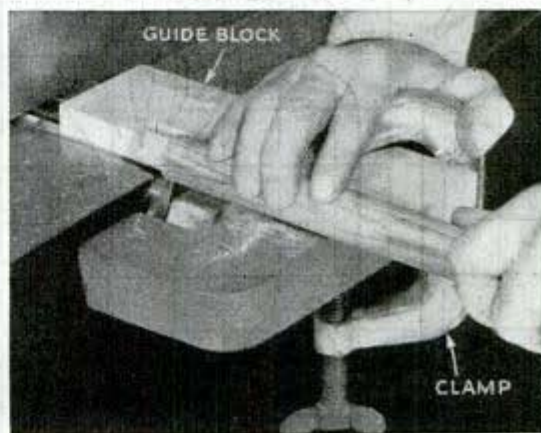
This neat box, which is large enough to hold two layers of regular-size cigarettes as shown in Fig. 1, is exceptionally attractive when made of walnut or mahogany. Top and bottom pieces are of $\frac{1}{8}$ -in. stock, and are jigsawed to the shape represented by line A of Fig. 2. The body of the box is made of $\frac{5}{8}$ -in. stock, and is marked off according to line B, Fig. 2, after which it is jigsawed to shape as in Fig. 3. From this piece a rectangular cutout, shown by the dotted line in Fig. 2, is made to take the cigarettes. For king-size cigarettes, the

width can be increased. To form a shoulder on the top, a rectangular piece is cut to fit into the cutout of the body and positioned as in Fig. 4, after which all parts are glued together. The box is sanded smooth and finished by staining and varnishing, then rubbed down with fine steel wool or pumice and oil.—Charles and Bertram Brownold, Woodmere, N. Y.

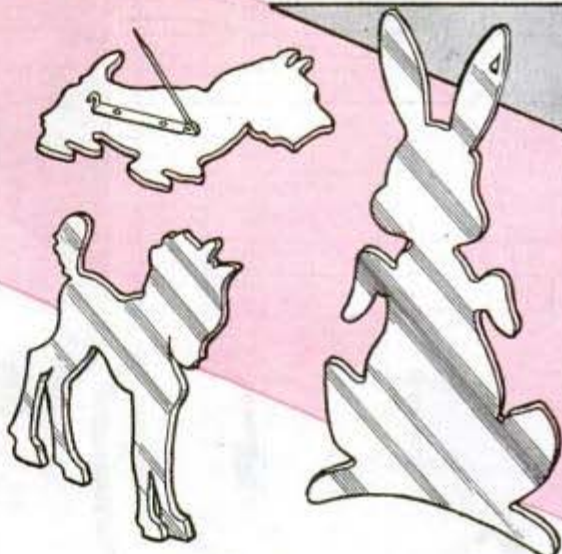
Tenons at Ends of Round Work Cut Quickly on Jointer

Lacking other means, smooth tenons can be cut on round stock by working the wood on a jointer. A wooden guide block clamped to the jointer table serves both as guide and stop. The work is pushed along the guide and into the cutter until it is stopped by a shoulder on the guide block, after which it is rotated slowly in the same direction as that of the cutterhead.

☐ If a house is to be unoccupied during the winter months, drain the plumbing system and pour light oil or kerosene into the drain traps. Kerosene does not freeze, and will take the place of water in preventing seepage of sewer gas into the house.



NOVELTY JEWELRY

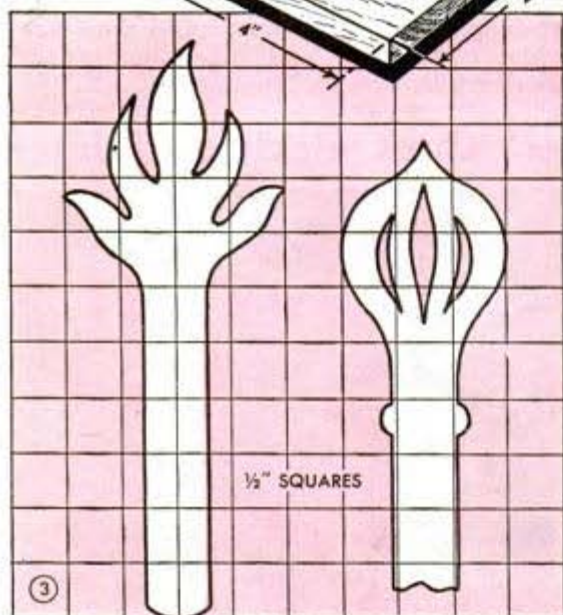
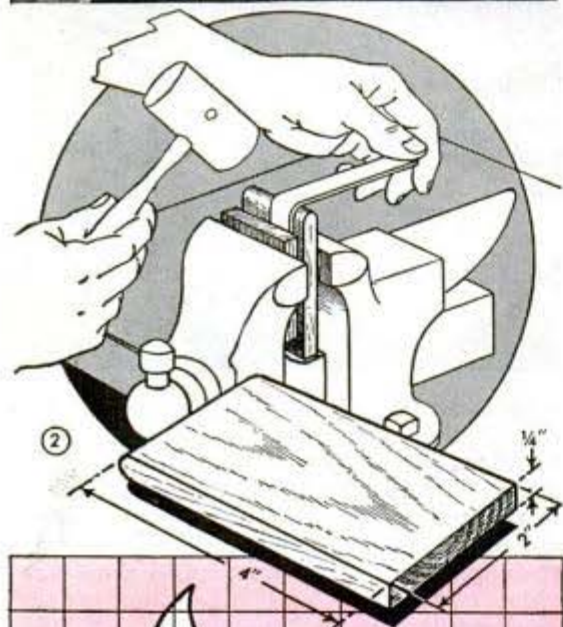


By R. O. Buck

MANY attractive and unusual articles of jewelry, such as napkin clasps and rings, bracelets, pins and brooches, can be made from small pieces of sheet metal. The work is learned easily, requires only a few common hand tools and provides unlimited opportunity for originality in design. Novelty jewelry makes an ideal gift and for this reason it finds a ready market wherever souvenirs are in demand.

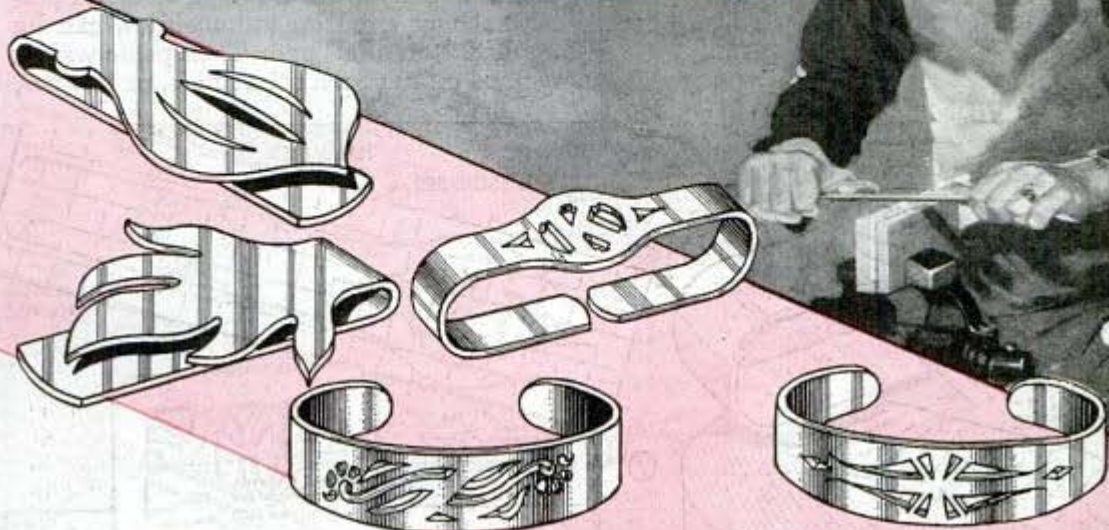
Materials: Half-hard aluminum, soft brass, cold-rolled copper, German silver, nickel and many other metals and alloys are suitable, the thickness, or gauge, of the metal depending on the article to be made. For napkin clasps and rings, 16-gauge metal is suitable, but for pins and other ornamental items, metal as light as 36 gauge, which is a little less than $\frac{1}{64}$ in., can be used.

Napkin clasps: These popular and useful articles not only are the easiest to make, but illustrate the procedures to be followed in fashioning the more difficult pieces. From a sheet of 16-gauge aluminum or German silver, a strip 2 by $5\frac{1}{4}$ in. is cut with tin snips as in Fig. 13. A design such as one of those shown in Fig. 3 is drawn on paper, which is cemented to the metal strip. Shellac or rubber cement can be used as an adhesive. When this has dried, the metal is trimmed down roughly to the shape of the design, then scrollsawed to finish size. For sawing, a notched and slotted board is used as in Fig. 1. The board is clamped to the workbench and the metal is positioned so that the lines to be sawed are over the notched cutout. The work should be held firmly on the cutting board



from SHEET METAL

Servicemen especially will find that crafting jewelry from metal not only solves the gift problem, but also offers a profitable recreation

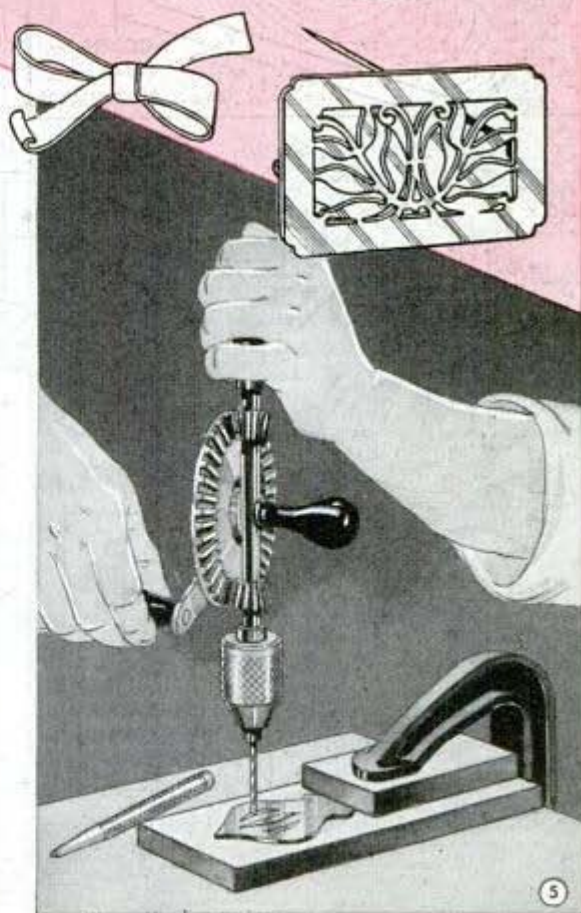


Photos courtesy United Service Organization, Chicago

to prevent vibration while being sawed, as this may cause the blade to break. With the blade teeth pointing toward the handle, the saw is tilted forward slightly except when cutting a sharp corner. This must be done slowly to allow the blade to clear away enough stock to turn without binding or breaking. Wax rubbed on the blade will serve as a lubricant so that it will cut freely.

When using a design like that shown in the right-hand detail of Fig. 3, portions of the metal must be sawed out. This is done by first drilling small holes through which the saw blade can be inserted. The work is clamped between two wood blocks as in Fig. 5 so that the drill will cut through the metal without damaging the workbench. The locations of the holes should be center-punched before drilling so that the drill will not slip out of place and scratch the metal.

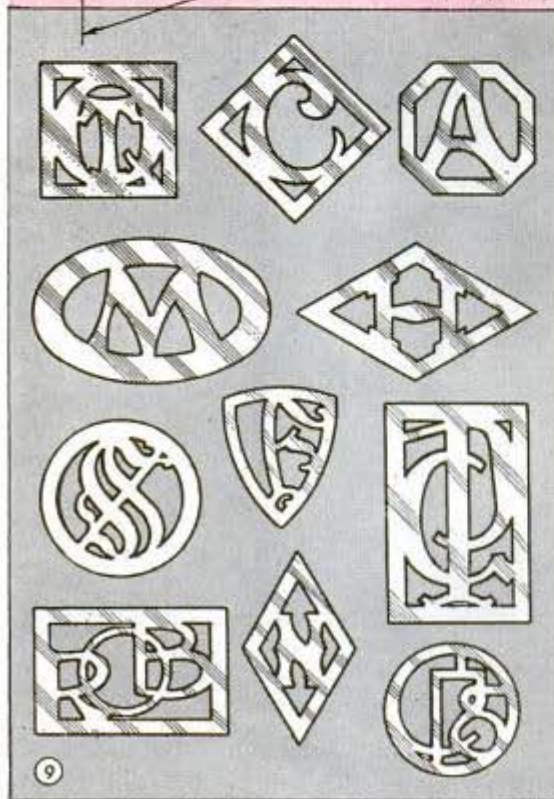
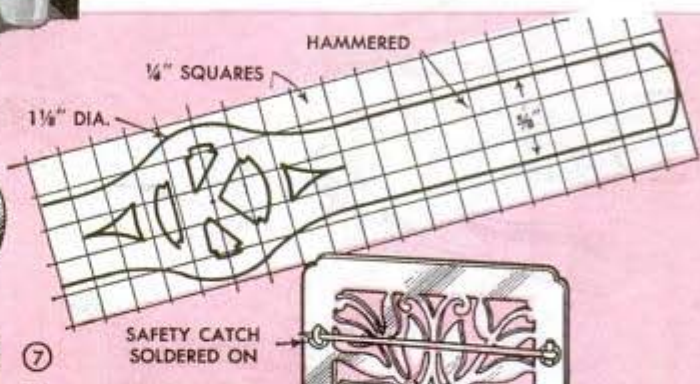
After all sawing has been done, the edges are smoothed by draw-filing. The work is held in a vise between two blocks of wood, which are placed about $\frac{1}{8}$ in. below the edge of the work in order to give greatest support to it. A small mill file then is gripped with both hands and drawn flat in one direction only along the edge of the





metal, Fig. 4. Because aluminum and other soft metals clog a file quickly, chalk should be rubbed on the file frequently to prevent its filling up. When all edges have been filed smooth, they should be rubbed down with a strip of medium emery cloth followed by a strip of No. 0 cloth.

The metal is polished with a fine abrasive such as powdered pumice or ordinary kitchen scouring preparations applied with a damp cloth. Fine steel wool can be used to produce a dull, rich finish, but for a bright luster jeweler's rouge, or metal polish such as used on automobiles, can be applied with a felt pad. Then paste wax is rubbed on to protect the finish, or lacquer,

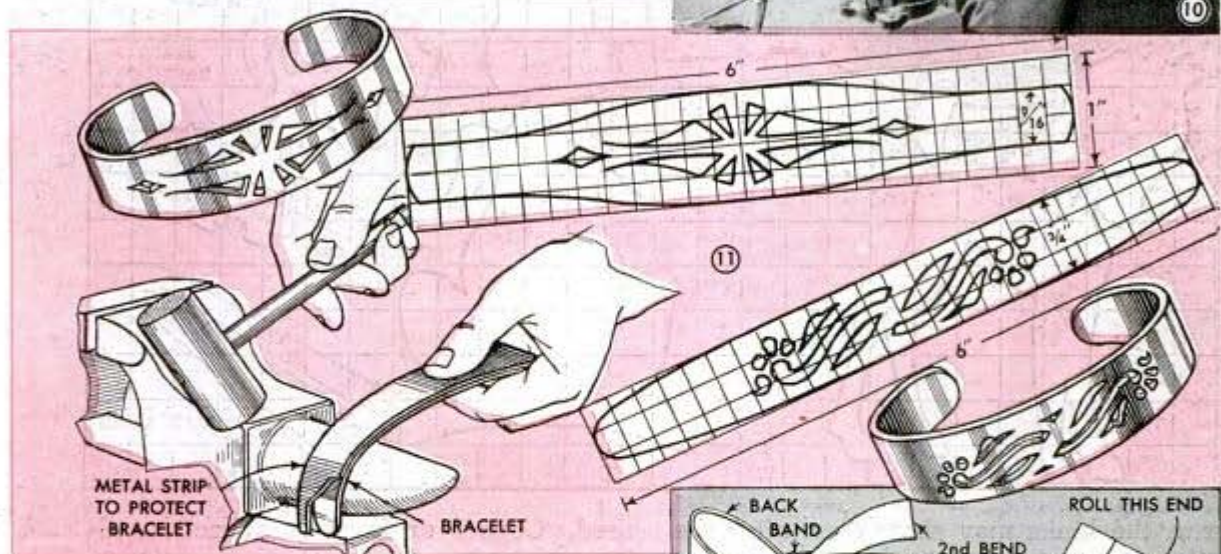


which is more durable, is applied with a small brush, Fig. 6.

To shape the clasp, the scrolled end is clamped between two blocks in a vise as in Fig. 2, the end of one block being rounded to assure a uniform curve when the metal is bent over it. When shaping the clasp push down gradually with one hand and at the same time tap it lightly with a mallet.

Napkin ring: The napkin ring, Fig. 7, is made in the same way as the clasps, although a differently shaped forming block is used. Monograms and initials, which may be varied to suit individual requirements for decorating the ring, are illustrated in Fig. 9. Before shaping and polishing the ring, its entire surface, or a

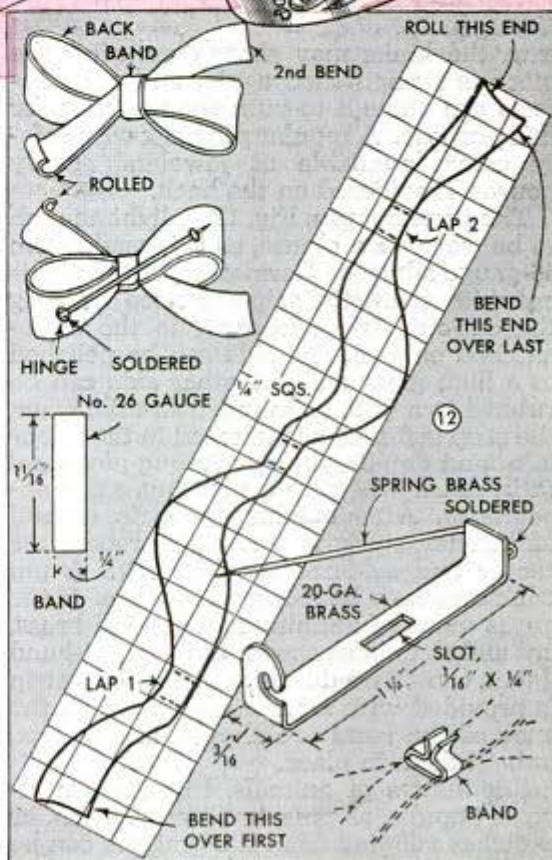
small portion of it, can be hammered to produce a pleasing effect. This is done by tapping the surface lightly with a ball-peen hammer, or by indenting the surface with a punch made by rounding one end of a short length of $\frac{3}{8}$ -in. dowel. To bend the ring, a line is marked on one side of the forming block across its center, and the strip of metal, after being scrollsawed, filed and polished as previously explained, is positioned over it so that half its length extends on each side of the line. The strip, of course, must be aligned carefully along the edges of the block so that, when bent, the ends will meet exactly. Then the strip is covered with a small wooden block and

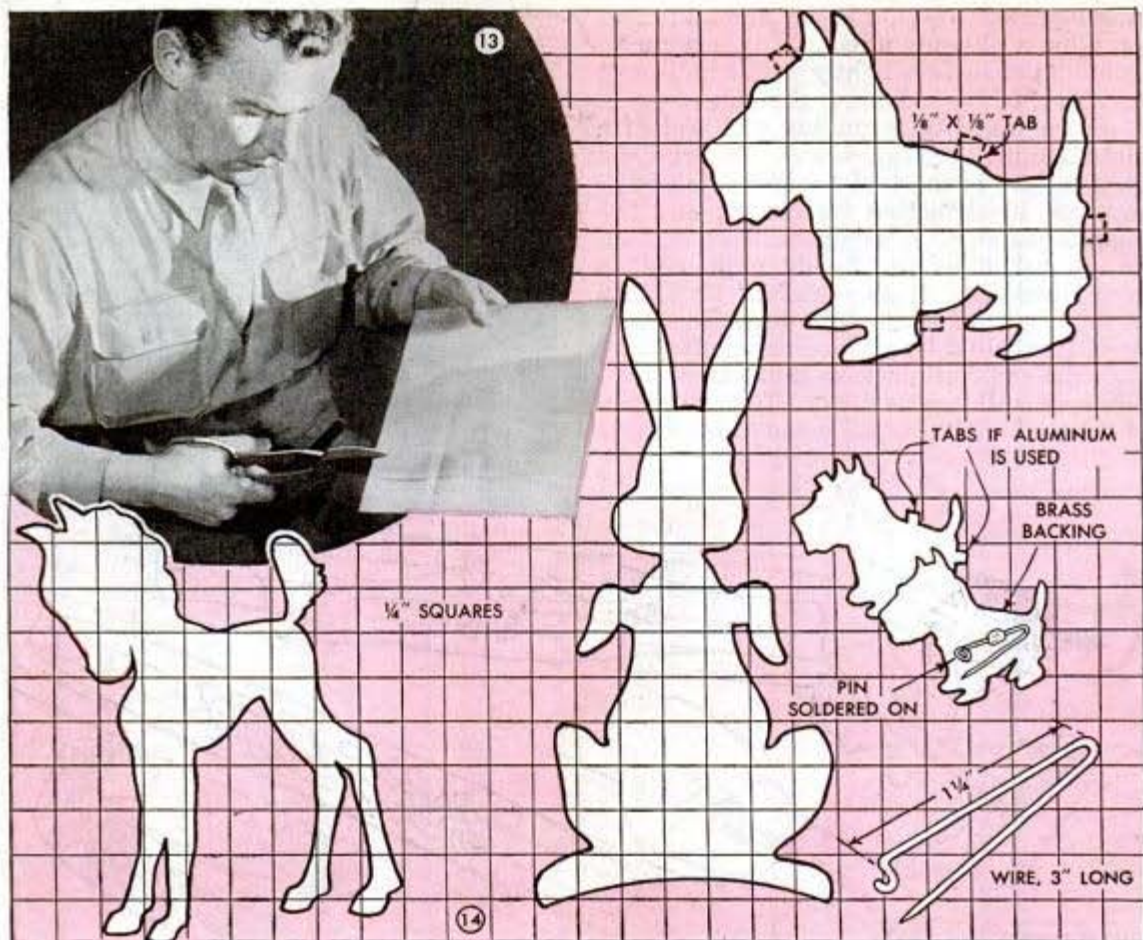


clamps are tightened over the work, after which the ends are bent and tapped with a mallet until the ring is completely formed.

Filigreed bracelets: Although they are made in much the same way as the napkin rings, the bracelets shown in Fig. 11 require a little more experience because of the intricacy of their designs and the small portions to be sawed out. Nickel or German silver is preferable to brass, copper or aluminum for making bracelets. These are formed over the end of an anvil as in Fig. 10. When doing this work, care must be taken to avoid distorting the web pieces of the design. For this reason, a thin metal strip is laid over the work to protect it while it is tapped with a mallet, as indicated in the lower left-hand detail of Fig. 11.

Pins and brooches: Several kinds of pins and brooches are shown in Figs. 8, 12 and 14. For the filigree-type brooch, Fig. 8, 20-gauge silver or German silver is suitable. When sawing metal of this thickness, it is best to use the slotted end of the sawing board shown in Fig. 1, rather than the notched end, so that the work will be well supported. If the piece buckles under the





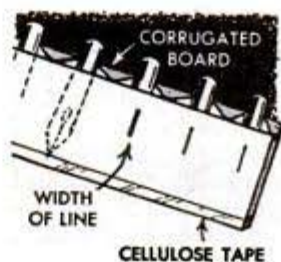
saw, the kinks may show even after the piece is straightened again, and such defects are enough to ruin the material for this purpose. A regular pin back with safety catch, available at jewelers' supply houses, is soldered on the back.

The bowknot pin, Fig. 12, is light enough to be worn on a blouse, as it is made from 36-gauge silver or German silver, which is cut with small tin snips. Before bending the cut-out strip according to the cross-hatched pattern, one side can be polished to a high gloss and the other side can be rubbed to a dull, satin finish so that, when the strip is folded as indicated in the upper left-hand details, the alternating gloss and satin finish will give a pleasing, silky appearance. After bending the strip, a band of heavier stock is wrapped around the center and soldered at the back. A pin back may now be soldered in place. If the pin is made of aluminum, a strip of brass, cut and shaped as shown in the right-hand detail, can be used instead. The brass strip is provided with a slot through which the ends of the band are slipped and peened to hold them in place.

Silhouettes of animals, Fig. 14, are always popular as pins, but trees, leaves, or sketches adapted from illustrations can be

used. Copper or brass is attractive, although aluminum also is satisfactory. However, if aluminum is used the pin fastening cannot be soldered to the back unless special solder is used. Instead, tabs should be provided for folding over a brass backing to which the pin can be attached, as indicated in the right-hand details of Fig. 14. If a pin back or pin mounting is not available, one can be improvised from a length of spring wire, or an ordinary safety pin may be substituted.

Inked Lines Show Width of Pens Held in Corrugated Board

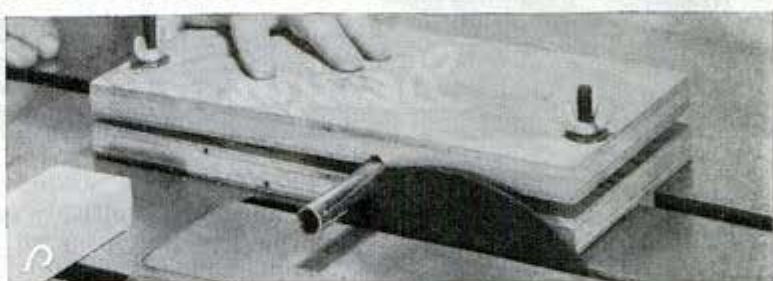


Artists will find that a strip of corrugated cardboard sealed at the bottom edge is an excellent means of holding an assortment of lettering pens. By drawing a line with each pen on the outside of the pocket in which it is held, the proper point can be selected merely by glancing at the strip.

Thomas J. Mahan, East St. Louis, Ill.

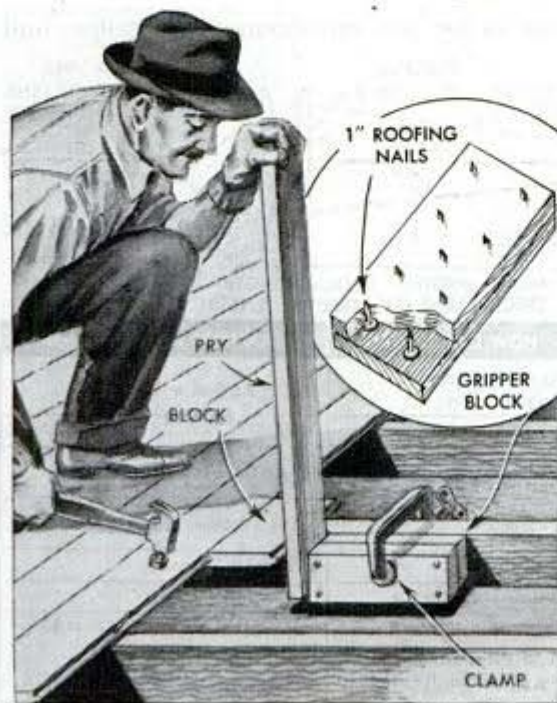
Jig Holds Irregularly Shaped Work for Sawing

With this jig, it is possible to hold work of irregular shape safely and cut it accurately on a circular saw. It is especially handy in gripping disks to be cut as in the upper photo, or for holding rods and tubes to be cut off as in the lower photo. The jig consists of two blocks of $\frac{3}{4}$ -in. plywood held together by two carriage bolts, the heads of the bolts being countersunk into the lower block. The jig is guided straight across the saw table by a strip nailed to the underside of the lower block to slide in the miter-gauge groove in the table. If the jig is used to grip cylindrical work, such as rods and tubes, two V-grooves, one above the other, should be cut across the inner faces of the blocks to hold the work.



Gripper Block Assures Tight Seams When Laying Floor

When laying a new floor where a sub-floor is not used, this gripper block will provide a rigid stop for a pry bar used to force warped flooring boards into position



before nailing them. The block is made from two $\frac{3}{4}$ -in. pieces, one of which is drilled to take roofing nails that project through it slightly. The other piece is screwed in place over the nail heads to hold them. In use, the block is attached to a joist with a C-clamp so that the projecting ends of the nails sink into the joist to prevent slipping. A piece of 2 by 4-in. stock about 3 ft. long is used as a pry bar. To avoid damaging the tongue or groove on a floor board, place a short block of flooring between the pry bar and the board.

Harold Jackson, Kankakee, Ill.

Part of Tennis Ball Used as Shield Over Greasy Trailer Hitch

By cutting off about one third of an old tennis ball and using the remainder as a cup to be slipped over the metal ball of an auto-trailer hitch, you can keep your hands and clothing from becoming soiled by accidentally brushing against these parts. Also, the tennis ball will be a shield against rain and weather and help prevent rusting.

A. W. Skerry, Pomona, Calif.

Door hinges can be kept from squeaking by an application of powdered graphite.



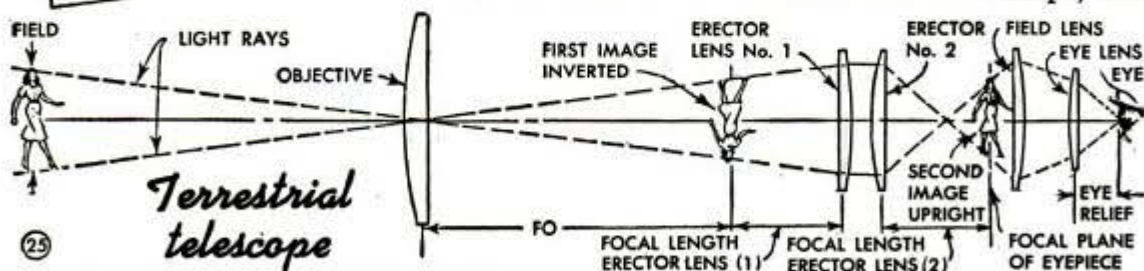
Design and Construction

24

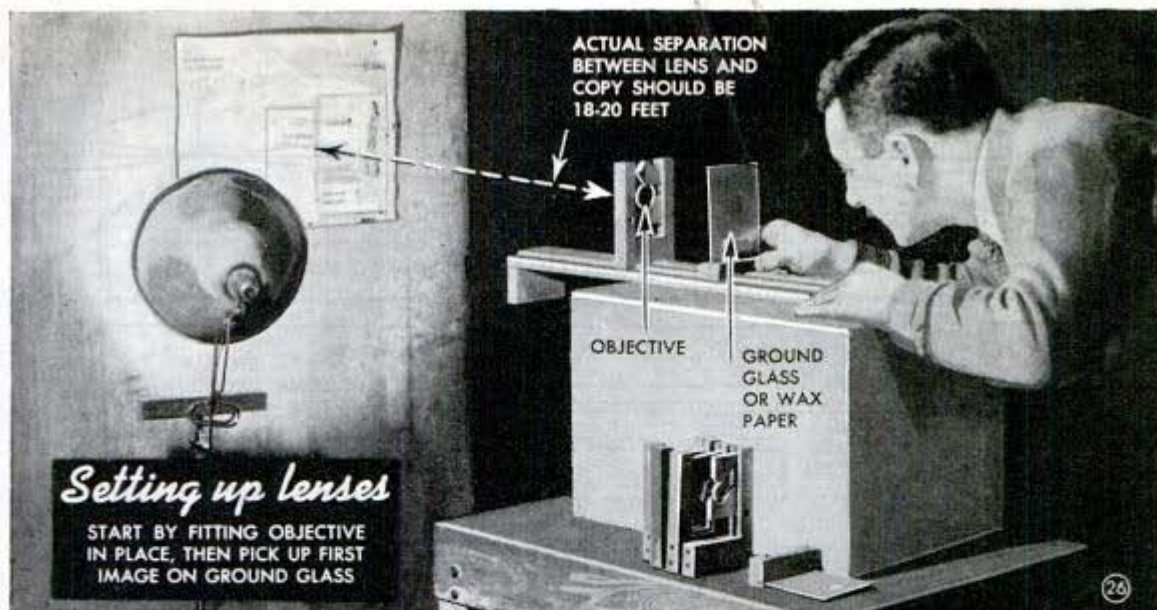
IMAGE SIZE (40° APPARENT FIELD)			
M	Factor	M	Factor
8X	.087	17X	.042
9X	.077	18X	.038
10X	.070	19X	.036
11X	.063	20X	.035
12X	.058	21X	.033
13X	.054	22X	.031
14X	.049	24X	.029
15X	.047	26X	.026
16X	.044	28X	.024

IF YOU made one of the telescopes described last month, you already are familiar with the basic information necessary to construct a terrestrial telescope, which is one for viewing objects on land. Obviously, it must show an upright image, and in order to do this with the astronomical telescope already described, it is necessary to add two lenses between the objective and eyepiece, as in Fig. 25. This type of erecting system permits added magnification through the erectors.

Normal lens system: This also is shown in Fig. 25. The field lens and eye lens making up the eyepiece are the same as for the astronomical telescope, and



CHARACTERISTIC	NORMAL VALUE	HOW CALCULATED	EXAMPLE, 11X (from text)
1 Equivalent focus of objective	1 to 3 times focal length of objective	FO times erector magnification	$132 \times 2 = 264$ mm.
2 Erector magnification	1X to 3X	$E-2 \div E-1$	$80 \div 41 = 2X$
3 Magnification	13 times DO (in inches)	FO or equivalent FO divided by FE	$264 \div 24 = 11X$
4 First image size	$\frac{1}{4}$ " to $\frac{3}{4}$ "	Value from Fig. 24 times FO	$.063 \times 5.18 = .326 = \frac{3}{16}$ "
5 Exit pupil	2 to 5 mm. ($\frac{1}{16}$ " to $\frac{3}{16}$ ")	DO \div M	$32 \div 11 = 3$ mm.
6 Eye relief	$\frac{3}{16}$ " (min.) to 1"	Measure direct	$\frac{3}{16}$ " scant
7 Luminosity	10 to 100%	$(DO \div 5)^2 \div M^2$	$(32 \div 5)^2 \div 11^2 = 36 \div 121 = 30\%$
8 Field in yds. at 1,000 yds.	10 to 90 yards depending on magnification	Read value from Fig. 24 as yards (see text)	63 yards (see text)



Setting up lenses

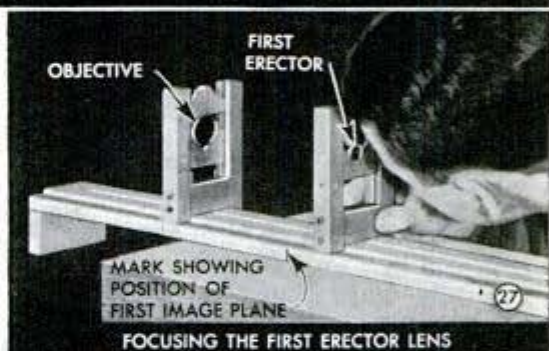
START BY FITTING OBJECTIVE IN PLACE, THEN PICK UP FIRST IMAGE ON GROUND GLASS

of TELESCOPES PART 2 *By Sam Brown*

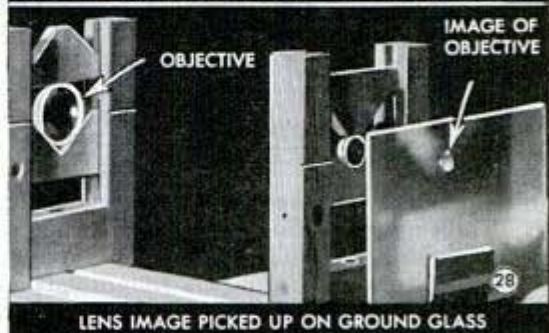
can be Huygenian, Ramsden or Kellner as previously described. The one shown here is a Ramsden. The eyepiece together with the two erectors make an erecting eyepiece, and all four lenses are mounted at a fixed spacing in the draw tube. Fig. 25 shows erectors of equal focal length, spaced at their focal lengths from the two image planes. With this setup, the erectors give unity magnification; that is, they add nothing to the magnification of the system.

Designing your own scope: The best way to make a scope is to design and test your own. First, select suitable lenses, Fig. 32, and run through the simple calculations and other data. Then make a layout, tracing the light rays and, at the same time, check the system on the optical bench. This procedure, using the 11X scope shown in Fig. 23 as an example, will be described in detail. Preliminary calculations are given in the right-hand column of the table.

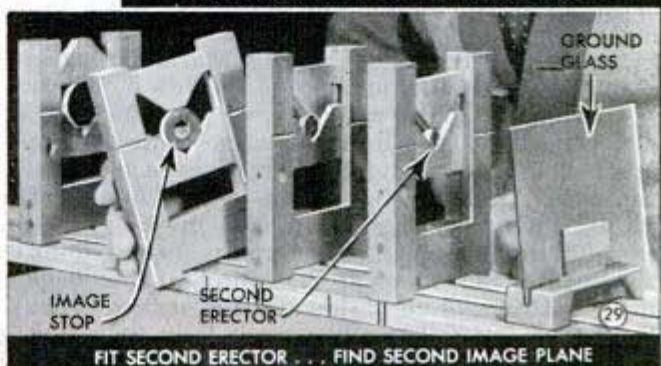
Making the layout: Start the layout as in Fig. 30, drawing a centerline and a line indicating the diameter of the objective. Set up the objective on an optical bench, with test copy about 20 ft. away. Take a piece of ground glass and pull it back from the objective until you get the image in sharp focus, Fig. 26. This image marks the first image plane. Measure the distance from objective to image plane and make a corresponding line on your layout. Next, set up the first erector lens and move it back and forth



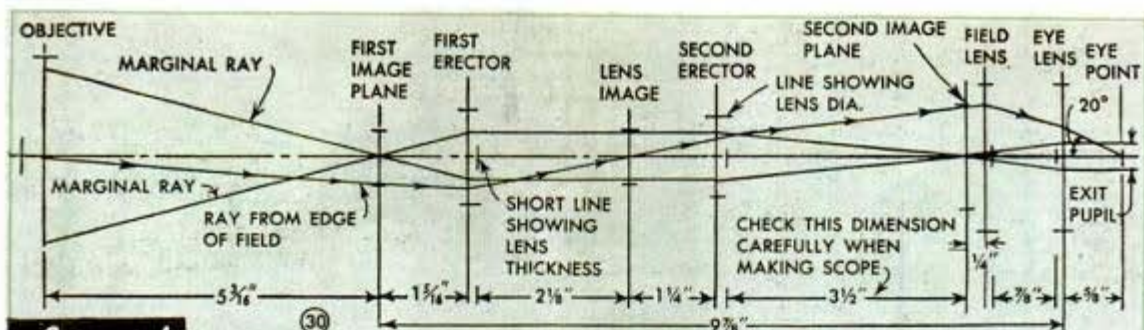
FOCUSING THE FIRST ERECTOR LENS



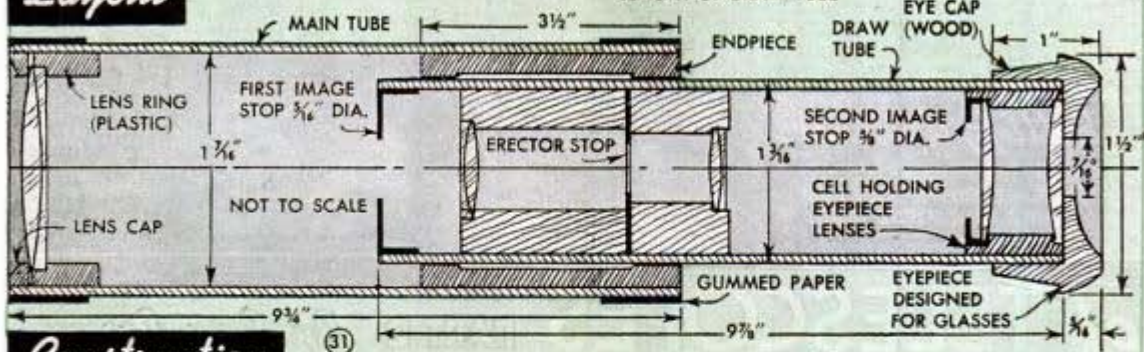
LENS IMAGE PICKED UP ON GROUND GLASS



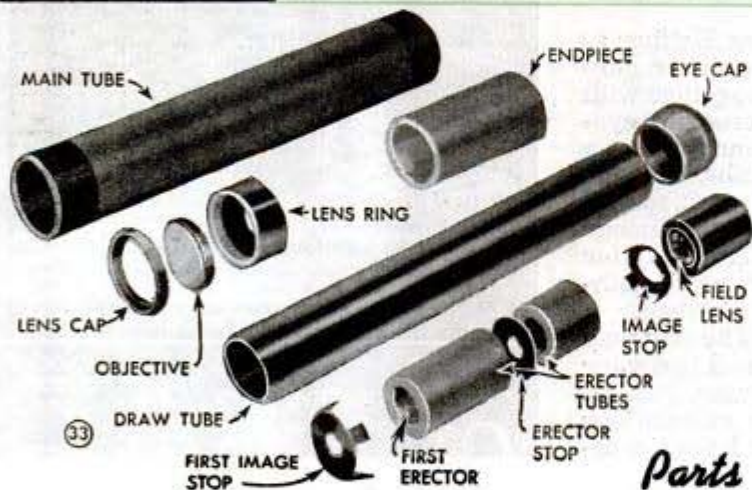
FIT SECOND ERECTOR . . . FIND SECOND IMAGE PLANE



Layout



Construction



32 Lenses

	Inches		MM.	
	Dia.	F.L.	Dia.	F.L.
Objective	1 1/4	5 3/16	32	132
E-1	5/8	1 1/8	15	41
E-2	1/2	3/8	12	80
Field	3/8	1 3/16	22	32
Eye	3/8	1 3/16	22	32

See right col. Fig 25 for other data

11X Terrestrial

This typical scope, ideal for hunting or observation, is used to show method of setting up and checking lens systems.

Parts

until you get the copy in sharp focus, Fig. 27. Then measure the distance from image plane or objective and mark on the layout.

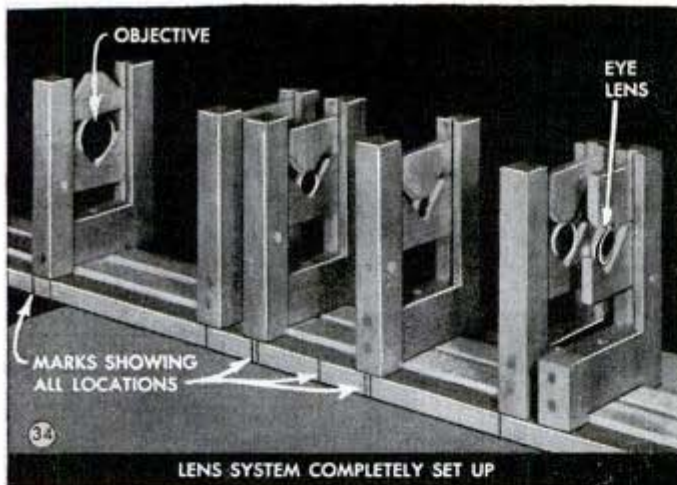
Size of image: Find 11X magnification in Fig. 24, and opposite this read the factor, .063. Apply calculation No. 4, Fig. 25; the answer is 5/16 in., which is the size of the image at the first image plane. Mark the diameter on the layout.

Tracing the light rays: Now, you can draw the light rays from objective to first erector, Fig. 30, using only three rays to represent the extremes, thus embracing all of the many light rays which pass through the telescope. The pair of marginal rays comes to a focus at the center of the image plane and continues until it strikes the first erector. The other ray is from the extreme edge of the field or picture and

will pass through the extreme edge of the same "picture" inside your telescope. The erector lens must be large enough to receive these rays.

Close or spaced erectors: Here you have to decide whether you want the erectors close together or spaced well apart. Either way is suitable. Close spacing has an advantage in compactness, but it also requires longer eye relief. Therefore, it is best to space the erectors farther apart in order to shorten eye relief.

Lens image: In wide spacing, there will be an image of the objective lens between the erectors, and in close spacing, the image will be behind the second erector. The next step is to find this lens image. Use the ground glass and move it up behind the first erector until you get a circle of



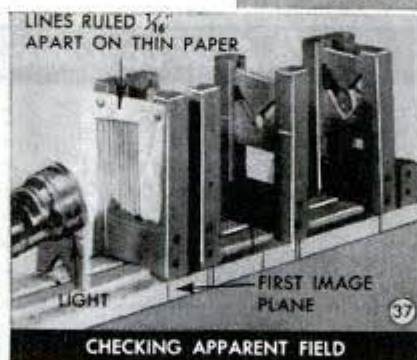
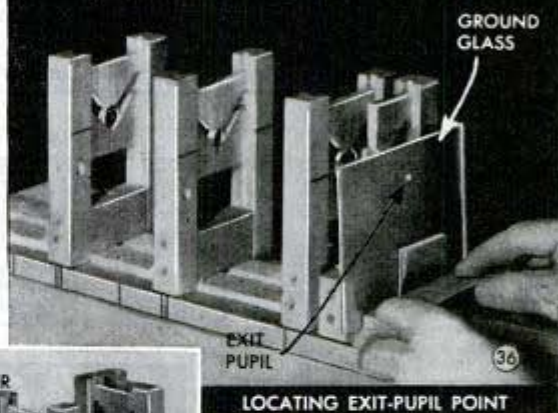
LENS SYSTEM COMPLETELY SET UP



VISUAL CHECK OF MAGNIFICATION

light in sharp focus as in Fig. 28. This is the lens image. Mark its size and position on the layout. Continue the light rays. The marginal rays are parallel with the centerline. Note that since they originally passed through the edge of the objective, they now will pass through the edge of the objective image. Similarly, the ray from the edge of the field, which originally passed through the center of the objective, now passes through the center of the objective image. These rays continue until they strike the second erector. To favor the small second erector, it is placed about $1\frac{1}{4}$ in. behind the lens image.

The second image: Put the ground glass behind the second erector and pull it back until you get a sharp image of the copy. This is the second image plane, and will be upright. Indicate its position on the layout and make a ring of cardboard with a central hole the same size as the first image, which is $\frac{5}{16}$ in. Mount this disk at the first image plane as in Fig. 29. Since you are using 2X magnification through the erectors, the image on the ground glass at the second image plane should be about $\frac{5}{8}$ in. in diameter. Mark the diameter on the layout. Set up the eyepiece and focus. Mark the position of field and eye lenses on the layout. Continue the light rays from the second erector, through the second image, to the field lens. Fig. 34 shows the complete setup on an optical bench. On the layout, you now work from the eye end to complete the ray tracing. Find the exit-pupil point, Fig. 36. Mark this point on the layout and draw a line from it to the eye-lens line at an angle of 20 deg. to the centerline. Connect this point on the eye lens with the end of the



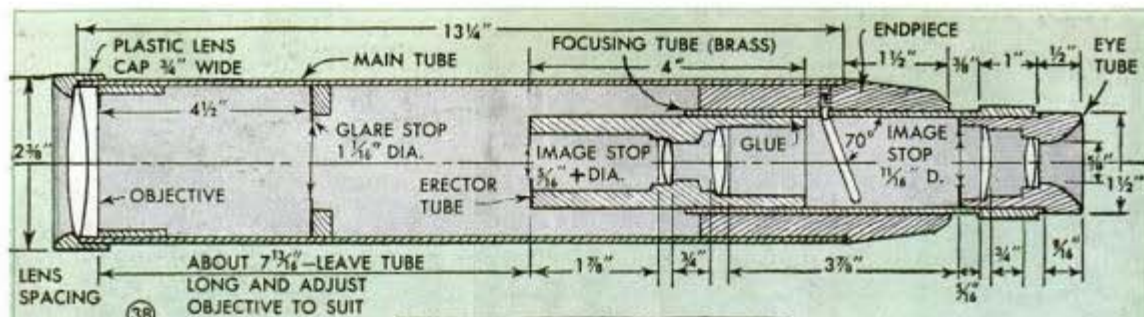
CHECKING APPARENT FIELD

edge-of-field ray at the field lens. Measure the diameter of the exit pupil and draw lines parallel with the centerline, connecting them with the ends of marginal rays at the field lens.

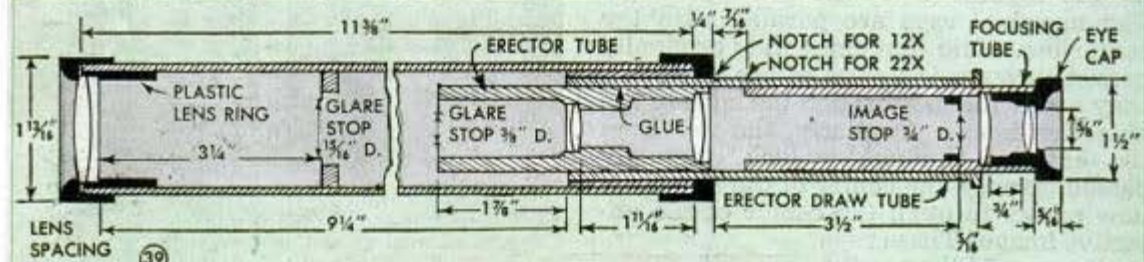
Mechanical construction: This is shown in

Figs. 31 and 33. Two tubes are used; one houses the objective and the other carries the erecting eyepiece. The hole in the eye cap is determined by the 20-deg. line on the layout. The depth of the eye cap should be such as to set the proper eye relief. The one shown is shallow for use with eye glasses. The scope as set up is focused at 20 ft., which represents the longest extension required.

Visual check of magnification: Make a visual test by looking through the telescope with one eye and directly at the copy with the other eye, Fig. 35. You will see the two views one over the other. Note sizes; that is, so many lines of copy as seen by scope covers the full sheet of copy as seen by eye. Now measure the two distances. In this particular case, $1\frac{3}{4}$ in. of copy seen through the scope covers the full height of



LENSES					14x Spiral focusing			TUBES			
	Millimeters		Inches		Combined focus of eyepiece = $\frac{45 \times 38}{45 + 38 - 19} = 27$ mm.	Main	Dia.	Length	Erector	Dia.	Length
	Dia.	Focus	Dia.	Focus							
Objective	52	193	2.04	7.60	Erector magnification = $95 \div 49 = 1.9X$		2 1/4" I.D.	13 1/4"			
Erector 1	18	49	.71	1.93	Equiv. focus of objective = $193 \times 1.9 = 367$ mm.				1 3/8" O.D.	4"	
Erector 2	25	95	.98	3.74	Magnification = $367 \div 27 = 13 1/2 X$				2 1/4" O.D.	3 3/8"	
Field	26	45	1.02	1.77	Luminosity = 59%				1 3/8" I.D.	5 3/8"	
Eye	17	38	.67	1.49	Field (actual) = 40 yds. at 1,000 yds.				1 1/2" O.D.	1 1/4"	



LENSES					12x to 22x variable			TUBES					
	Millimeters		Inches		Eyepiece: 27 mm. focus Erector magnification: 1.9X Equiv. focus of objective = $181 \times 1.9 = 344$ mm. Magnification = $344 \div 27 = 13X$ normal Luminosity at 12X = 35% Luminosity at 22X = 10% Field (12X): 42 yds. at 1,000 yds. Field (22X): 23 yds. at 1,000 yds. <th rowspan="2">Main</th> <th rowspan="2">Dia.</th> <th rowspan="2">Length</th> <th rowspan="2">Erector</th> <th rowspan="2">Dia.</th> <th rowspan="2">Length</th>	Main	Dia.	Length	Erector	Dia.	Length		
	Dia.	Focus	Dia.	Focus									
Objective	36	181	1.42	7.13			1 11/16" O.D.	11 3/8"					
Other lenses same as scope at top of page. Various styles or powers of eyepieces can be substituted without affecting the general construction									1 3/8" O.D.	3 3/8"			
									*Erector draw	1 3/8" I.D.	6"		
									Focusing	1 3/8" O.D.	4 1/4"		
									Eye cap	1 1/2" O.D.	1 1/4"		

copy, 20 in. Then, 20 divided by 1.75 equals about 12X magnification.

Visual check of field: The field is checked by measuring the width of copy you can see through the scope at 20 ft. Multiply this distance in inches by 4 to get the approximate field in yards at 1000 yards. In this case, the field at 20 ft. measures 14 in., so the field at 1000 yards will be 56 yds. This is a little less than the paper value as determined from calculation No. 8, Fig. 25. No. 8 calculation is based on maintaining a full 40-deg. apparent field, which is not always the case.

Visual check of apparent field: The apparent field angle is the extreme angle which light rays make on reaching the eye; the true field angle is the apparent field angle divided by the magnification. Values given in Fig. 24 take a 40-deg. apparent field for granted. You can make a visual check by ruling lines 1/16 in. apart on a sheet

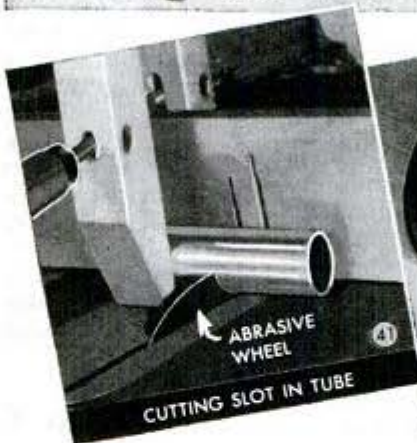
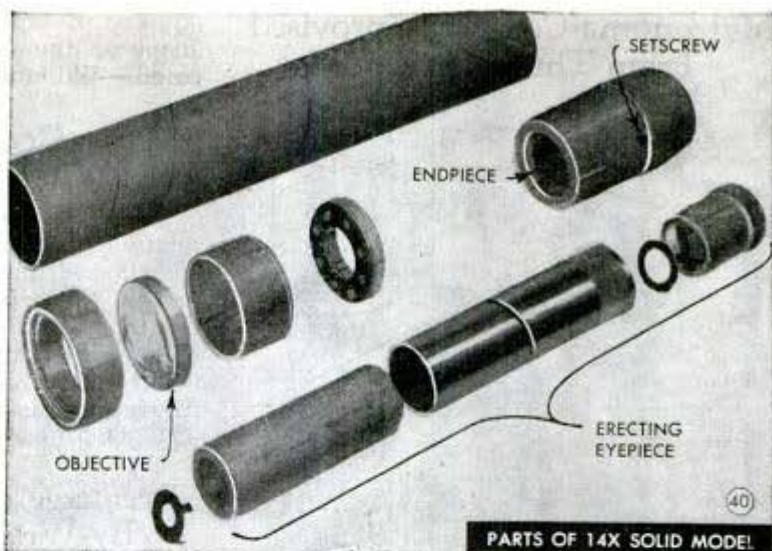
of tracing or other thin paper. Mount this at the first image plane and illuminate it from the objective side, Fig. 37. Count the number of lines you can see through the eyepiece. If the eyepiece is maintaining a 40-deg. field, you should see five lines. Less than this means you are not getting a 40-deg. field, the reason being that erector magnification at the second image plane makes the image too large to be viewed by a normal-size eyepiece. This merely means that the field of view will be somewhat reduced in size and calculation No. 8 cannot then be used.

Luminosity: In daylight, the pupil of your eye is about 5 mm. in diameter. Calculation No. 7, Fig. 25, gives light percentage and is based on 100 percent for a 5-mm. pupil. At night, the pupil of your eye dilates to about 7 mm. To find luminosity of any scope as a night glass, substitute 7 for 5 in the calculation.

Conjugate magnification:

As described, erector magnification is obtained when the second erector is of longer focal length than the first. Another way of getting erector magnification is by setting up the lenses at distances other than their focal lengths. This works exactly like a camera. Consider the first image to be a solid object, such as a person's head. To get a large picture of this object, the camera lens is pushed close to it, at the same time extending the bellows. You do the same thing in a telescope by pushing the first erector closer to the first image plane. This gives a large second image at a distance farther back than the focal length of the second erector. A small amount of conjugate magnification usually is introduced when any lens system is set up by eye; you can deliberately introduce a great amount of magnification in this way. The 11X scope can be pushed up to 30X if desired. However, note that the second image is much too large to be viewed by the eyepiece, with the result that you lose field area, and the increase in magnification means less illumination. Conjugate magnification cannot be calculated by the simple rules given, but it is easily determined visually.

Specific designs: Dimensioned designs are impractical as there is no assurance that you can get tubes and lenses specified. However, such designs are useful as a general guide, and two are shown and briefly described. The first is a 14X spiral-focusing scope, as diagrammed in Fig. 38 and further illustrated by Figs. 23, 40, 41 and 42. It is a solid model and does not telescope. Using the short objectives described in this article, the whole range of focusing from 20 ft. to infinity is very short, averaging $\frac{1}{2}$ in. or less of travel. Hence, it is practical to make a solid scope and confine the focusing to a threaded or spiral-focusing device. This one uses a spiral. It is cut about halfway across the focusing tube, which should be metal or plastic to have the required stiffness. The job is easily



done on a circular saw, using an abrasive wheel, as shown in Fig. 41. A setscrew through the endpiece engages in this slot, permitting a travel of about $\frac{3}{8}$ in. as the focusing tube is turned. The wooden tube in which erectors are mounted is a drive or glued fit inside the focusing tube. Lens spacing is about normal, so that the true magnification is equivalent to DO divided by FE, or 14X. The eyepiece is a modified Kellner, with field lens of slightly longer focus than eye lens.

The second specific design, Figs. 23 and 39, features conjugate magnification. As previously described, high magnification is obtained by pushing the erectors close to the first image; at the same time it is necessary to extend the eyepiece a considerable distance to bring the object into focus. In this scope, the erector draw tube slides inside the main tube and the focusing tube slides inside the erector draw tube. Marks or notches on the erector tube indicate the setting for high or low magnification and the setting can be anywhere between these marks.

(Continued next month)

Metronome Can Be Improvised From Three Tin Cans



Three tin cans and a shutoff cock can be assembled to make a metronome. One of the cans should be a little smaller than the others so that it can be placed within another. The cock is soldered over a hole punched close to the edge of one can, which is partially filled with water and set at the edge of a table. The second can is placed on the floor under it, and the third, which has an air hole punched in the bottom, is inverted and placed within the second. The cock is turned to allow water to drip at the desired frequency and strike the inverted can, which amplifies the sound.—Wm. Riederich, Elmhurst, Ill.

Needle and Thread Guide Wick Through Cigarette Lighter

The usual difficult job of getting a new wick into a cigarette lighter can be simplified if a threaded needle is used as a guide. Sew through the new wick, loop the thread around the end, and secure it tightly. After removing the old wick from the lighter, insert the needle and thread in the wick opening and pull the new wick through, then trim with a pair of scissors.—James D. Callahan, Lincoln, Nebr.

Snap Fasteners on Overshoes Taped to Protect Hose



Adhesive tape will help prevent snags and runs in your hose caused by the snap fasteners on overshoes. Cut small

squares of tape and stick them over the snaps on the inside of the shoes as indicated.—William Swallow, Brooklyn, N. Y.

Shaving Cream Is Good Lubricant When Driving Screws

To avoid temperature difficulties common when wax or soap is used as a lubricant for driving screws, one handyman prefers the brush type shaving cream for the job. Besides being the right consistency at all times, it leaves no stain on the wood into which the screw is driven, and the tube or jar is neat and easy to store.

C. D. Mulcahy, Jr., Las Cruces, N. Mex.

Breakage of Crayons Avoided By Wrapping With Tape

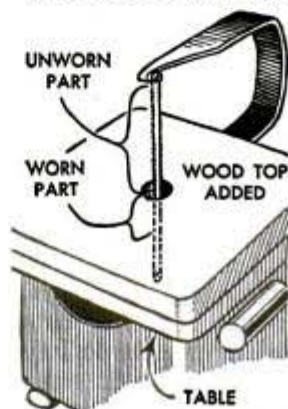
If a small child presses so hard on crayons that they are reduced to short pieces, wind gummed paper tape around them spirally. This reinforcement strengthens the crayons so that they are difficult to break. The tape can be peeled off easily as the crayons wear down.—Benjamin Nielsen, Aurora, Nebr.



Code to Type Secret Messages

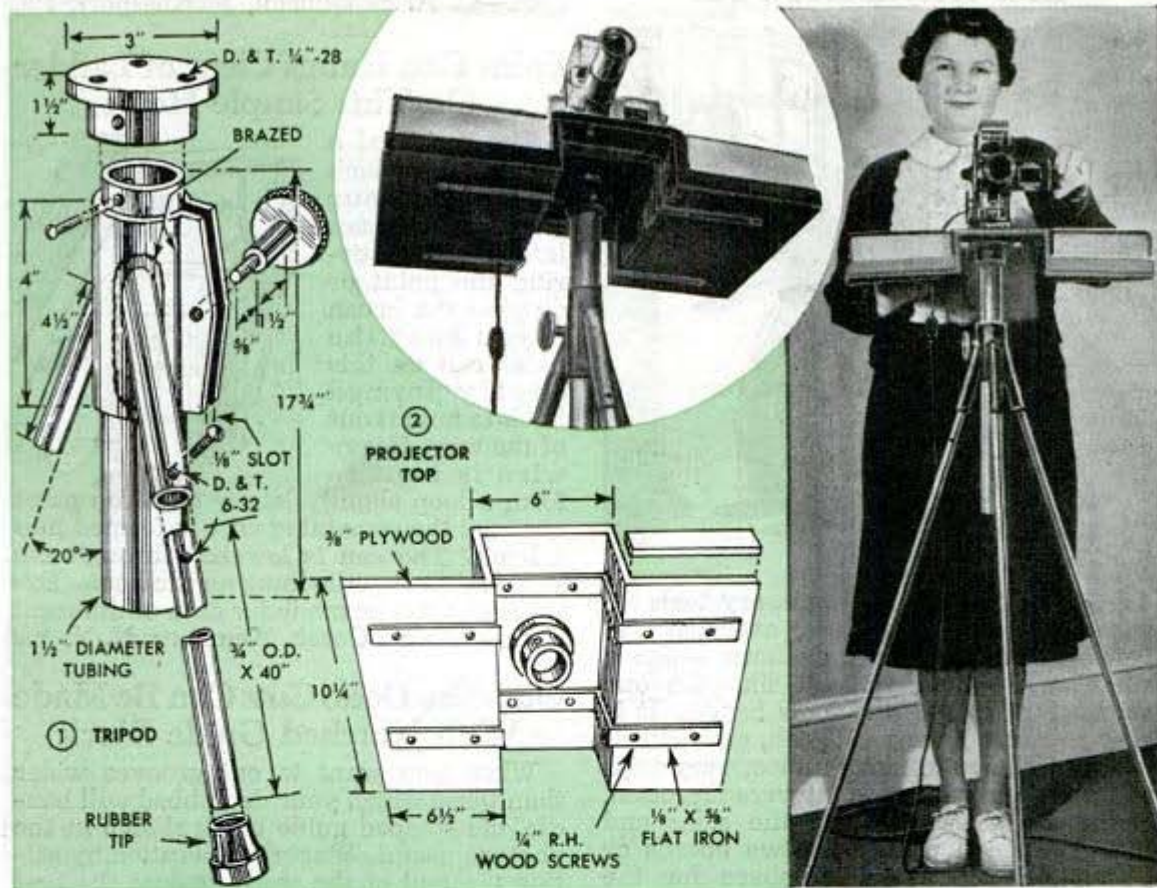
Anyone using the touch system of typewriting can write secret messages easily by simply shifting the hands one key to the right, and then operating the machine in the usual manner. As an example, the familiar phrase, "Now is the time for all good men," would appear "Mpe od yjr yo,r gpt s;; hppf ,rm/" To transpose, the operator uses the "hunt and punch" system, but strikes the key to the left of the letter in the message.

Table of Magnetic Jigsaw Raised To Use Unworn Teeth of Blade



When the lower portion of the blade on a magnetic jigsaw becomes dull, add a wooden top to the table so that unworn teeth, higher on the blade, will contact the work. The top is trimmed to fit, and a hole is drilled for the blade.

Metal-Tube Tripod for Color-Slide Projector



Designed for use when projecting color slides, this sturdy tripod is adjustable in height and may also be used with a movie projector. It has a wide top or platform on which there is ample space for the projector and two boxes of slides or other equipment. The tripod can be made from any corrosion resistant tubing such as brass, aluminum, duralumin, etc., and is assembled as in Fig. 1. A main or center tube that carries the head slides inside an adjustment clamp to which leg sockets are brazed. The head is turned to the size and shape indicated, and is held in the upper end of the tube by a setscrew. A 4-in. length of 1 1/2-in. tubing with a 1/8-in. slot cut in it between two pieces of flat iron which have been brazed on as shown serves as the adjustment clamp. The flat pieces are drilled and tapped for a thumbscrew for tightening. After the clamp has been completed, the leg sockets of 3/4-in. I.D. tubing are brazed to it at angles of 20 degrees. The sockets are spaced equally and are drilled and tapped at their lower ends for setscrews, which hold the legs in place. These are 40-in. lengths of 3/4-in. O.D. tubing, which have rubber crutch tips slipped over the lower ends. The projector top

or platform completes the job, and is assembled from plywood and flat-iron strips and screwed to the tripod head as indicated in Fig. 2. For a neat appearance give the clamp and leg sockets a black crackle finish and glue green felt on the projector top.—Alfred Harth, Chicago.

Battery Tester for Photoflash Gun

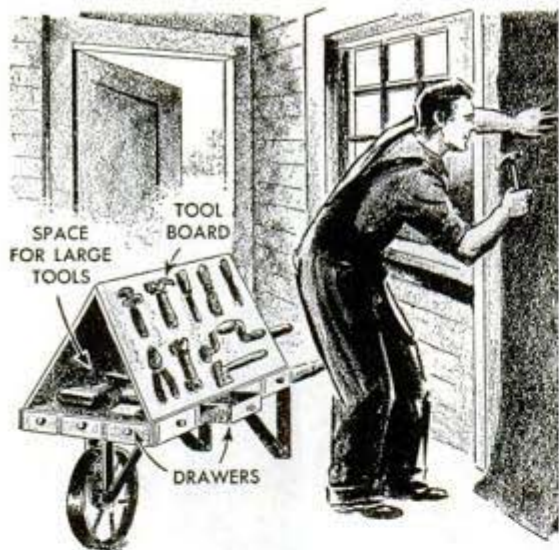
A tester for dry cells used in a photoflash gun can be improvised from a flashlight bulb, a short length of extension cord and two rubber plugs. One wire of the cord is soldered to the center terminal of the bulb and the other to the threaded base, after which the cord is inserted through the neck of the male plug and fastened to the screw posts. By pulling the cord tight, the bulb will seat itself in the neck of the plug. The plugs then are assembled and screwed into the gun case.



George T. Lundeen, Madison, Wis.

☞ The glass of a filament-type black-light bulb makes an excellent filter when used with an ordinary photoflood lamp.

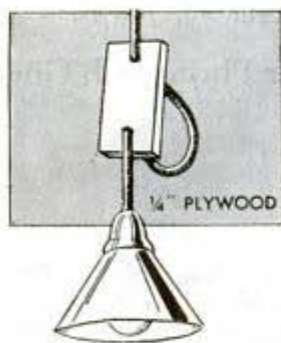
Necessary Tools Always at Hand In a Wheelbarrow Kit



In order to have the necessary tools always together for making everyday repairs around the home or farm, make a wheelbarrow-type tool kit like the one shown for keeping the tools handy. It is easy to move from job to job, and with it you won't have to make unnecessary trips to the shop to get tools that were forgotten. There are drawers along the sides and front for small parts, and two boards or panels provide mounting space for the smaller hand tools. Space for large tools is provided under the panels.

Cpl. H. S. Hamrick, Titusville, Fla.

Overhead Light Can Be Raised By Wood Block on Cord



Adjusting the height of a light over a workbench can be done by means of a block of wood which is drilled to take the lamp cord. Of course the socket must be removed to allow the cord to be threaded through the holes.

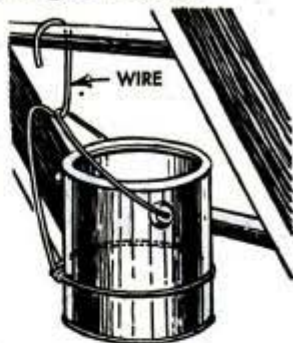
Stopping Leaks in Gasoline Tanks

It's unnecessary to drain and remove the gas tank from your car in order to stop a pinhole leak. All you need is a wood screw of a size to fit the hole, a leather washer and some liquid solder. First, wire-brush the surface around the leak, then drive in the screw with the washer on it. When leaking has stopped and the surface is dry,

cover the patch with enough liquid solder to form a substantial covering over the spot.—C. A. Broadhead, McKeesport, Pa.

Paint Can Hangs Clear of Ladder On This Simple Hook

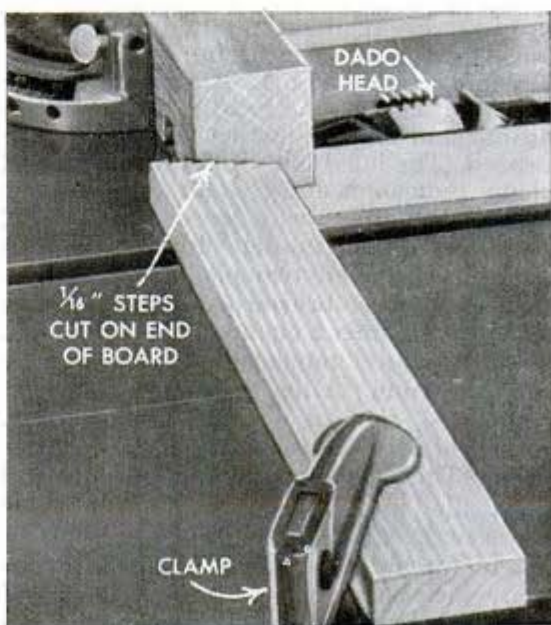
The rung of a ladder on which you hang your paint can will not interfere with stirring the paint or dipping the brush if you hang the paint can on this easily formed hook to hold it out of the way. Heavy wire is bent to



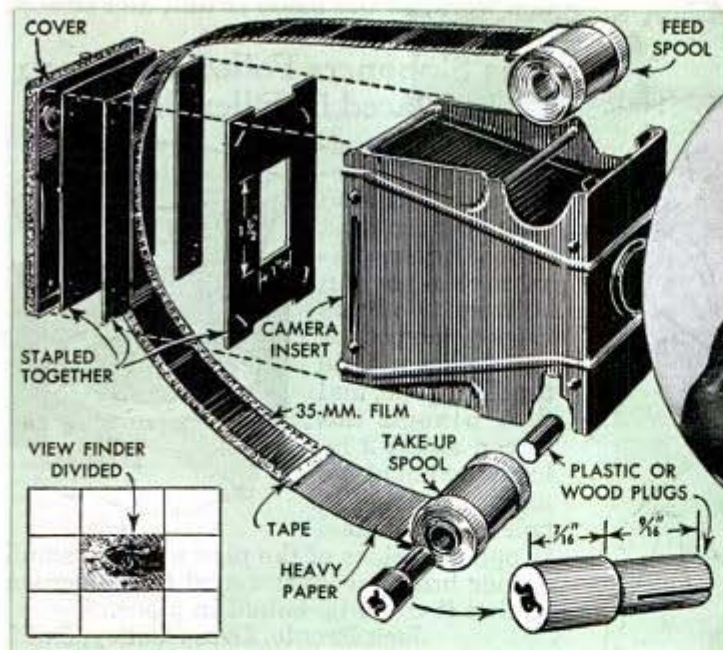
form a loop slightly larger than the paint can, and the remaining wire is formed into a hook. The can is lowered through the loop and the handle hung on the hook. Extra hooks can be made for cans of different sizes.—Leo W. Corah, Kenmore, N. Y.

Odd-Size Dado Cuts Can Be Made With Notched Guide Block

When you want to cut grooves wider than those which your dado head will handle, the stepped guide block shown in the photo is useful. Start the operation by setting the end of the work against the first step of the guide block. Make the cut, which will be the thickness of the dado head. Then reset the work against any shoulder of the guide block to get the required width of cut. The guide also can be used with a single saw, stepping up one notch to cut a groove $\frac{3}{16}$ in. wide.



Adapting a Box Camera to Take 35-mm. Film



it passes over the rollers on the camera insert. Next, two wooden or plastic plugs are

Box cameras can be adapted to take 35-mm. film if this size is preferable because the cost per exposure is lower. To make the change, an auxiliary mask is needed. This consists of a back piece, two guide strips and a frame, all of which are cut from cardboard and stapled together as indicated in the upper left-hand detail. The back should be slightly smaller than the camera cover, and the guide strips are spaced to allow the film to move snugly between them. The frame has a 1 by 1½-in. cutout in the center, which is equal to the size of two single 35-mm. frames. A small recess the width of the film is cut in the top and bottom edges of the frame so that the latter will not scratch the film as

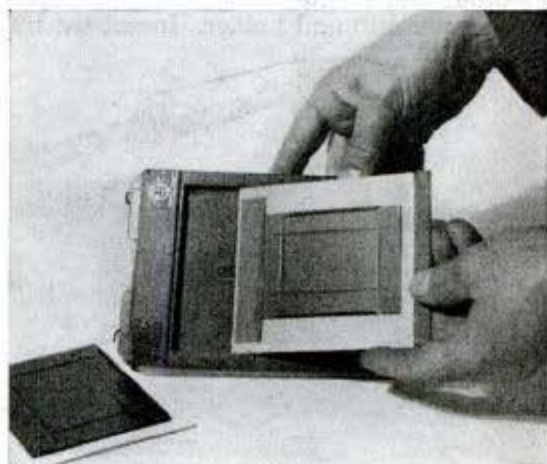
made. One acts as a spacer to keep the take-up spool centered. The other plug is slotted at both ends. One end fits over the key in the take-up spool and the other end slips over the film winding key on the camera. In use, the feed spool is placed in the trough provided for this purpose and the film is pulled out, pushed through the cardboard mask and attached by cellulose tape to a strip of heavy paper, which is wound on the take-up spool. One revolution of the film-winding key advances the film about 1½ in. for the first six frames, then about 1¾ in. Divide the glass view finder into nine equal parts; the center division will serve to position the camera for an exposure.—Merel Meyer, Chicago.

Small Cut Film Held in Large Camera by Cardboard Insert

Any small-size film can be used in a 4 by 5 or even larger camera without a reducing back if a cardboard insert is fitted into the regular film holder. A septum to take the smaller-size film is centered on this and glued in place, and a strip of cellulose tape is applied at the top of the septum to hold the film. Dimensions of the substitute film then are penciled on the ground glass.

R. M. Roland, Chicago.

☐ The handles of old toothbrushes can be used as stirring rods when mixing small amounts of chemicals such as reducers and toners. As the handles are made of plastic, they will not affect the solutions and can be cleaned in running water.



Gripper to Attach Skid Chains Of the Strap-On Type



Attaching strap-on type skid chains is no problem if you use this gripper piece to pull the strap through the slots in disk wheels. It consists of a length of leather with steel grips at one end. In use, the gripper end is slipped through the wheel slot from the outside and fastened to the end of the chain strap, which then is pulled through the slot as indicated.

O. H. Dissman, Westfield, N. J.

Small Screw Driver Improvised From Pen Nib and Holder

If you need a small screw driver for emergency repairs on eyeglasses, watches or other fine work, you can improvise one from a pen nib and holder. Insert the nib

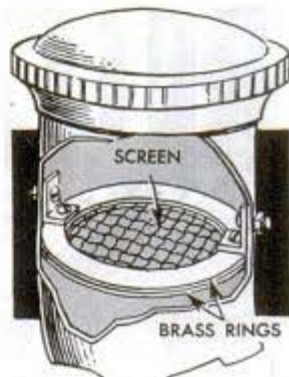


pointed end first in the holder and you will have a screw driver that is ideal for this work, as the blade is thin and strong.

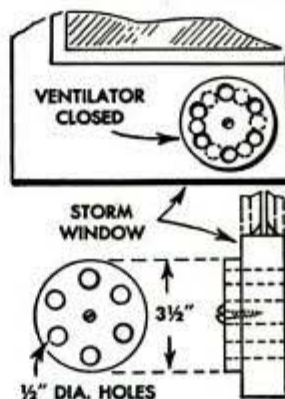
Gas Siphoners Foiled by Screen Placed in Filler Pipe

To prevent siphoning of gasoline from his auto tank, one motorist bolted heavy $\frac{1}{8}$ -in. mesh screen between two brass rings of the proper size to fit inside the filler pipe, and then placed this screen about 2 in. from the top of the pipe. To install it, holes were drilled in opposite sides of the pipe and two small corner braces were fastened to the screen so that it could be bolted in place.

Jack Bronte, Grass Valley, Calif.



Disk-Type Vents in Storm Sash Control Ventilation Closely

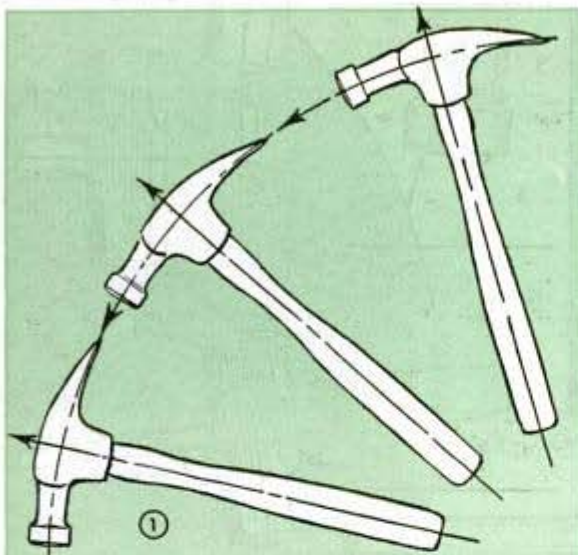


Instead of propping storm sash open, or using pivoted flaps over large openings in them to permit ventilation, use disks in which equally-spaced holes are drilled to coincide with similar holes drilled in the sash. This permits fine adjustment of venti-

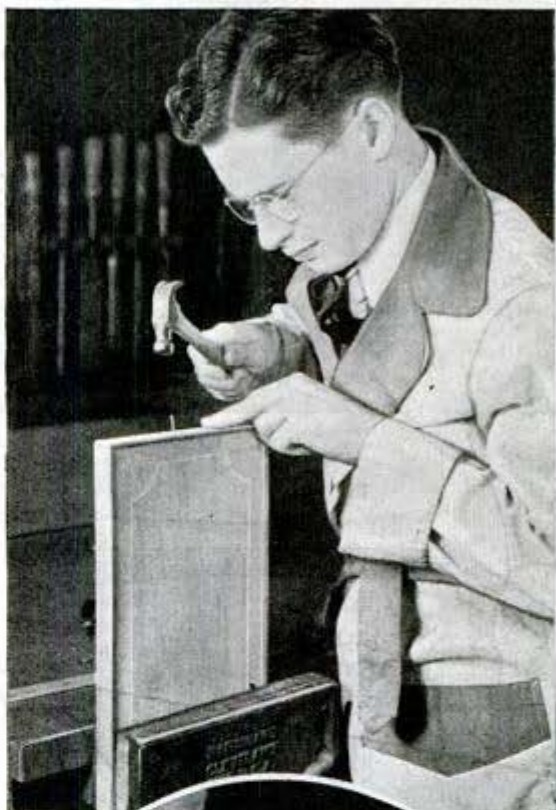
lation to get just the amount desired. When drilling the holes in the disks be sure they are spaced exactly like those in the window so that when the disks are turned to a predetermined position all the openings are closed.—Harold Akst, Freeport, N. Y.

Blotting Paper Protects Shelves In Medicine Cabinets

Use blotting paper to line shelves in medicine cabinets and the bottoms of cosmetic drawers. Then if liquids that stain are spilled or run down the sides of the containers, they will be absorbed without damaging the shelves. Large sheet blotters made for desk pads are ideal for this purpose, and can be obtained in a variety of colors to harmonize with the shelves or drawers.—Shirley L. Adler, Denver, Colo.



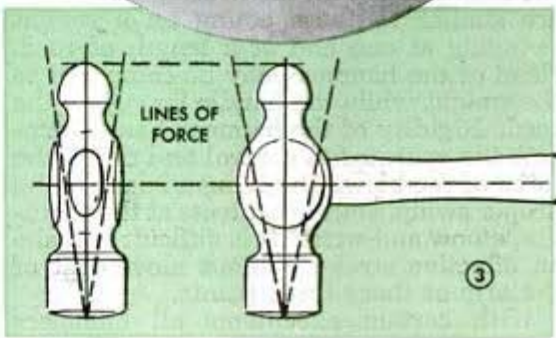
HINTS ON *Hammering* by W. Clyde Lamme

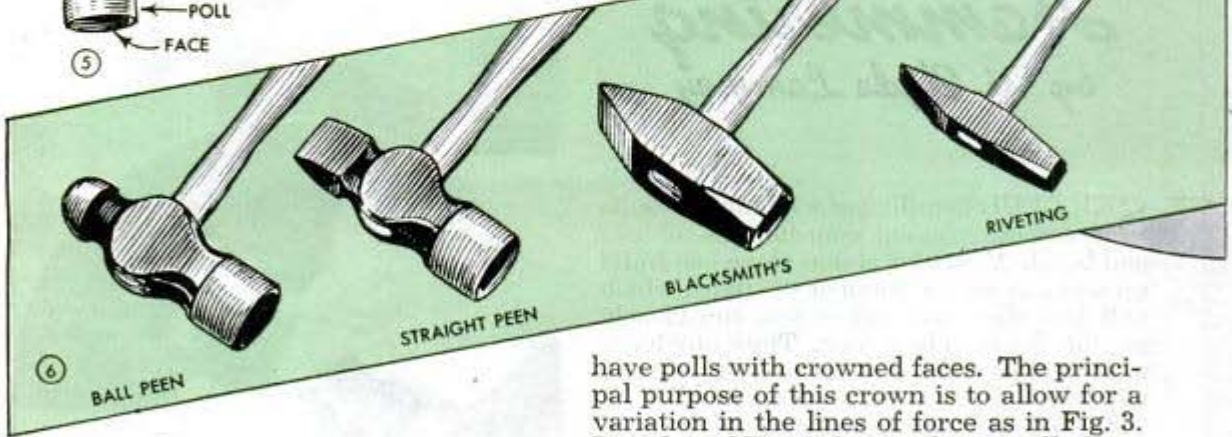
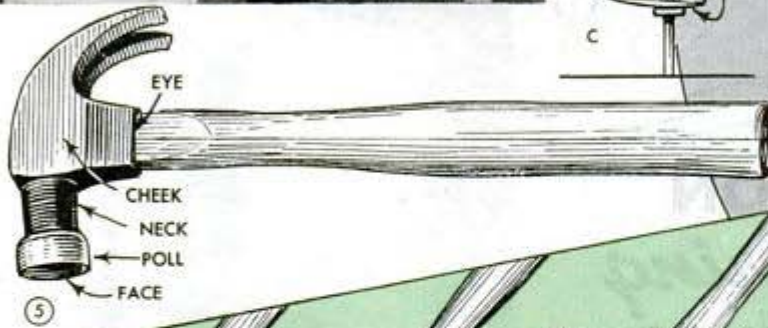
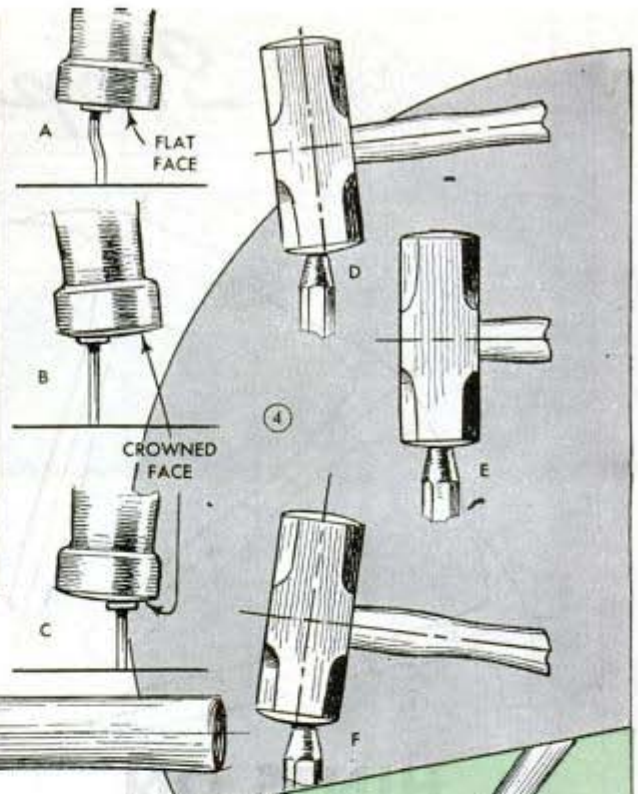


SKILLFUL handling of a hammer results from the trained coordination of eye and hand. Muscular action alone can build up and control the force of the blow, which will lack direction unless you can clearly see the object to be struck. Thus, any hammering operation compares quite closely with the technique of throwing a ball.

Fig. 5 details and names parts of the head of an ordinary "nail" hammer. This is important to know when you buy one. Examine the head of a top-quality hammer and you will see that the poll and face are ground to a true curve, the cheeks are sized equally, the eye is slightly tapered and the claws are finished and ground to identical shape. And along the handle of a well-balanced tool is a point where the hammer hangs and "feels" just right when you grasp the handle in your hand.

Fig. 2 shows the accepted manner of holding a hammer when doing any work requiring a degree of precision. The thumb extended along the handle as shown aids in control, gives a surer grip and is less tiring in most hammering operations. On nearly all hammers the handle is shaped to give the most comfortable grip when



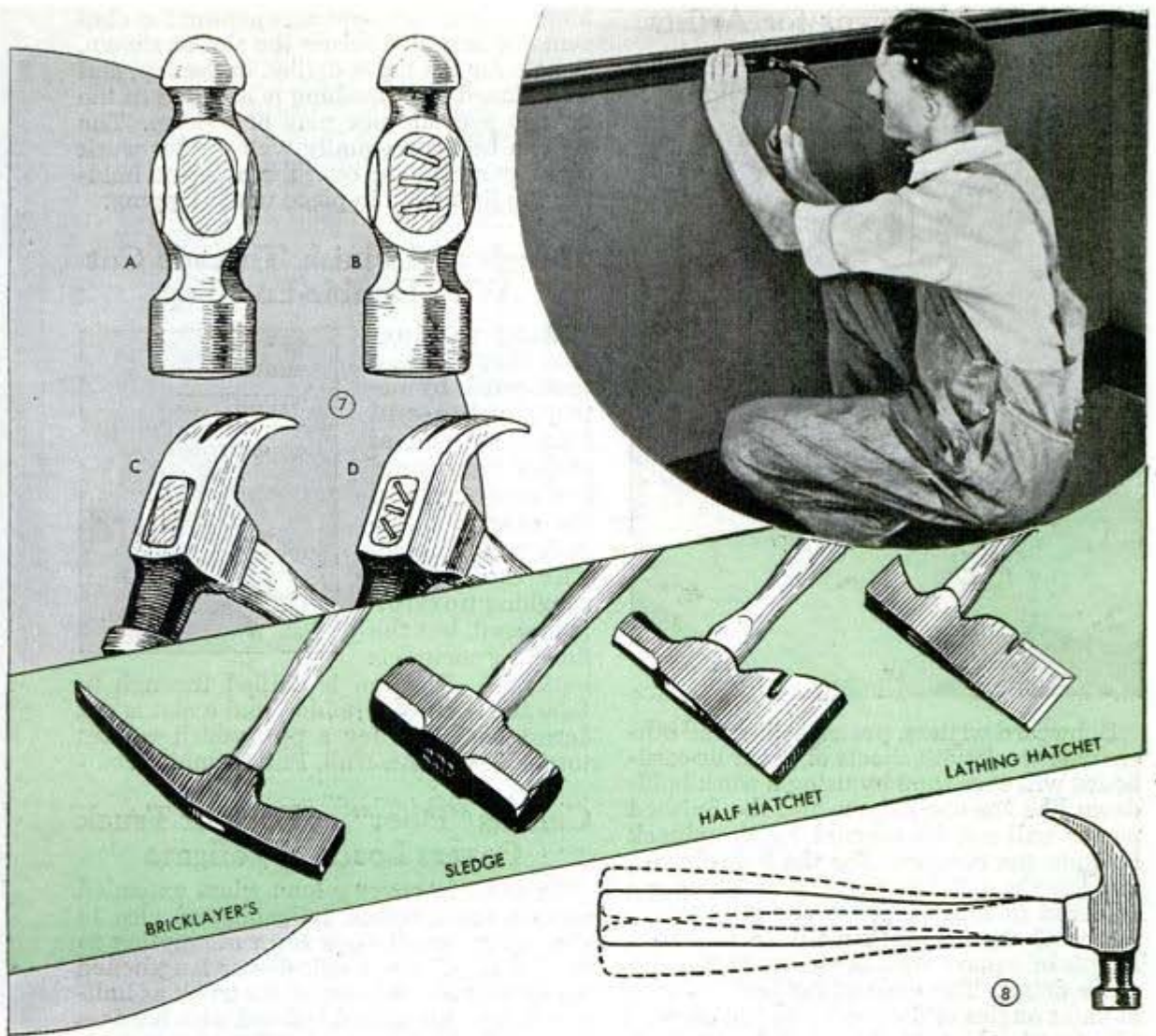


grasped approximately at the point indicated. The common types of hammers, hatchets and sledges used by craftsmen in a variety of work are shown in Fig. 6.

Fig. 1 shows in a simplified manner how the forces acting on the head of a hammer are similar to those acting on a weight swinging at one end of a length of cord. Head of the hammer may be compared to the weight while the handle supplants the cord. Rigidity of the hammer handle enables the operator to control and direct the force of the blow. In giving a hammer the proper swing, your arm pivots at the shoulder, elbow and wrist. It is difficult to make an effective stroke without movement of the arm at these three points.

With certain exceptions all hammers

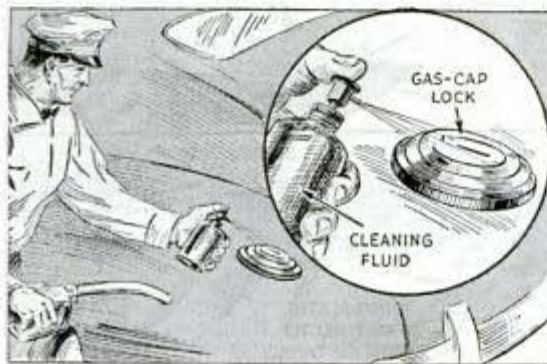
have polls with crowned faces. The principal purpose of this crown is to allow for a variation in the lines of force as in Fig. 3. Detail A of Fig. 4 shows what usually happens when you try to drive a nail with a hammer having a poll face either worn or ground flat, or where the surface of the face is otherwise irregular. Generally the nail will bend or the hammer head will glance off the head of the nail. Details B and C show, in somewhat exaggerated form, how a crowned face helps to prevent this. Due to the curve of the poll face the centerline or axis of the hammer can angle as much as 5 degrees or more with the centerline of the nail and still the blow will be fully effective. Likewise it will be seen from details D and F of Fig. 4 that the angle can vary about the same amount in another direction; that is, the angle of the handle can vary 5 degrees or more above or below the theoretical perpendicular, as



shown at E in Fig. 4, and still the blow will be delivered with full force. Therefore, it's important that the poll face of any hammer used for these purposes be ground to a regular curve without pits or irregularities.

As indicated in Figs. 7 and 8 there's a trick in fitting a hammer handle. First, it's important to trim the handle to a close fit in the eye. In some hammers the eye is slightly tapered. The purpose of this is to

prevent the handle from pulling out when wedged in place. The error of fit shown in details A and C of Fig. 7 should be avoided as it may result in the irregularity diagrammed in Fig. 8. When properly fitted the handle will wedge into the head as shown at B and D, Fig. 7, and will be true with the head both vertically and horizontally. If available, metal wedges should be used to tighten the handle in the head.



Frozen Lock on Fuel-Tank Cap Thawed With Glass Cleaner

If the lock on the gas-tank cap of your car freezes so that the key will not enter, you can save time in freeing it by using windshield cleaning fluid. This can be sprayed over the lock, as only a few drops are needed to thaw the ice so that the key will enter and turn the lock.

Plastic paint can be given a "rough texture" effect by applying it with a rough 4-in. wall brush, used in a semicircular sweep.

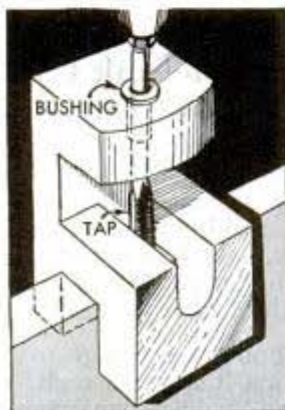
Work Hold-Downs for Artists Eliminate Use of Thumbtacks



Showcard writers, poster artists and others who work with sheets of paper or cardboard will save time by using a work hold-down like the one shown, and the finished poster will not be marred by thumbtack holes in the corners. For the hold-downs, two lengths of flat iron are used. These are soldered to hinges, which are attached to pieces of sheet metal bent to fit around a length of square rod, as shown in the circular detail. The ends of the rod are bent at right angles and screwed to the corners of a drawing board to form a slide on which the hold-downs can be adjusted for different sizes of work. By bending the ends of the hold-downs at a right angle, they will grip the lower edge of the board snugly.

Opie Read, Jr., Chicago.

Tapping Jig Reduces Breakage And Starts Taps True

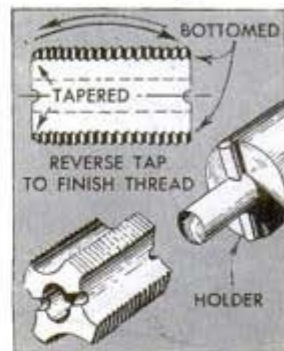


To prevent breakage of taps through faulty starting, a jig like the one shown can be used, especially in production shops for tapping holes located along edges of plates. The jig is made from any available scrap. A slot the size of the plate is milled

along the bottom, and an opening for chip removal is milled across the slot as shown. A hole for the tap is drilled in the top, and a hardened steel bushing is inserted in the hole to prevent side play of the tap. The jig can be used equally well on flat work by aligning the tap over the hole and holding the jig firmly in place while tapping.

Rough and Finish Threads Cut With Double-End Tap

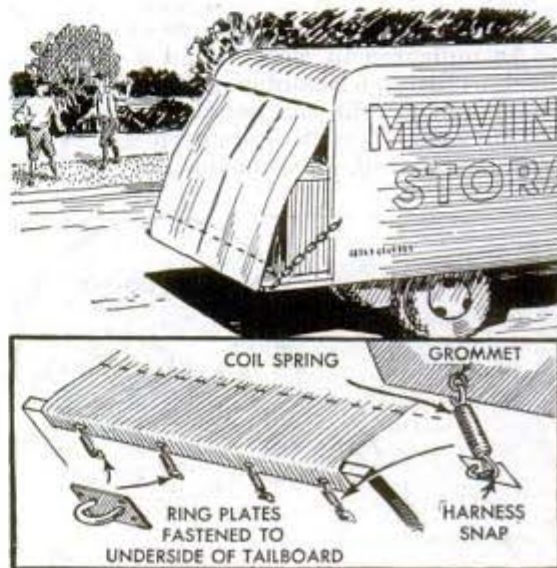
Many production shops speed their work by using double-end taps. One end of such a tap is used for roughing and the other for finishing the thread. The end of the roughing portion is tapered, but the finishing portion is bottomed.



The tap is drilled through to take the shaft of a holder, and a slot is cut across each end for a pin, which rotates the tap.—Gordon Null, Philadelphia, Pa.

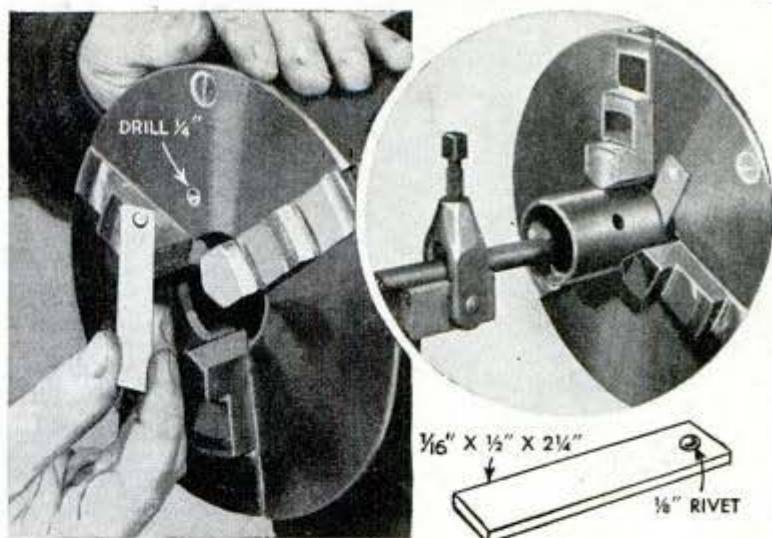
Canvas "Door" at Back of Truck Covers Load on Tailgate

In order to cover a load when extended out on the lowered tailgate, and also to discourage small boys from attempting to "hop a ride," one truck driver lengthened the canvas at the back of the truck as indicated. The lower end is fitted with harness snaps attached to small coil springs which engage ring plates screwed to the underside of the tailgate. The springs also keep the canvas from flapping.



Backstop Held in Lathe Chuck While Turning

Unlike backstops often used in lathe chucks, this one will not fall out of place while machining work, as it is held by a rivet which slips into a shallow hole in the chuck face. The stop is a piece of flat iron having a round-headed rivet near one end. The backstop is held against the chuck with the rivet head in the hole while the work is pushed against it and the chuck jaws tightened. This method of mounting keeps the backstop from falling out.



Fly Cutter Bores Rough and Finish Holes in One Operation

Used with a spring-collet chuck on a drill press, a boring-bar or fly-cutter holder that turns in a bushing on the drill-press table can be used for rough-boring holes as well as for finishing them without changing cutting bits. The holder is a round bar slotted at a 45-deg. angle to provide room for three or four cutting bits with spacers between them. The bits are positioned so that they overlap slightly to allow successive depths of cut, progressing from rough to light cutting, and are held in the bar with socket-head setscrews. Stepped bores can be cut also with this tool by setting the bits to cut the required depth of the steps, spacers being used to allow for the length of the steps. The drill-press stop should be set so that the spindle will feed only to the required depth. When cutting finish bores,

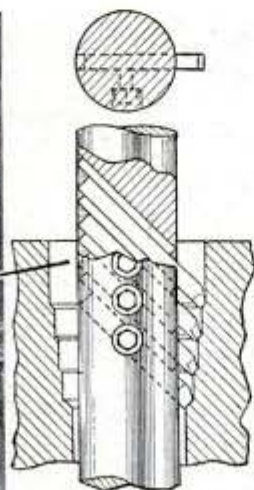
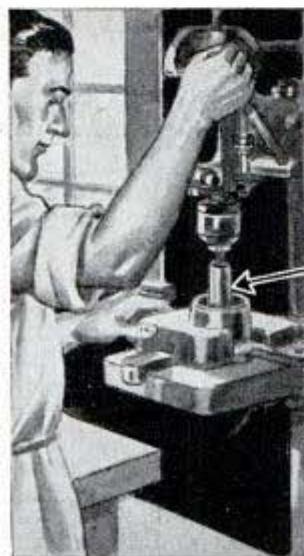
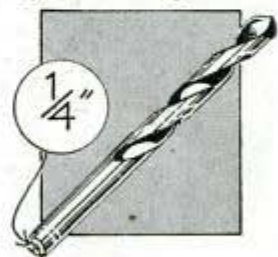
the spindle should be allowed to come to a full stop at the bottom of the cut to eliminate the spiral groove caused by the dragging of the tool when it is withdrawn from the hole. The tool then will cut a straight, shallow groove that may be rubbed down with emery cloth to remove the burred edge and leave a smooth bore.

Orville E. Hyler, Peoria, Ill.

Size Mark on End of Twist Drill Is Not Effaced by Chuck Jaws

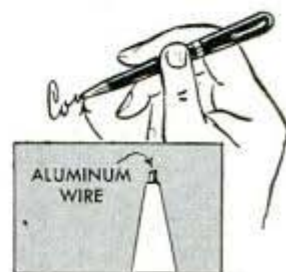
As the shanks of twist drills are not hardened, the identifying marks stamped on them often become effaced when the drills slip in the chuck. If the shank end is ground flat and the size is stamped on this, the marks will not become obliterated.

Frank Sima, Berwyn, Ill.



Mechanical Pencil Grips Wire Used for Marking Metal

If a lead pencil cannot be used to mark metals, aluminum wire may be suitable. For convenience, the wire may be inserted in a mechanical pencil in place of the lead.



THREAD CUTTING

By H. J. Chamberland



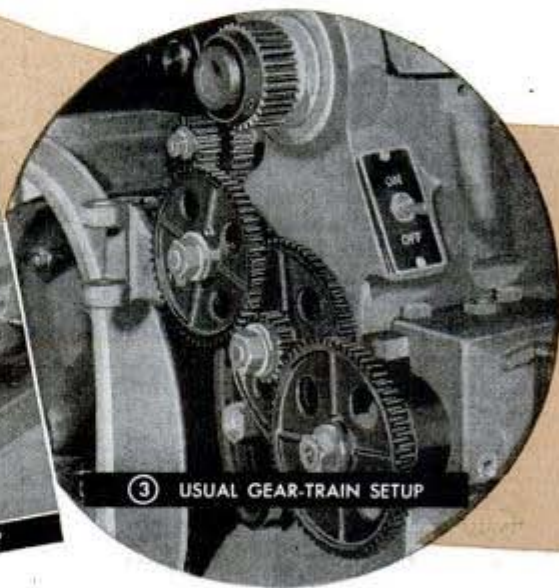
ONE of the most interesting of all lathe operations is cutting screw threads because it requires an accurate sense of timing on the part of the operator and his fullest attention to many details, and also because the work can be varied to cut threads of many different kinds. In ordinary turning, such as in facing, the spindle speed remains constant while the tool can be hand-fed across the work at almost any rate of speed, depending upon the metal being turned. Moreover, the tool can be fed in and stopped at any point on the work without damaging it, except



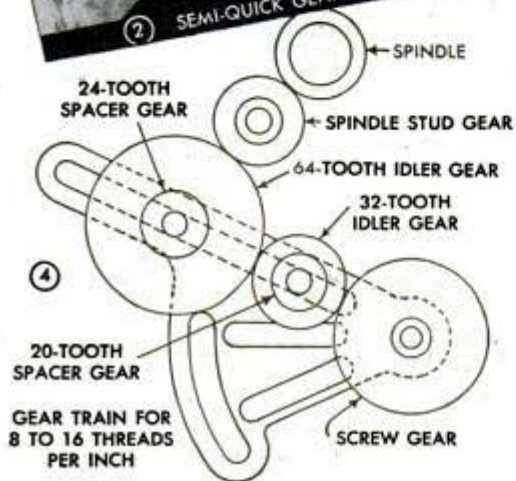
CLEARANCE



SEMI-QUICK GEAR TRAIN TO SPEED SETUP



USUAL GEAR-TRAIN SETUP

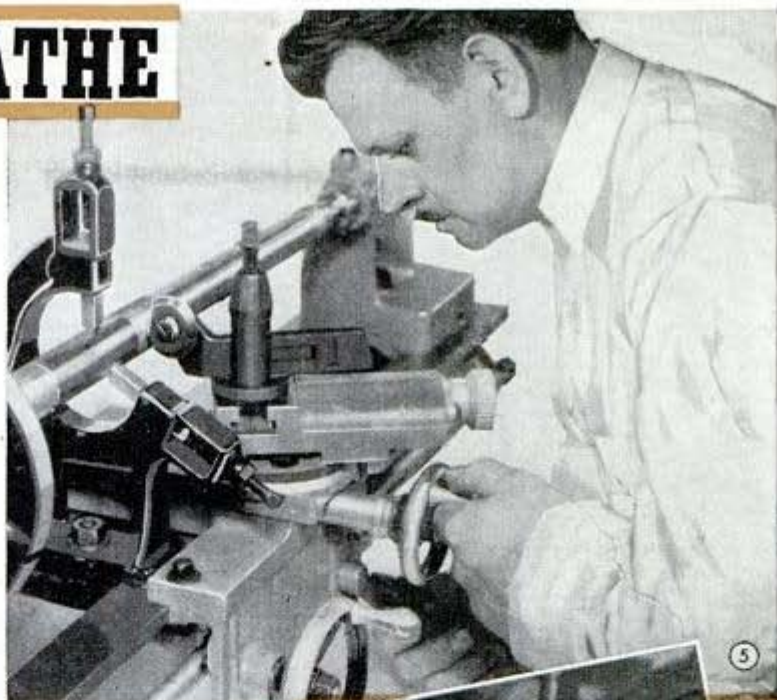


in taking a finishing cut, when a shallow shoulder will result. But in cutting threads, the ratio between spindle speed and rate of feed is of the greatest importance as it determines the pitch of the thread being cut, and the feed cannot be stopped short of the end of the thread unless the tool is withdrawn or it will cut into and spoil the threads. Also, threads generally are not cut in one operation but by successive passes of the tool over the work, the cutter taking a deeper bite at each pass. When the tool has been withdrawn and positioned for the next pass, it can be fed in only at specified intervals so that it will coincide with the thread cut in its previous travel over the work.

When preparing to cut threads, the lathe,

on your LATHE

and especially the lead screw, must be clean and free from dust and chips. The centers should be aligned carefully so that the work will run concentrically, and the work must be straight and true within .001 in. to assure uniform depth of thread. These precautions having been taken, the next step is to set up the proper gear train to cut the desired thread. This is done by removing certain gears and replacing them with others of different size, or by changing their location, Fig. 3. On some lathes gear changing is done automatically by setting a lever at desig-

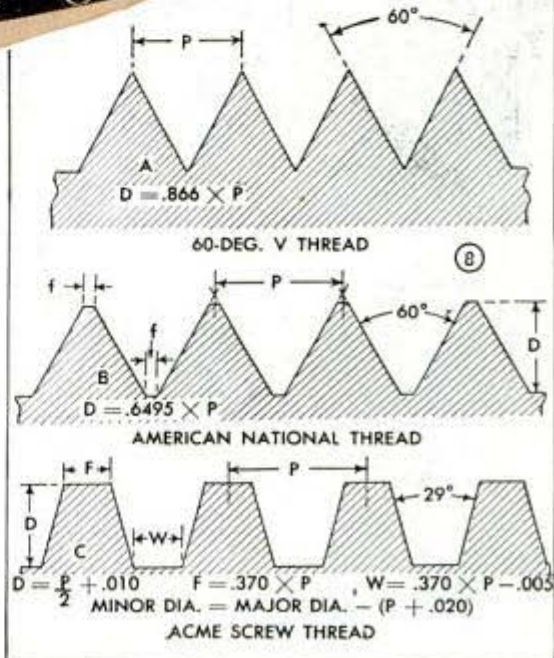


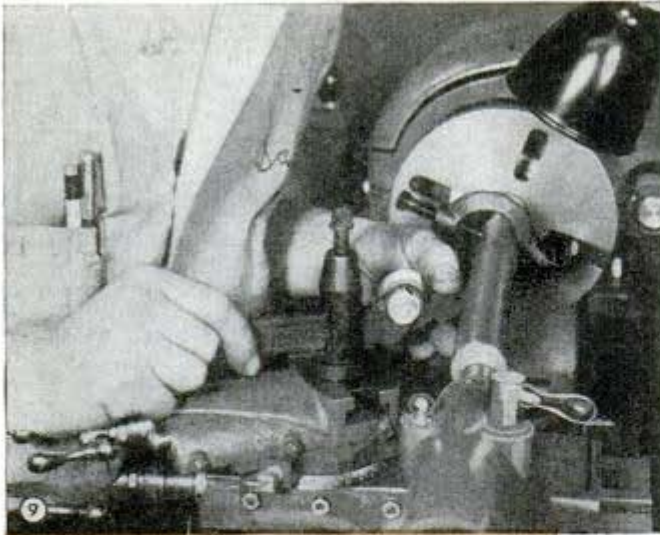
CUTTING ACME-FORM SCREW THREAD



CHECKING AMERICAN NATIONAL THREAD

nated positions; others use a semi-quick arrangement of gears to speed the setup, Fig. 2. With the semi-quick setup, six different threads can be cut with the same gear train, whereas with the usual gear train only three different threads can be cut. Regardless of design, all lathes are provided with a chart by which the desired gear train may be selected. It is important, of course, to check the setup to make sure that gears with the proper number of teeth have been selected and that they are positioned in correct order on the bracket, Fig. 4. The gears must be arranged so that the carriage will travel toward the headstock for a right-hand thread. For a left-hand thread, the carriage can be reversed to

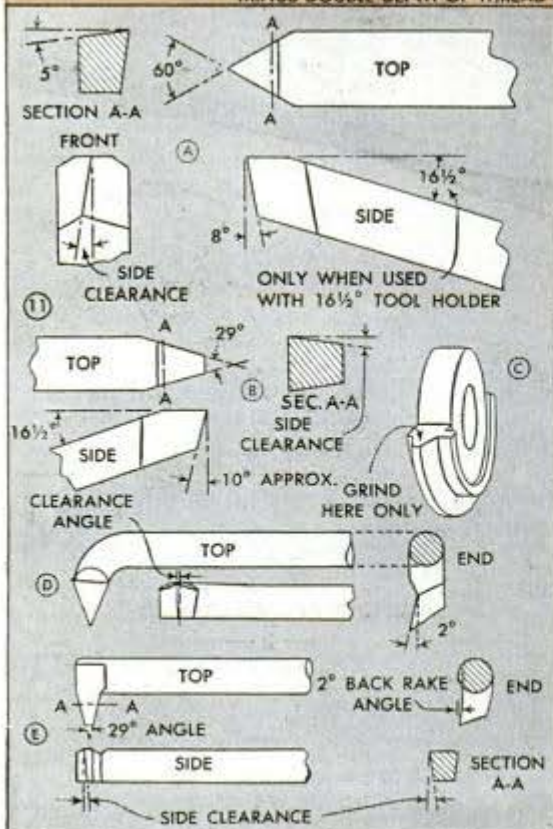
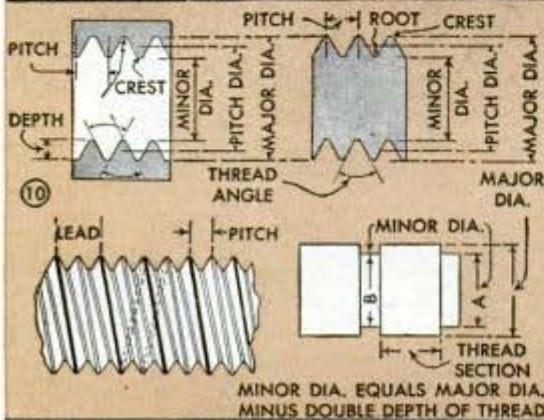




travel toward the tailstock. The gears should not mesh tightly but have clearance, as indicated in the detail below Fig. 1. Clearance can be determined by adjusting the gears with a piece of paper between the teeth. When the gears are properly arranged, a small amount of graphite grease should be applied to the teeth for smooth, noiseless operation.

Although there are many forms of threads, only the three most commonly used need be considered here. These are the V, American National and Acme, shown in Fig. 8. Notice that the first two are 60-deg. threads. The V-form generally is used only for fine threading, while the Acme is a coarse,

strong thread such as that used on the screw of a lathe. The threads are diagrammed according to a simplified formula in which D represents single depth of thread, P is pitch, and F designates the width of the flat at bottom and top, which are also known as the root and crest. Since the top and bottom of Acme threads are not equal, W is used for the bottom dimension. As shown in the upper details of Fig. 10, pitch is the distance from a point on one thread to a corresponding point on the next thread, measured parallel with the axis. The distance a screw advances axially in one turn is called the "lead." When cutting the usual single thread, therefore,



(12) DOUBLE DEPTH OF THE V AND NATIONAL-FORM THREADS

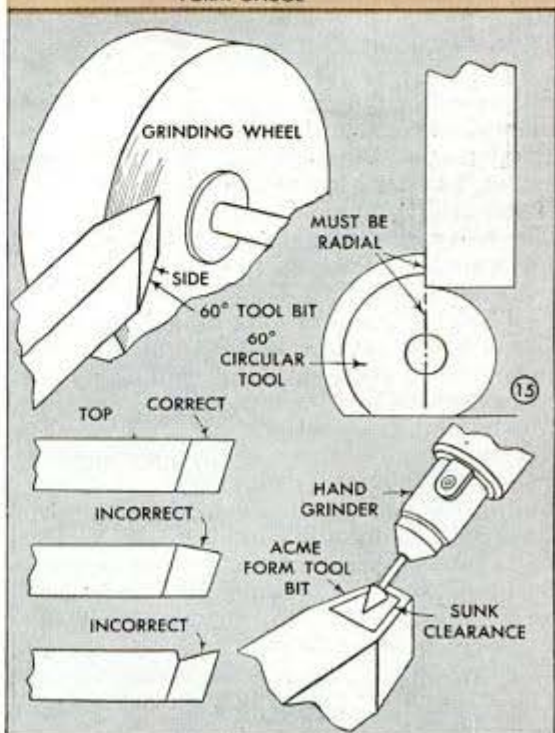
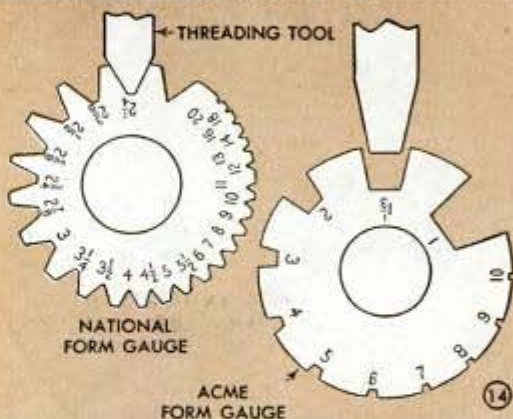
Threads Per Inch	American National (U. S.) (in inches)	Theoretical V Thread (in inches)
80	.0162	.0216
72	.0180	.0240
64	.0203	.0271
60	.0217	.0289
56	.0232	.0309
50	.0260	.0346
48	.0271	.0361
44	.0295	.0394
40	.0325	.0433
36	.0361	.0481
32	.0406	.0541
30	.0433	.0577
28	.0464	.0619
27	.0481	.0642
26	.0500	.0666
24	.0541	.0722
22	.0590	.0787
20	.0650	.0866
18	.0722	.0962
16	.0812	.1083
14	.0928	.1237
13	.0999	.1332
12	.1085	.1443
11 1/2	.1130	.1506
11	.1181	.1575
10	.1299	.1732
9	.1443	.1925
8	.1624	.2165
7 1/2	.1732	.2309
7	.1856	.2474
6	.2165	.2887
5 1/2	.2362	.3149
5	.2598	.3464
4 1/2	.2887	.3849
4	.3248	.4330
3 1/2	.3712	.4949
3 1/4	.3997	.5329
3	.4330	.5773

the lead is equal to the pitch, but when cutting a double thread, the lead is twice the pitch, as shown in the lower left-hand detail, Fig. 10.

Pitch diameter of a straight screw thread is equivalent to the diameter of an imaginary cylinder that would pass through the threads at points where the width of the threads would equal the width of the spaces between adjacent sides of the threads. This is illustrated in the right-hand detail of Fig. 10, which shows also the major and minor, or largest and smallest diameters of threads. When the major diameter is known, the minor diameter can be determined from the table, Fig. 12, which lists the double depth of threads from 3 to 80 per inch.

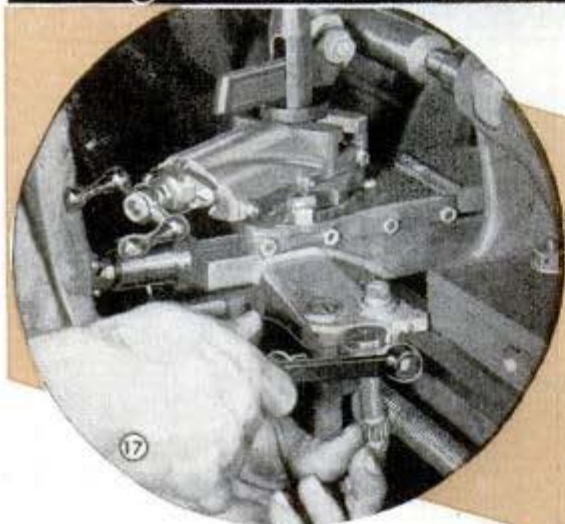
Various threading tools are illustrated in Fig. 11. The pointed tool A is used to cut V-threads, but can be used also to cut threads with a V-bottom, leaving the top flat. A screw cut in this manner will fit a National-form nut. This tool can be used to cut National-form threads when the point is ground to fit the proper slot of the gauge shown in the left-hand detail, Fig. 14. Tool B, Fig. 11, is used to cut Acme threads after grinding the point to fit the gauge shown in the right-hand detail of Fig. 14. Fig. 6 shows an Acme thread being cut. Tool bits like these must be carefully and repeatedly ground so that the angle is exactly right and allows enough side clearance to compensate for the rapid advance of the tool. Detail C, Fig. 11, shows a circular-type tool used for cutting external National-form threads, and Fig. 5 shows the tool in use. Internal threads are cut in the same way as external threads, except that tools of the type shown at D and E, Fig. 11, are used. Fig. 16 illustrates the cutting of an internal thread. In the case of internal threads, the bore of the hole becomes the minor diameter of the thread, and must be as accurately turned for concentricity as a shaft or spindle that is to be externally threaded.

Cutting tools can be ground more easily if gripped in a holder. The tool is held against the face of a wheel, Fig. 13, or against the side as in the upper left-hand detail of Fig. 15. The lower left-hand details show correctly and incorrectly ground tools for purposes of comparison. The circular-type tool is very easily ground against the side of the wheel, as in the upper right-hand detail of Fig. 15. The entire cutting surface of the tool must be kept flat on the wheel, its axis parallel with the wheel side. The Acme tool will



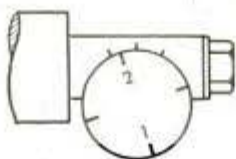


16 SETUP FOR CUTTING INTERNAL THREAD



17

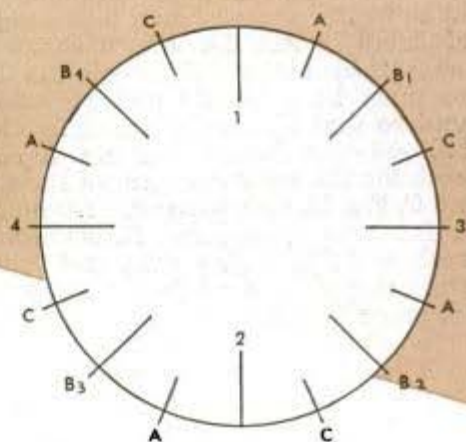
cut more easily if a slight clearance is ground in the face near the cutting edges, as indicated in the lower right-hand detail. The clearance should not, however, be closer to the edge than $\frac{1}{32}$ in.



2

When all preparations have been made, the tailstock center is lubricated with some preparation such as white lead and sperm oil, graphite and tallow, or red lead and mineral oil to keep the center from heating excessively, and the work is positioned between lathe centers as in Fig. 1. It must not be removed from the centers until the thread is completely cut because it is almost impossible to recenter it in the original position. The compound rest is set at an angle of 29 deg., Fig. 17, and the tool is mounted in the tool post with the point of the tool exactly on the lathe-center line, Fig. 9, a center gauge being used to position the tool.

The threading dial, Fig. 18, is set by tightening a nut to engage a pinion against the lathe feed screw, as shown in Fig. 17, causing the dial to rotate with the feed screw. The purpose of the dial is to position the tool accurately in relation to the work so that after being withdrawn at the completion of a cut, the tool will return to the same starting place for the next cut, thus eliminating the necessity of reversing the direction of the carriage to return the tool after each cut. Standard threading dials are divided by four marks, as shown in the left-hand detail of Fig. 18, but additional marks may be provided, as in the right-hand detail, to suit exceptional threading operations. When cutting threads of 6, 8, 12 or any other even number per inch, the dial is engaged when any one of its four marks coincides with a stationary mark on the dial housing. If the

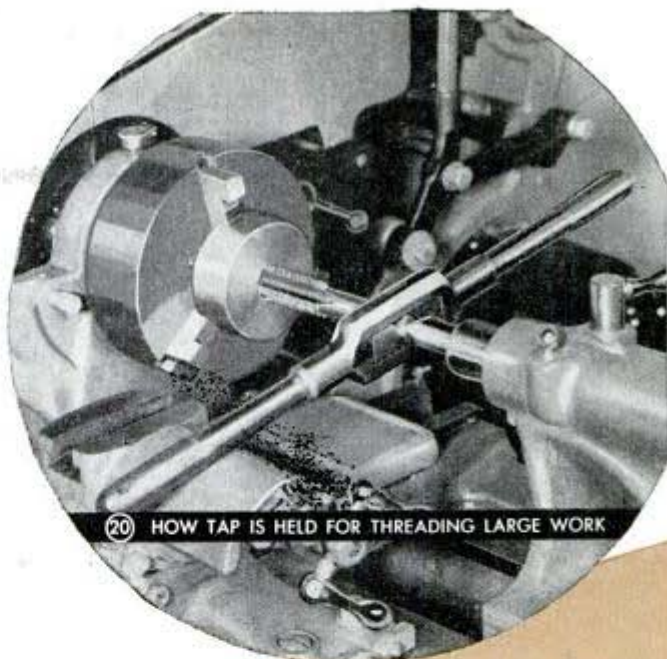


18 EXTRA MARKINGS FOR CUTTING MULTIPLE THREADS

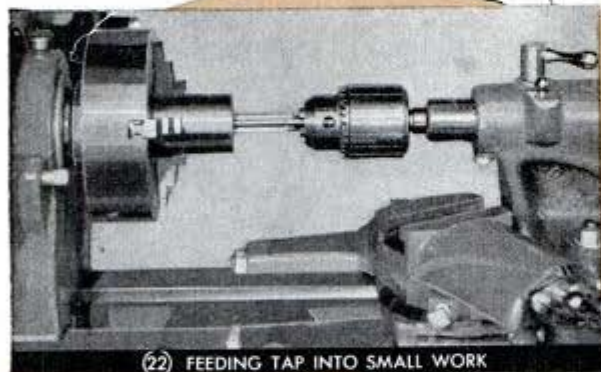


19 LARD OIL APPLIED TO THREAD BEING CUT

threads are odd numbered, the dial is engaged only when mark 1 or 2 is in line with the stationary mark. For half-numbered threads, such as those of $4\frac{1}{2}$, $5\frac{1}{2}$ or $7\frac{1}{2}$ per inch, the dial must be engaged at the same mark on each successive cut. A slow spindle speed is used in thread cutting, thereby assuring ample time to engage the dial at the proper mark, and lard oil is applied to the work after each cut, Fig. 19. The tool is always fed into the work with the compound. When feeding in the tool, the gauge mark on the compound must be noted so that cuts of suitable depth are taken. For roughing the thread in steel, the maximum depth of cut should be not over .005 in., and for the last two or three cuts, no more than .001 in. Heavier cuts may be taken on brass, bronze and aluminum. As the thread nears completion, it can be checked with a screw-pitch



20 HOW TAP IS HELD FOR THREADING LARGE WORK



22 FEEDING TAP INTO SMALL WORK

gauge, Fig. 7. Left-hand threads are cut in the same way as right-hand threads, except that for left-hand cutting the carriage travels toward the tailstock and the compound rest is set at 29 deg. in the opposite direction.

For threading bores under 1 in. in diameter, taps are used instead of internal threading tools, as in this case taps are easier to use and will remove more metal in a given time than any other cutting tool that can be used for this purpose. If the bore is long, the work should be done on a lathe. In that event, the back gears are used for maximum driving power and minimum spindle speed. Taps under $\frac{1}{2}$ in. in diameter usually are gripped in a drill chuck that is held in the tailstock, Fig. 22. The



21 WHEEL FACE SHAPED TO FIT CONTOUR OF TAP CHAMFER

tailstock ram should be controlled so that its advance will correspond to that of the tap into the work. Large taps are gripped in a tap wrench and centered, with the wrench handle resting against the compound as in Fig. 20. The ram must be advanced gradually with a constant pressure to prevent breaking the tap. Taps should never be ground freehand if it is possible to use more reliable means. The only safe procedure is to hold the tap on centers that are positioned to keep the angle of the chamfer in line with the wheel face, Fig. 21. For best results, the wheel face should be concave to fit the contour of the chamfer. Each chamfer should be relieved to within $\frac{1}{64}$ in. of the cutting edge, and then oilstoned.

❑ Lacquer-enamel tints can be made by mixing tube colors in oil with clear lacquer, a procedure that is quite practical although lacquer and linseed oil ordinarily are not used together.

Self-Centering Holder for Punch Is Useful in Layout Work



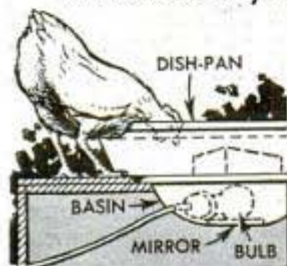
Those whose work requires drilling holes located in an arc or around the circumference of a circle will find an adjustable self-centering punch holder like the one shown a great help. It is made by cutting a slot in a length of $\frac{1}{16}$ by $\frac{3}{4}$ -in. flat iron for about three quarters of its length, and giving the unslotted end a quarter twist as shown. This end then is bent into an eye in which a center punch can be held snugly. As a pivot, a bolt held by a wing nut can be used. The head is cut off and the bolt is inserted in the slot and threaded into an acorn nut, which will center the holder in any punch mark in the work.

Used Brick Moistened in Water To Soften Dried Mortar

When reclaiming used brick, dried mortar can be removed more easily if the brick are first piled, then wet with a hose and allowed to stand overnight. By doing this, moisture will penetrate the mortar so that it will not adhere to the brick so firmly. Wetting the brick also eliminates most of the dust from the cleaning operation.

John Krill, Youngstown, Ohio.

Dishpan for Watering Chickens Is Heated by Electric Lamp



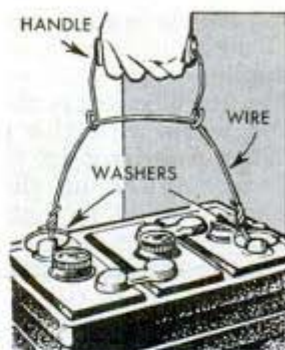
A dishpan can be used as a chicken waterer that will not freeze if it is set on a box over a basin in which an electric lamp is placed. The box is cut out to take the

basin, which is drilled for an electric cord. A small mirror is placed under the lamp to direct the heat against the pan. This can be weighted by a brick to prevent tipping.

Arlo Ranniger, Coon Rapids, Iowa.

Carrier for Storage Battery Is Easy to Make

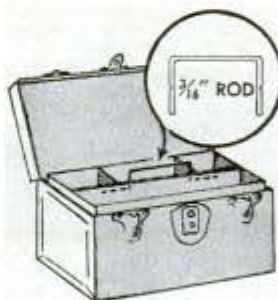
A length of heavy wire having a couple of $\frac{3}{4}$ -in. iron washers at each end will provide a handy carrier for storage batteries. A hand grip is made by drilling a short dowel through the center and inserting a piece of



wire, which is bent over the carrier as shown. To use the carrier, slip the washers over the binding posts of the battery and raise it. The inner edges of the washers will bite into the posts and hold firmly.

George E. Gambler, Bethlehem, Pa.

Inside Handle Improves Toolbox



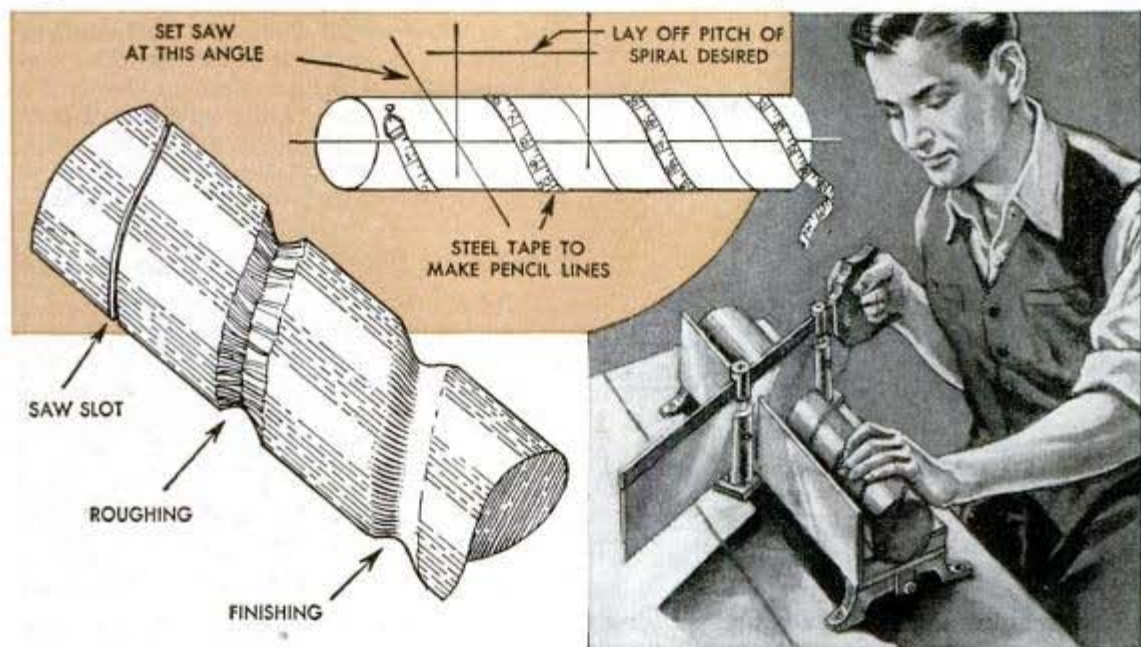
tray, and a length of rod or heavy wire is bent to a U-shape and inserted in them, the ends being bent at a right angle to prevent slipping.—R. Scaford, New York.

Rubber Band on Bucket Bail Serves as Rest for Brush



To keep his paste brush out of the bucket when not in use, one paper hanger lays the brush on a rubber band slipped over the bail ears. The band, which can be cut from an inner tube, also holds the bail upright so it can be grasped quickly.

Spindles Marked for Sawing Spirals by Hand



Cutting spiral grooves accurately in a wooden spindle with a handsaw and a miter box is not difficult. The pitch of the spiral is laid out on the spindle, over which a steel tape is wound so that one edge of the tape coincides with the layout marks to serve as a guide for tracing the course of the spiral around the spindle. After this is done, the spindle is placed on the miter-

box bed and the saw is adjusted at the angle of the spiral. A saw cut is made to a depth of about $\frac{1}{32}$ in., then the spindle is rotated and sawed again, the process being repeated until the full length of the spindle has been cut. The groove is roughed out by chisel to the desired width and sanded smooth as indicated in the left-hand detail.

Ralph D. Curtis, Santa Monica, Calif.

Bar on Exit Helps Pedestrians Avoid Oncoming Trucks

To prevent employees from hurrying through a doorway into an adjoining truck driveway, where they were in danger of being hurt by oncoming trucks, the proprietor of a dairy screwed an iron bar to the frame of the door. One end of the bar is bent so that when installed it projects at an angle into the driveway, leaving only a narrow passage for pedestrians. Now employees are retarded long enough within the building to be warned of approaching danger, and cannot hurry through the exit into the path of trucks.

Gemma Hayes, New York.

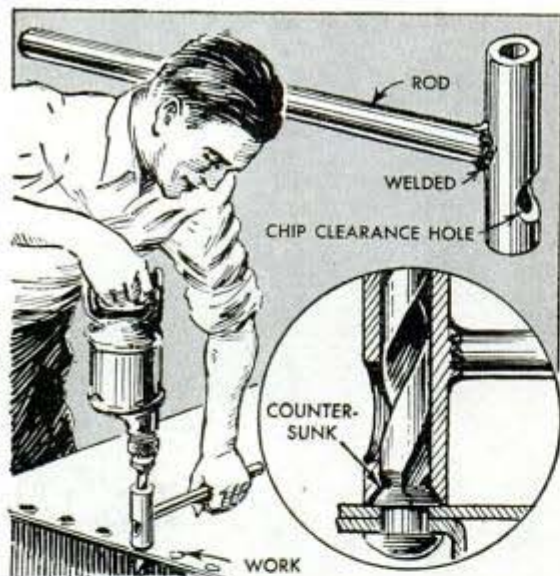
Sawdust Aids in Removing Paint

Using sawdust with paint remover is often more effective than merely applying the remover and scraping the work. The remover is brushed on and the work surface is scrubbed until it no longer feels tacky. Then more remover is added, sawdust is spread over it and scrubbed with a wood block until the work is dry, after which the paint can be scraped off easily.

John B. Cornell, Graniteville, R. I.



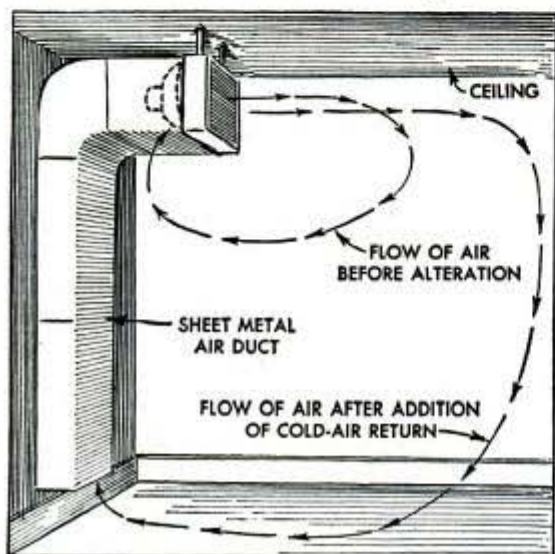
Jig Eliminates Center-Punching When Drilling Out Rivets



In removing rivets by center-punching and drilling, the drill sometimes works off center, thus spoiling the rivet hole. A jig like the one shown will guide the drill true, as well as eliminate the need for center-punching the rivet. It is made by welding two lengths of round stock of suitable size at right angles, one to be used as a handle and the other, of slightly larger diameter, to be used as the guide. The latter is drilled to size, a chip-clearance hole is made near the lower end, and the bottom edge is countersunk to fit over a rivet head in seating the guide.

Improving Ceiling Heater Unit

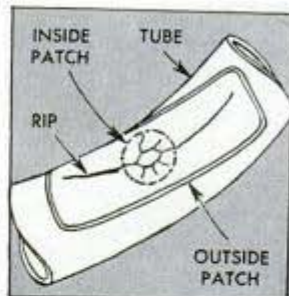
Warm air from a ceiling heater unit of the type having a blower usually remains at a fairly high level in the room, circulat-



ing close to the ceiling, unless some provision is made for leading the cool air at floor level up to the heating unit. To do this, a sheet-metal duct can be installed. The area of the cool-air duct should be two or three times larger than that of the warm-air vent so that the velocity of cool air drawn across the floor will be reduced, otherwise this circulation may cause discomfort.—W. R. Bufkin, Evansville, Ind.

Patching Blown-Out Auto Tubes

Often when a tire blows out the tube is torn so badly that the torn edges fall inward and a regular patch cannot be applied. However, by first applying a small patch to the inside surface of the tube under the tear and bringing the torn edges together over the patch, they will be held while an external patch is applied. Of course, the inner surface of the tube surrounding the opening must be cleaned as usual before applying the patch.



Harold L. Williams, Bronx, N. Y.

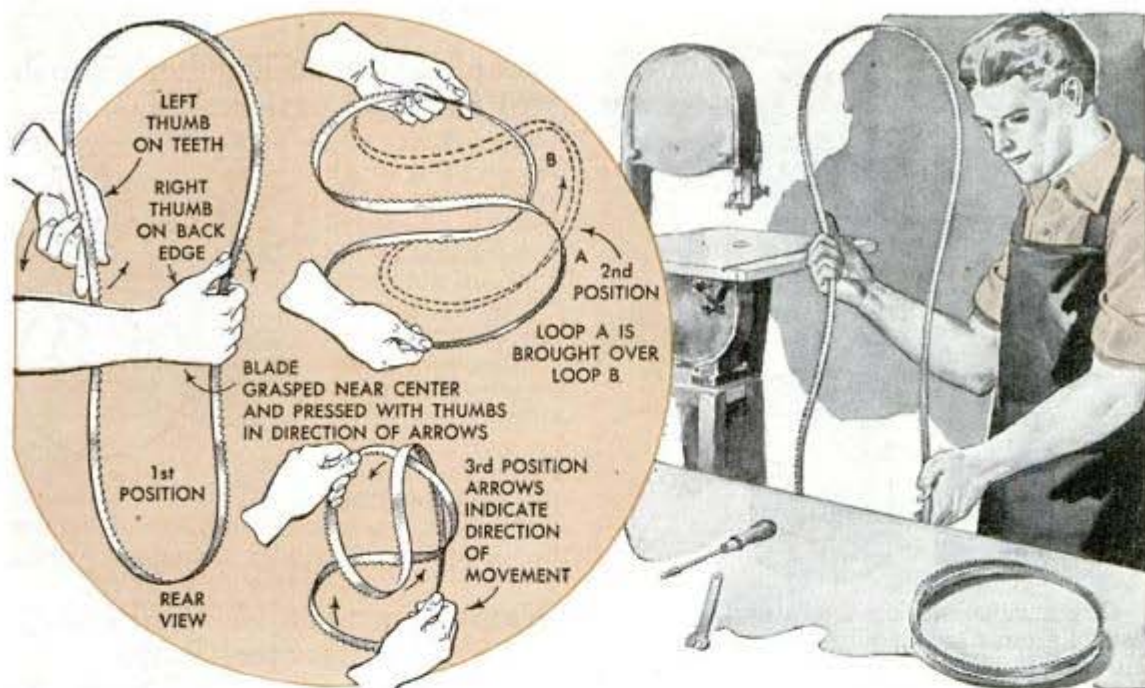
Plastic Face Added to Hammer By Slip-On Tube

If occasionally you need a hammer with a plastic face and your toolbox is already crowded, you can make a simple attachment that slips over the face of your regular hammer and takes very little room in the box. The attachment consists of a short length of steel tubing, long enough to project over the edge of the hammer face, and a plug of plastic that is fitted into the end of the tube. The tubing is reamed out so that it fits the hammer snugly, then the plug is turned down to fit tightly into the end of the tube. After this the edge of the plug is turned flush with the outside of the tubing.—S. Winston, Brooklyn, N. Y.



Unless the thermostatically operated carburetor heat control valve, which warms the combustible mixture in most cars before it enters the cylinder, is working properly, top economy and efficiency in engine performance are impossible.

Three-Step Method of Coiling Band-Saw Blade

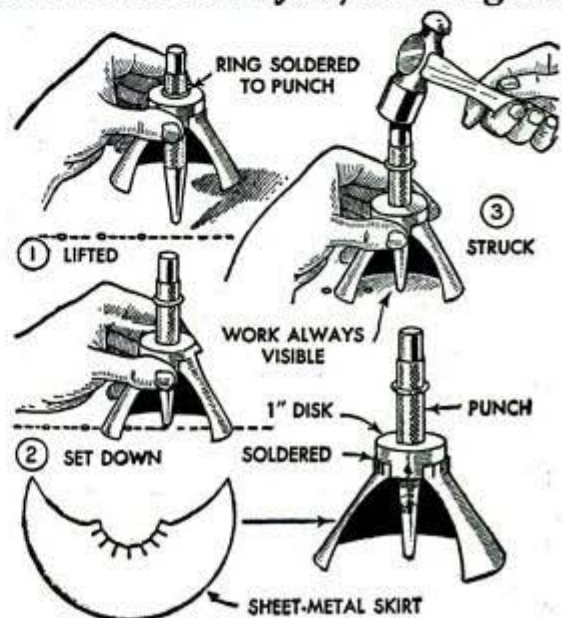


Coiling a band-saw blade is easy to do if you bear in mind that it must be folded in three parts, or loops, in order to coil properly. The first step is to grasp the blade correctly, as the manner in which this is done determines how the first loop will be formed. Both hands hold the blade at about the center, the left hand turned downward with the thumb on the teeth and the right hand turned upward with the thumb on the back edge, as shown in the left-hand detail. The thumbs must not press against

the sides of the blade. Next the hands are slowly turned at the wrist so that the left hand swings upward and the right hand swings downward away from the body. This motion will throw the blade into two loops, A and B, as shown in the upper righthand detail. Then loop B is carefully moved over loop A, as diagrammed in the lower right-hand detail, which brings the blade into the third position. Now the loops are moved as indicated by the arrows to coil the blade ready for storing.

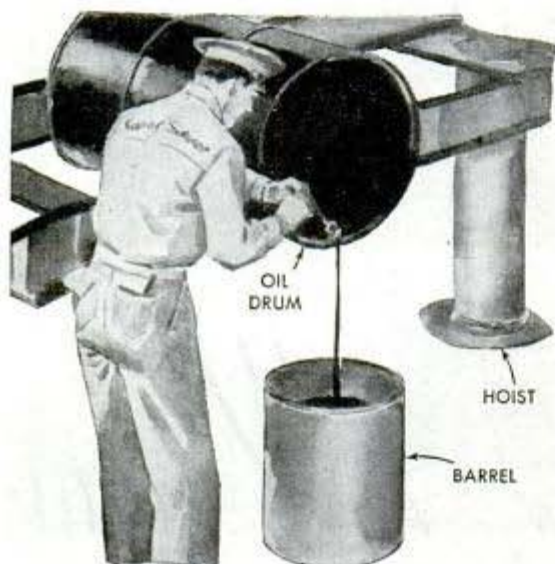
Skirted Holder for Prick Punch Prevents Injury to Fingers

When a prick punch is accidentally tilted as it is struck, the hammer may glance off and strike the operator's fingers. But injury of this kind is prevented when the punch is set in a holder like the one shown, which keeps the punch in a vertical position as in Fig. 3. Also, the holder is grasped instead of the punch, as the latter is retained by a ring soldered to it as shown in Fig. 1. The assembly can thus be lifted and moved from one mark to the next, Fig. 2. The holder consists of a 1-in. disk such as a piece of rod, which is drilled to take the punch, as indicated in the lower right-hand detail, and a sheet-metal skirt is cut to the form shown in the lower left-hand detail, and soldered around the disk. As the skirt is cut away to form a large opening, the work can be seen at all times.



Keep a magnet at the lathe for cleaning metal chips out of hard-to-get-at places.

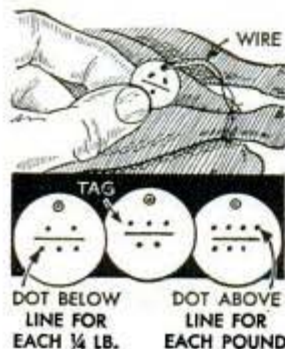
Oil Drum Raised on Auto Hoist To Fill Service Barrel



One service-station operator fills an oil barrel from a drum without heavy lifting. He merely rolls the drum onto a hydraulic hoist and turns it tap-end outward. Then the barrel is set on the floor in front of the drum, and the hoist is raised.

Maurice Rogstad, Menominee, Wis.

Stamped Metal Tags Tied to Fowl Record Their Live Weight



One poultry dealer who sells live weight tags the birds so that they can be identified after being dressed. The tags, which are small disks of copper tied to cords, are prick-punched to show pound and quarter-pound weights, the pound marks being stamped above a scored cross line and the quarter-pound marks below. The tags can be cleaned and used repeatedly.—J. W. Cartmill, Tampa, Fla.

Slit Hose Supports Price Tag On Auto-Battery Post

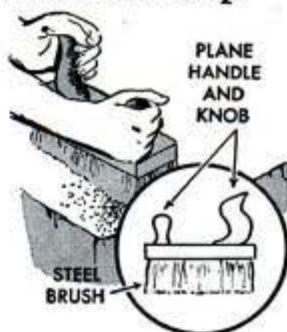


By slitting a length of auto-heater hose for a short distance, it can be used to hold a price tag on a storage battery. The hose is slipped

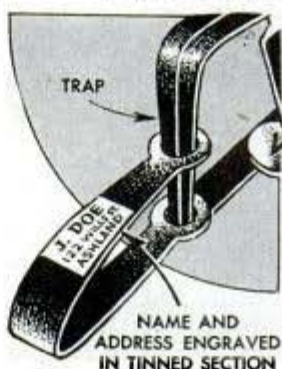
over one of the terminal posts to support the tag in a vertical position so that it can be read easily.

Plane Handle on Butcher's Brush Provides Comfortable Grip

One butcher screwed a knob and handle taken from a discarded wood plane to the back of the steel-bristle brush used for cleaning his cutting block. As considerable pressure on the brush is required to clean the block, the knob and handle provided an easy method of exerting the necessary force without tiring his hands.



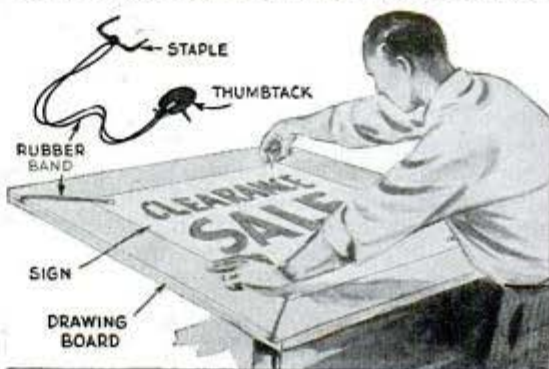
Name Engraved in Tin Plating Identifies Steel Traps



As a means of identification, one trapper tinned a small portion of the spring on each of his traps and engraved his name and address in the plating with a nail. With ordinary use, the inscription will last indefinitely.

Thumbtacks for Drawing Board Are Held by Rubber Bands

Instead of replacing thumbtacks in the drawing board when removing finished work, one show-card writer attaches them to long rubber bands, which he staples to the edge of his board. When the tacks are needed again, they are easily reached without pulling them from the drawing board.



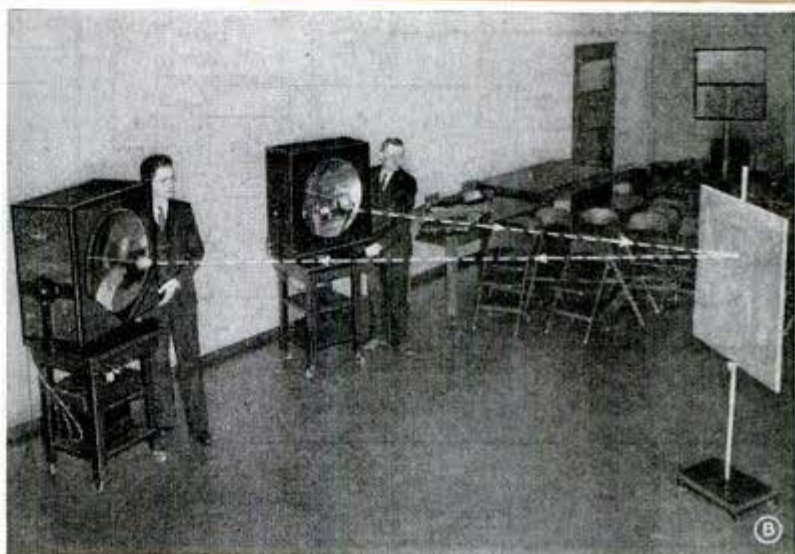
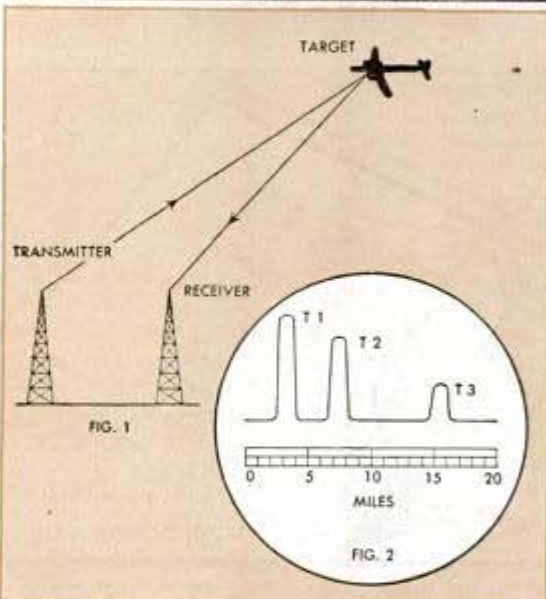


BASIC PRINCIPLES OF RADAR

RADAR systems are based upon the fact that extremely short radio waves have the uncanny ability to bounce off a solid object and be instantly picked up by a suitable receiver. In other words, these microwaves will be reflected upon encountering any object having different electrical characteristics from those of the transmission medium. Since it is known that radio waves have the same speed as light, the time they require to travel from the transmitter to the target and be reflected back to the receiver, if accurately determined, will show the distance to the target.

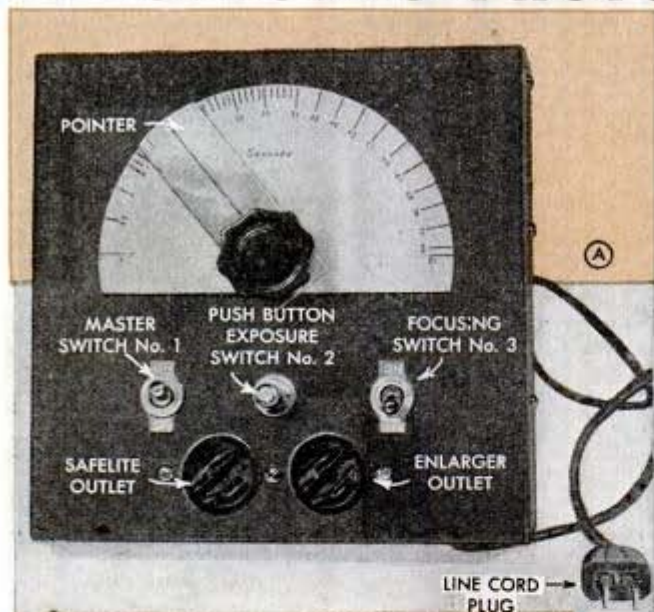
Consisting fundamentally of a transmitter and a receiver, the radar unit broadcasts short waves over the area to be explored. When some of these waves are reflected back to the receiver, as in Fig. 1, the transit time is determined by viewing the received signals on the screen of a cathode-ray tube provided with a scale graduated to show distance. Directly above the scale a horizontal image of the continuously transmitted signal is reproduced. The signals reflected from the target are received, amplified and then superimposed on the horizontal signal and these appear as vertical signals at points on the tube screen which show the exact distance from target to receiver. For example, T_1 in Fig. 2 would indicate a target 3 miles away; T_2 , 7 miles and T_3 , 15 miles. As the targets move, the images on the screen keep pace with them. The vertical and horizontal position of the target is determined by rotating directional antenna in a manner similar to that employed with an ordinary radio direction finder.

Photo A shows a "Philco" type SG ship search radar master station; any number of repeater viewing units may be located at remote points on the ship. Photo B, made at the Westinghouse East Pittsburgh laboratory in 1933, demonstrates the radar principle; at this time it was called radio "beamcasting."



ELECTRONIC PHOTO-PRINT TIMER

By Arthur I. Rattray



ACCURATELY controlled timing enables the busy photographer to make uniform prints. This is especially important when making a large number of duplicate prints, such as personalized Christmas cards and similar printing of favorite snapshots. This electronic timer is easily calibrated by means of any self-starting electric clock, with a sweep second hand, plugged into the "enlarger" socket. The time range is from 1 to 80 seconds and the unit will control any electrical appliance or lamp that does not draw more than 250 watts. The relay winding is in the plate circuit of the 117L7-GT tube which, when heated, draws plate current and closes the relay.

The "safelite" is on all the time except during the exposure timing period.

The sheet metal base is detailed in Fig. 1 and the schematic circuit diagram is given in Fig. 2; a simplified pictorial wiring diagram appears in Fig. 3. Switches 1 and 3 are ordinary s.p.s.t. toggle types. Photos A, B and C show various views of the completed unit.

In operation, during the warm-up period

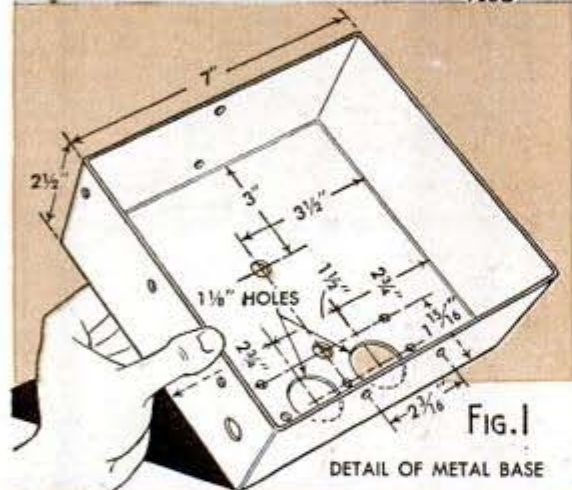


FIG. 1

DETAIL OF METAL BASE

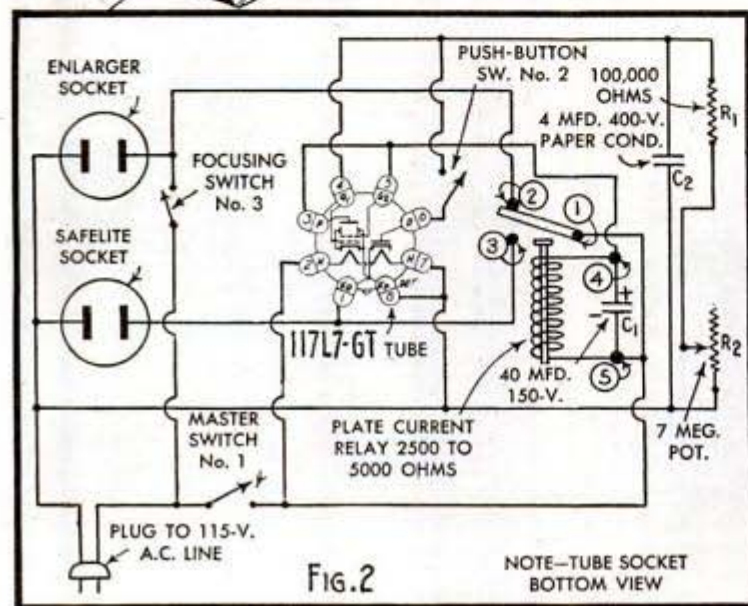
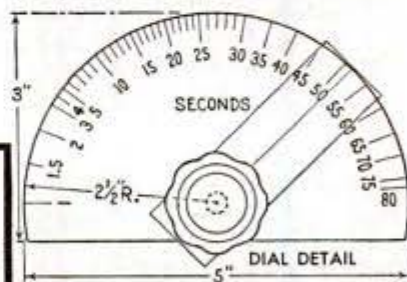


FIG. 2

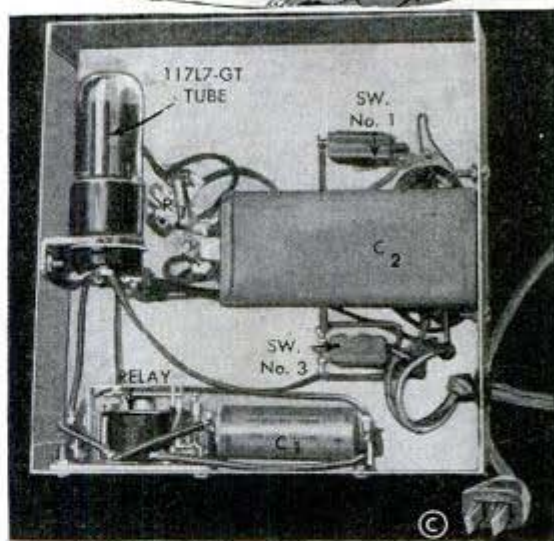
NOTE-TUBE SOCKET
BOTTOM VIEW



for ENLARGER or CONTACT PRINTER

with master switch No. 1 on, the enlarger or printer lamp will light, but as soon as the initial warm-up period is complete it will automatically go out unless focusing switch No. 3 is thrown on for focusing purposes. Keep switch No. 1 on while focusing. Select the time desired by varying control R_2 (dial knob), then press push-button exposure switch No. 2. Switch No. 2 is a s.p.s.t. normally open, push-to-close momentary-type. When it is pressed, condenser C_2 charges; this places a high negative bias on the control grid of the tube, reducing its plate current immediately to the point where the relay drops out. The time required for the plate current to build up again to the point where the relay is actuated is the timing period of printing.

To calibrate your timer, secure the white paper dial on the chassis under pointer R_2 . The pointer is made from a strip of clear plastic $\frac{1}{16}$ by 1 by 3 in. Mark the seconds on the dial as indicated by the sweep second hand of the clock; where the various seconds come in on your dial scale will be approximately at the points shown. The unit should be warmed up for 20 to 30 minutes before calibration, and before using. Student list number for this unit is R-389.



no longer available

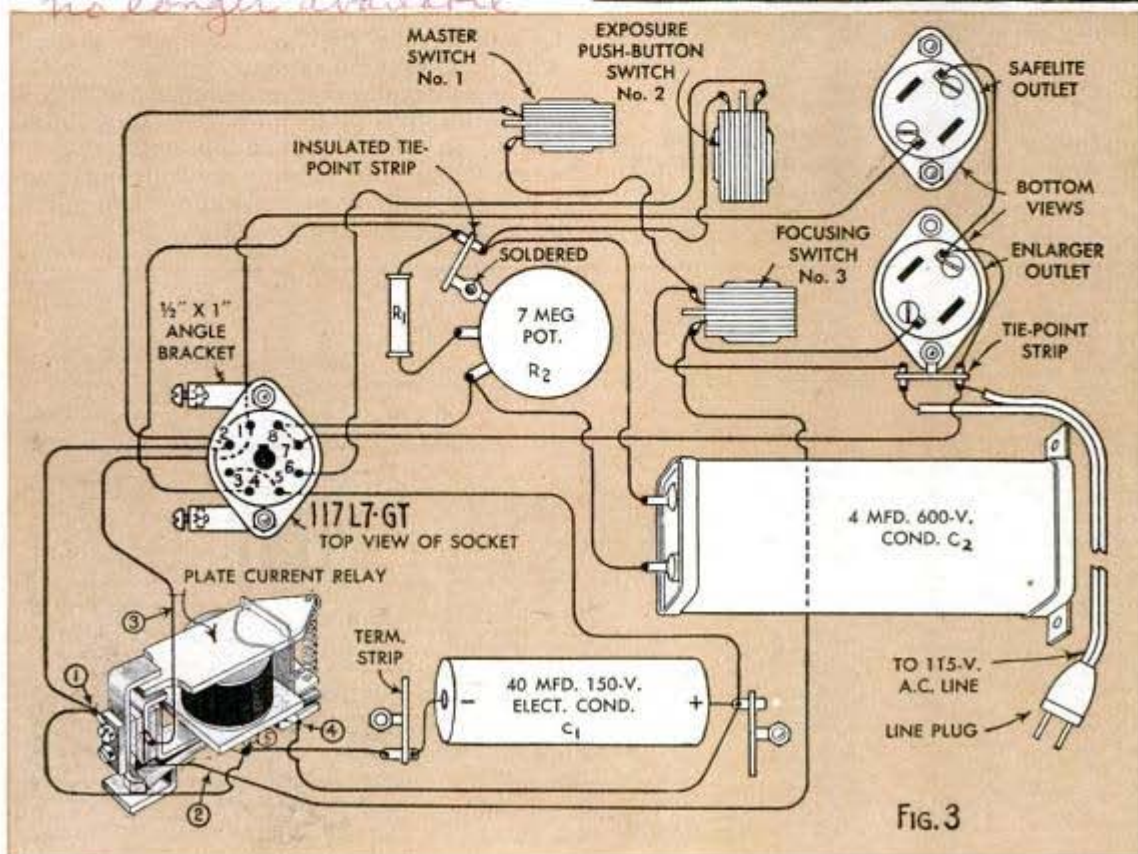
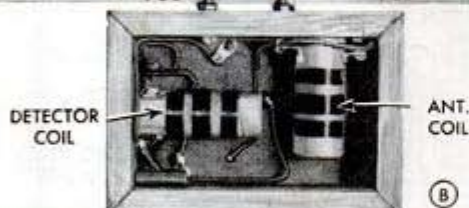
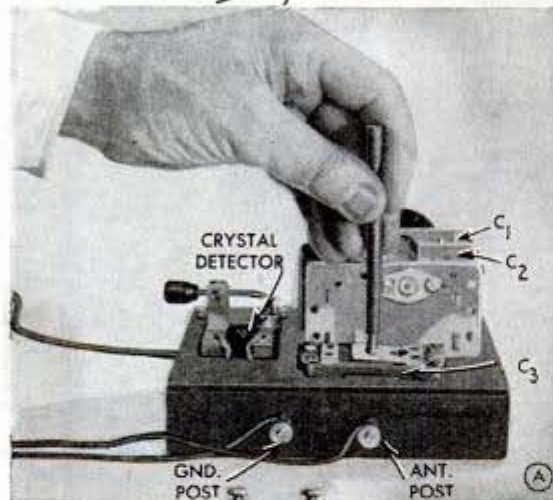


FIG. 3

Sharp-Tuning Crystal Set for Experimenters

By Walter B. Ford

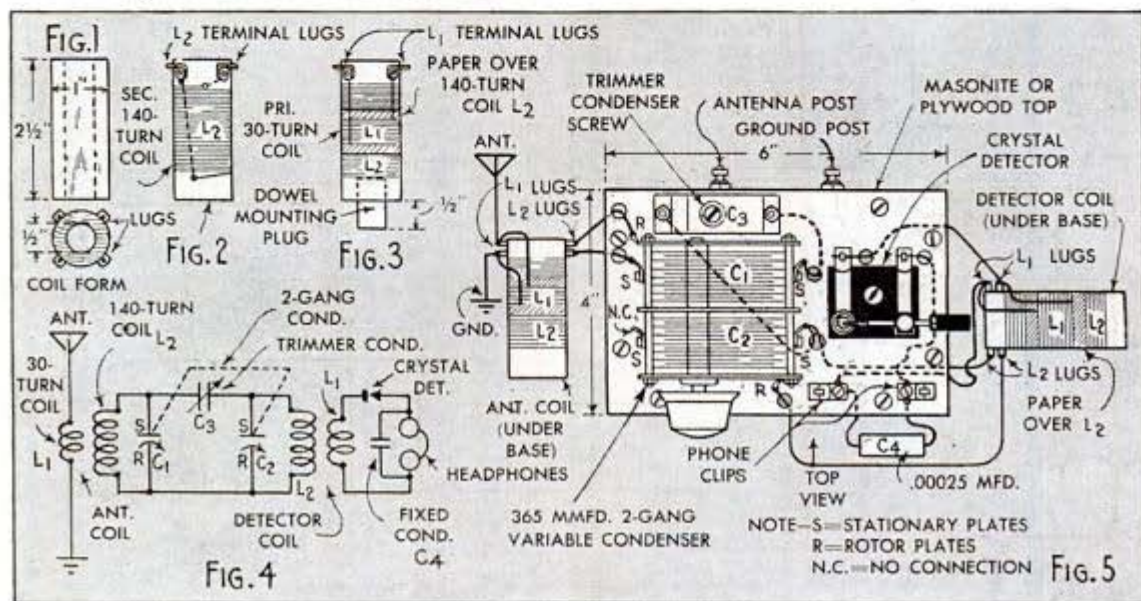


IF YOU are a finicky crystal set experimenter here is one that you will like to try. It employs the band-pass principle and provides two tuned circuits resulting in real selectivity which brings in the desired local station in congested radio areas without sacrificing tonal quality.

The parts are few and quite simple; however, the coil winding details must be followed carefully for maximum results. Two-gang variable tuning condenser (C_1 and C_2) is a common broadcast receiver type; C_3 may be a trimmer condenser of 3-30 mmfd. or similar capacity as the value is not critical; C_4 is a 200-volt .00025-mfd. paper-type tubular fixed condenser, and the crystal detector is an adjustable type. The case is made of $\frac{1}{2}$ -in. wood strips $1\frac{1}{2}$ in. wide; top is $\frac{1}{8}$ -in. hard-pressed wood.

Although the coils may be wound on cardboard mailing tube of the diameter specified, the ones used in the model were close-wound on wooden dowel rod on a lathe, and are as detailed in Figs. 1, 2 and 3. A $\frac{1}{2}$ -in. hole was drilled through the center of each piece, then small holes were drilled through the sides to anchor the coil ends and mount the terminal lugs. No. 30 enameled wire is used for all coils. Both the antenna coil and detector coil windings L_1 and L_2 are identical, and were coated with "coil dope" lacquer.

The schematic diagram appears in Fig. 4 and a top view pictorial wiring diagram in Fig. 5. In operation, condenser C_3 acts as a selectivity and volume control; once set for best results in your location it requires no further attention.



Tough but oh so gentle

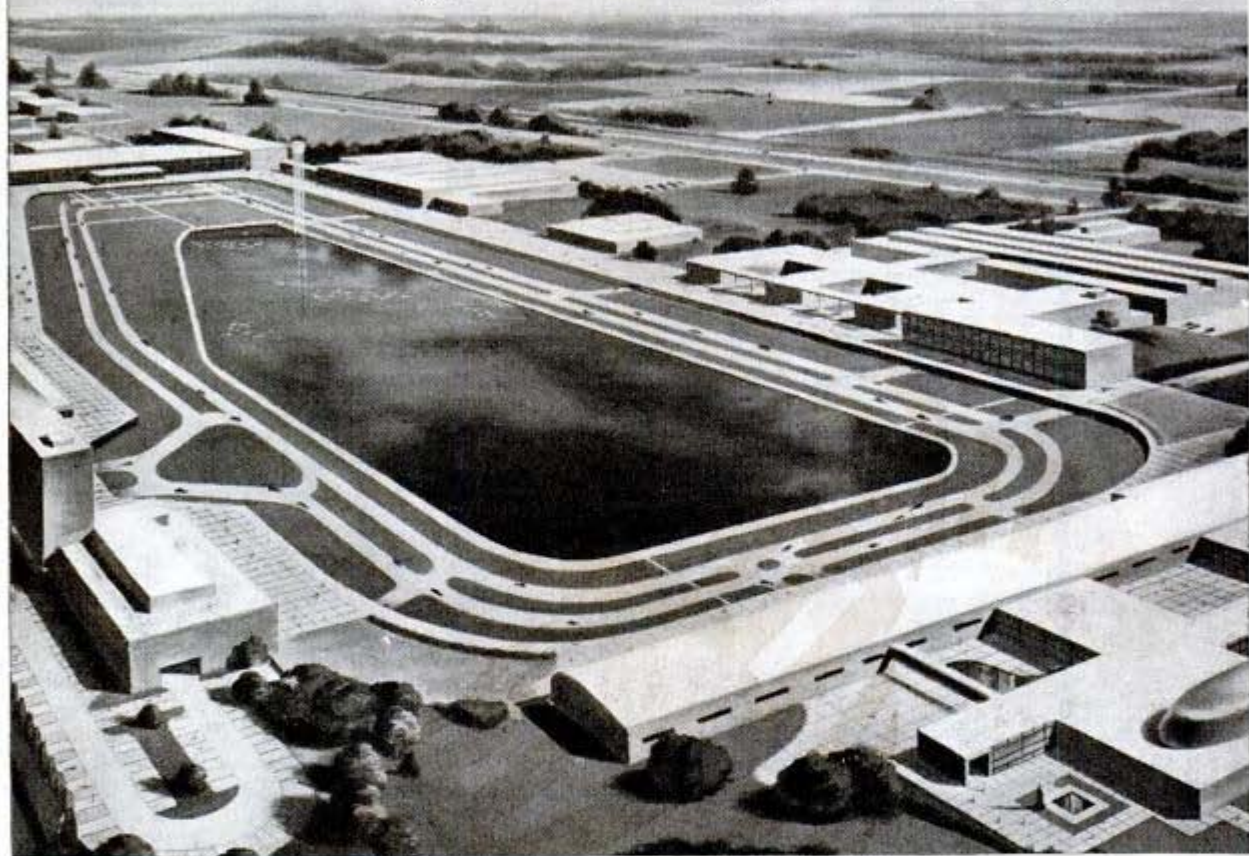
When you install new piston rings, it will pay you to get Hastings rings. They *stop* oil-pumping, *check* cylinder wear, *restore* engine performance. Ask your motor specialist.

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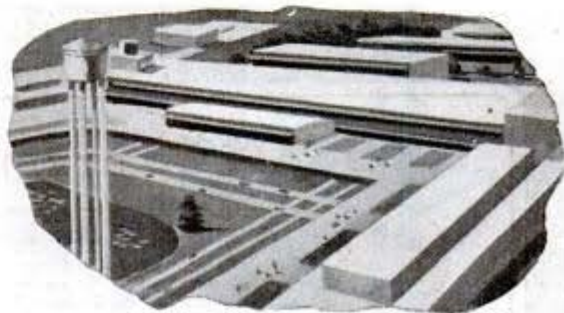
TO SPEED THE PACE OF PROGRESS

— and bring you better things more quickly



LOCATED ON a major highway leading from Detroit, access to the Center will be through the Administration Building sketched here. A system of modern roadways will provide practical opportunity to study traffic control as well as to make simple road tests of new car developments.

A FLOOD OF SUNSHINE will pour into the southern windows of the Research Buildings where experimental work is carried on in such diverse fields as the study of chlorophyl, research into fuels and engine design.



KEEP AMERICA STRONG—BUY VICTORY BONDS

**The New
GENERAL MOTORS TECHNICAL CENTER**
**will be created to stimulate opportunities,
promote employment and bring about
MORE and BETTER THINGS for MORE PEOPLE**

THESE are times when the world cries out for new and finer things. There is a great hunger, broad as all mankind, for happier relationships among men—for greater individual opportunity for accomplishment, for more and better goods within reach of everyone.

It is by satisfying this hunger that we can bring greatest benefit to our national economy in the future. Through such action lies the road to more good jobs, to an ever-rising standard of living through the continual replacement of old things with new and better ones.

The General Motors Technical Center is dedicated to such an objective. It will occupy a 350-acre tract of land outside of Detroit as soon as conditions permit. Its purpose is to develop new things that add to the comfort and security of our living, and to enable existing things to be made more efficiently, hence at lower selling prices, so more people may own and enjoy them—all with expanding job opportunities.

It will shorten the time required to bring the work of creative thinkers out of the idea stage and into usable reality.

Here in groups of buildings designed especially for the purpose, General Motors will gather in advantageous and inspiring new surroundings the most modern facilities for research,

advanced engineering, styling and the development of new manufacturing techniques.

Here physicists and engineers will discover new facts and convert them into new improved products. Stylists will give them new and more attractive form. Process engineers will develop better manufacturing techniques for making them.

Science here will go to work in the interest of economic progress. And history is full of proof that when science is so harnessed, more jobs are created, more comforts and conveniences are brought within reach of more people.

Serving as a source on which the engineering staffs of all of our Divisions may draw, the General Motors Technical Center will stimulate improvement in all General Motors products. Automobiles, refrigerators, Diesel engines, locomotives and other good and useful things may be expected to be improved at even faster pace than in the past.

But the work of the Technical Center will not be confined to existing things. It is dedicated to the idea that progress is the servant of mankind and that whosoever advances it not only helps himself but his fellow men. Its goal will be "more and better things for more people," whether that comes through improvement of the old or development of the new.

GENERAL MOTORS

MORE AND BETTER THINGS FOR MORE PEOPLE

CHEVROLET • PONTIAC • OLDSMOBILE • BUICK • CADILLAC • BODY BY FISHER • FRIGIDAIRE • GMC TRUCK AND COACH • GM DIESEL

Every Sunday Afternoon—GENERAL MOTORS SYMPHONY OF THE AIR—NBC Network

THE SPHINX USED
TO LOOK DOWN UPON:



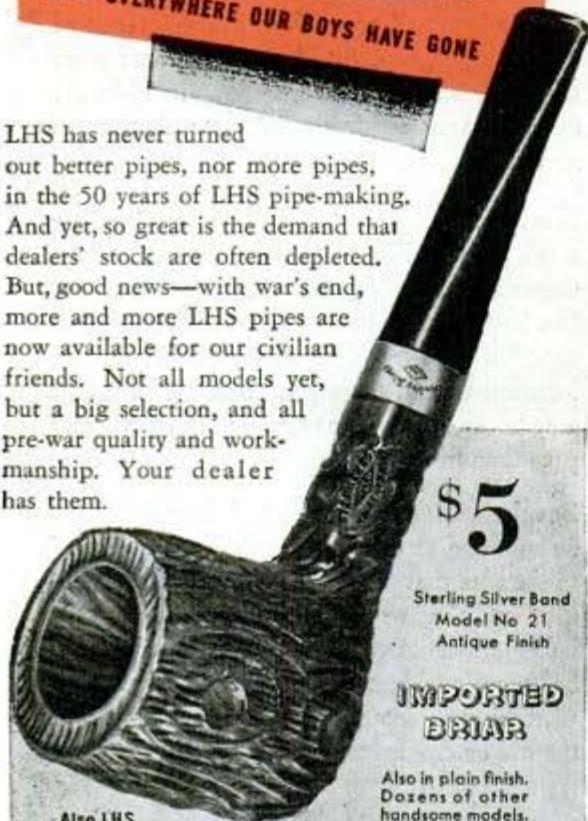
PIPES
LIKE
THESE
IN
EGYPT



LHS TODAY, IT'S
STERNCREST
STERLING

IN EGYPT,
AND EVERYWHERE OUR BOYS HAVE GONE

LHS has never turned out better pipes, nor more pipes, in the 50 years of LHS pipe-making. And yet, so great is the demand that dealers' stock are often depleted. But, good news—with war's end, more and more LHS pipes are now available for our civilian friends. Not all models yet, but a big selection, and all pre-war quality and workmanship. Your dealer has them.



\$5

Sterling Silver Band
Model No. 21
Antique Finish

IMPORTED
BRIAR

Also in plain finish.
Dozens of other
handsome models.

Also LHS
Sterncrest 14K
Specially selected
imported briar,
14K gold band,
Plain and antique
finishes . . . \$7.50

AT ALL GOOD DEALERS

KEEP ON BUYING
WAR BONDS



Reg. U.S. Pat. Off.

FREE—"Pointers on Pipes"—Write

L & H STERN, INC., Stern Bldg., 56 Pearl St., Brooklyn 1, N.Y.

Helium Is a Busy Bachelor

(Continued from page 53)

world in ocean depths. It is conservatively estimated that postwar divers will be able to recover a billion dollars more in salvage than they could have without helium.

Similar advantages are experienced in tunneling and other caisson work where men are subjected to high atmospheric pressures. Curiously, the "sky bends" suffered by some aviators at altitudes over 30,000 feet, and the "ear block" affliction, which is familiar alike to passengers and flyers, can also be prevented by breathing a man-made air of which helium is the chief component.

Though helium had been identified as part of the sun's atmosphere as far back as 1868 and its existence on earth established in 1895, the scene of its real advent as a future useful commodity was the village of Dexter, Kansas, in 1903. Drilling for oil, prospectors at Dexter had produced a flow of natural gas instead which was found to contain two percent helium.


Commercial companies, invited to assist in improving the process for extracting helium from natural gas, performed valuable service, but when the military significance of helium became known, it was decided to make its production a government monopoly. During World War II, Congress appropriated nearly \$17,000,000 for four new helium plants, all now in operation.

Recently the Bureau of Mines arranged to store surplus helium gas in a vast underground reservoir in a 50,000-acre natural gas field near Amarillo, Texas. A pipe line connects the reservoir with helium plants, insuring supplies on short notice.

What about the helium supply? Bureau of Mines estimates place our American potential at over 10 billion cubic feet, enough for quite a while. The natural gases of other continents contain very small percentages of helium.

(Continued to page 150)

**Model Builders
Attention!**



	V	V-2	V-3
Hex	1/2"	3/8"	5/16"
Thread	3/8"-24	1/4"-32	1/4"-32
Thread Length	7/32	7/32	5/32
Weight, Grams	8	3 1/2	2 1/2

Actual Size V-Plug

Champion spark plugs for model gas engines give the same dependable performance as regular Champions. Silliment sealed. Sillimanite insulator. Alloy needlepoint electrodes for easy starting. One piece construction.

CHAMPION

SPARK PLUG COMPANY • TOLEDO 1, OHIO



Because of their dependability

CHAMPION SPARK PLUGS

serve these leading airlines



The American people always give an overwhelming vote of confidence to that which they know they can depend upon. Champion Spark Plugs have won this vote of confidence and are preferred by users on land, sea and in the air.

CHAMPION SPARK PLUG COMPANY • TOLEDO 1, OHIO

DRILL PROTECTOR & DEPTH GAUGE

All in One

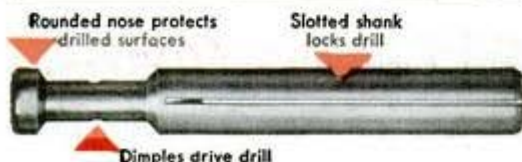
ENDS DRILL BREAKAGE

Now you can drill faster—and not worry about drill breakage. And you can do more accurate work. The new, precision-made Hartwell Protector & Depth Gauge reinforces drills, prevents them from bending or breaking. It is also a *depth gauge* and *stop*—can be used to measure depth of holes or to limit length of drill travel through thin material. It is available in 15 selected sizes, 1/16 through "F"—and will fit standard drill chucks.

HARTWELL

Engineering Company
Designers • Manufacturers • Distributors
3417 Crenshaw Blvd., Los Angeles 16, California

FREE: "Home Drilling Guide" for users of breast and portable power-driven drills. Write to above address.



Rounded nose protects drilled surfaces

Slotted shank locks drill

Dimples drive drill

GET IT AT YOUR HARDWARE STORE

There may exist another vast, untapped supply above the stratosphere. To think of such a supply as recoverable is as far-fetched as the idea was, in 1916, that there ever might be helium enough to fill a big balloon. But a helium-filled balloon has ascended with passengers to 72,395 feet, the highest yet. With designs improved by war experience, man will go higher.

ServRon 10—Floating Arsenal

(Continued from page 62)

virtually in the battle area, but more generally this is done at Navy yards, so that the floating dry docks will not be tied up and thereby imperil other ships needing repairs of a less serious nature.

Although ships of the supply "train" are designed for duties other than fighting, many such vessels have lively combat records. The USS Current, a Fleet tug, along with three other salvage vessels, made a 1000-mile dash into Jap-controlled waters and towed two damaged American warships to safety.

There are no wharves in the forward areas, so cargo handling means booming from ship to ship, or from ship to barge or boat. But that doesn't hinder the work of a special Seabee stevedore battalion which transferred thousands of tons of ammunition and other supplies into the magazines of warships that pounded the Japs from the Philippines to the Honshu coast. Loading nine LSTs with ammunition at sea for a combat operation was one of the Seabees' feats. The battalion considers that its toughest stevedore job was discharging the cargo of a torpedoed ammunition ship. They unloaded 2900 tons of precious high explosive at the rate of a ton per man-hour. In loading a battleship for preinvasion bombardment, they passed the ammunition at the rate of 40 tons an hour, completing their assignment four days early.

Even halfway around the world, the Navy likes to maintain its reputation as the best-fed military force in world history. Food is fuel to stoke the energetic officers and men of ServRon 10, and the arrival of a refrigerator ship from the States is like the arrival of Christmas. In its capacious zero-temperatured holds may be enough food to sustain a city of 100,000 for a month.

One of the proudest feats of ServRon 10 was the utilization of thousands of tons of American steel, accumulated by the Japs in anticipation of war. Painted with Japanese characters, huge "I" beams, made and stamped by American mills and bought by the Japs for some 20 fortified island in-

(Continued to page 152)

AUTO-LITE SPARK PLUGS

IGNITION ENGINEERED



"Ah did hear Paw tell 'er the spark plugs needed a good cleanin'."

DIRTY PLUGS NEED "PLUG-CHEK" TOO!

Cleaning a spark plug often isn't enough. The plugs may be faulty, the wrong type or improperly gapped. Auto-Lite "Plug-Chek" inspection service is the quick and accurate way to find what corrections should be made to improve gas mileage as much as 12%, according to tests by the American Automobile Association.

Have your spark plugs inspected the "Plug-Chek" way by your friendly Auto-Lite dealer. But if new plugs are needed, ask for Auto-Lite spark plugs — they're ignition engineered.

THE ELECTRIC AUTO-LITE COMPANY

TOLEDO, 1, OHIO • Merchandising Division • TORONTO, ONT.

BUY MORE BONDS

Now! CBS

Saturdays 8:00 P.M., E.T.

The **AUTO-LITE** Radio Show
starring

Dick Haymes

HELEN FORREST • GORDON JENKINS'
ORCHESTRA AND CHORUS



NOW! DUSTLESS SWEEPING



The Dustless brush is the only brush ever perfected for "Dustless" sweeping. This brush has a reservoir in its back for Arbitrin sweeping fluid. In the process of sweeping, Arbitrin filters through the brush and makes the best kind of sweeping compound out of every particle of dust it contacts. Besides reducing dust 97%, the Dustless brush also eliminates sweeping compound, saves labor and outlasts ordinary brushes 3 to 1. Get complete facts about this better method of sweeping. Write today.



- Dustless
- Speed Sweep
- Speed Wash brushes

MILWAUKEE DUSTLESS BRUSH COMPANY

528 N. 22nd Street • Milwaukee 3, Wisconsin

stallations, were put to good use in repairing battle-scarred Yank ships.

ServRon 10 is the "business end" of the American secret weapon whose long barrel is the well-guarded supply line from the continent. Backing up the service ships are some 300 advance bases, the miniature Pearl Harbors and Mare Islands that the Navy has installed on barren or tropical islands. In excess of 100,000 tons of supplies are moved each day, enough to fill the holds of 16 Liberty ships. Into these bases, and on to the Fleet, flows an estimated fourth of the industrial output of the United States, under the direction of Admiral Frederick J. Horne, USN, Vice-Chief of Naval Operations. At the peak, about 500,000 men were on duty in such bases.

It is the supply tender that keeps our Fleet mobile. Take the instances of water, fuel and ammunition. One admiral recently declared we were winning the Pacific War on fresh water. Most of the islands have little or no natural fresh water supply; distilling ships have been the answer, supplying our island outposts or ships under way.

Men—material—bases—ships: these are the components of Navy victory. Men with the new skills to repair delicate electronic devices; material—10 million spare parts; bases dotting the ocean; ships by the hundreds. From the enemy's viewpoint, the picture must have been one of engulfing destruction long before the final surrender.

One Step Short of Tokyo

(Continued from page 46)

shore. A production line for pallets is one of the thriving industries of the island.

Salvage operations are a major concern of the depot. There is one rule for each repair job: the equipment must work like new when it gets off the beach. Many weapons are rebuilt in the small arms repair unit.

"Nothing goes out of this shop we wouldn't want to use ourselves if we were face to face with the enemy," said a warrant officer, whose pride is a vaporizing tank. "Just hang one of these beat-up rifles down in the vapor, and the grease and coral and other stuff on it will drip right off. It's mighty powerful stuff. They call it trichlorethylene."

A new crew of Navy specialists has been brought into the depot to repair the huge, awkward LVTs (amphibious tractors). Under sprawling tarpaulins the men weld, retread, paint and repair engines on these vehicles 24 hours a day.

(Continued to page 154)

Why old cars "feel" better with **MARFAK LUBRICANT**

Marfak chassis lubricant is scientifically prepared to overcome the wear of bearing surfaces in old cars. Wear increases clearances, causing play and chattering in spring shackles, steering knuckle, king pins, etc. (Figure 1). These constant shocks further accelerate the wear of bearing surfaces and can cause front-wheel shimmy and excessive tire wear.

Fig. 1

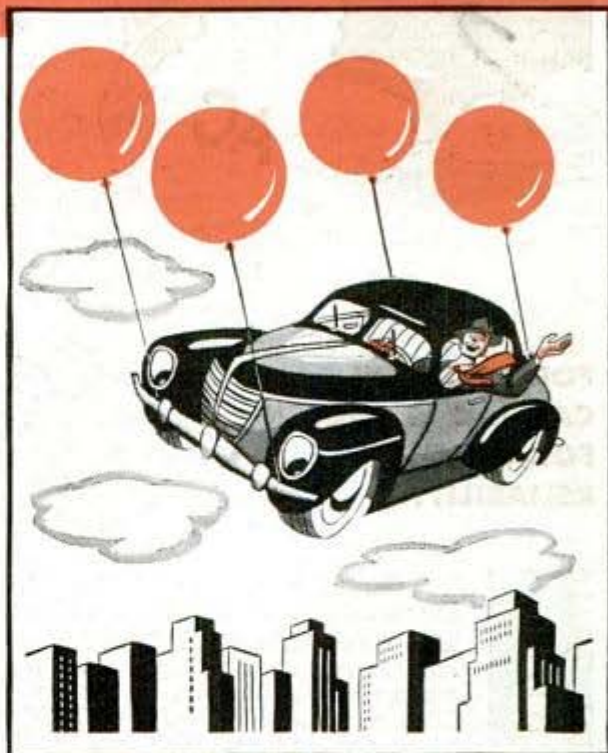
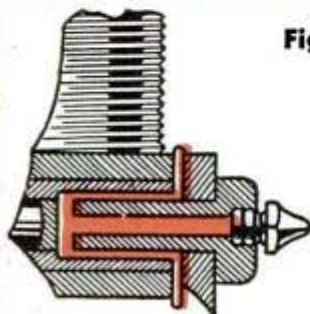
Marfak protects new bearings, sticks to the job and cushions shocks in worn bearings of old cars. Ordinary lubricants jar out.



The combination of its ingredients gives Marfak "body" that keeps the clearances between vital bearings filled with a lubricant that has both cohesive and adhesive qualities. You can *feel* its cushioning effect as you drive.

Fig. 2

Marfak forms protective collars that keep out dust and dirt, keep working lubricant fresh. Ordinary lubricants gum up and dry out.



Not only does Marfak cling to bearing surfaces and resist any tendency to wash-out, jar-out or squeeze-out, but it forms a protective collar that keeps out dust and dirt. (Figure 2).

Marfak also resists oxidation, and retains its superior lubricating qualities far beyond the life of ordinary lubricants. Because it stays on the job, it reduces wear and saves money by eliminating costly repairs and preserving tires.

Change to Marfak now. You'll find it economical in the long run, for it will help keep your car on the road!

THE TEXAS COMPANY



Don't miss the **TEXACO STAR THEATRE** on Sunday nights with **JAMES MELTON** and famous guest stars. See your newspaper for time and station.

You're welcome at **TEXACO DEALERS**

Let us
MARFAK
your car



Boston to Brownsville

FOR PLANE OR CAR—AC IS CHOSEN FOR UTMOST RELIABILITY



Aircraft Spark Plug

The Great Silver Fleet of Eastern Airlines standardizes on AC Spark Plugs. The remarkable reliability of these ceramic spark plugs began with the plugs which AC, alone, built for the Liberty engines of World War I. With Lindbergh, Acosta, Maitland, Byrd, — the Constellation and C-97, — these AC plugs set new, historic records. And in Allied fighters and bombers of World War II, improved versions of these ceramic AC's further proved their reliability.

AC pioneering with spark plugs for cars, trucks, and tractors made these aviation achievements possible. Indeed, it is one reason why 2 out of 4 new cars and trucks were AC equipped.

AC SPARK PLUG DIVISION • GENERAL MOTORS CORPORATION

AC SPARK PLUGS

LET'S FINISH THE JOB—BUY VICTORY BONDS

Far out on a bare tip of the island, in the midst of acres of ammunition dumps, an assembly line is at work salvaging thousands of tons of rusty 155-mm. shells. The shells are scraped clean, inspected and given a coat of camouflage paint.

The shoe and textile men fix an average of 1000 pairs of marine "boondockers" a month, and also repair cots and jeep tops. Sometimes a pair of nurse's shoes arrives to break the monotony.

It's Our Turn at the Potter's Wheel

(Continued from page 80)

Now the ware is ready for decorating, most of which is done by hand. After this work the ware again is fired so that the decoration becomes an integral part of the china.

The ceramics industry served nobly in the war. In 1942 Lenox, Inc., of Trenton, N. J., opened its Lenoxite division to manufacture steatite, or soapstone, which is mined in Tennessee.

Steatite won't shrink when high-fired, and has proved highly valuable for making radio and radar precision instruments, coil forms, resistor spools, insulators and mounting blocks.

Potency of the wonder drug, penicillin, is tested by dropping a solution into tiny steatite cylinders which have been placed in a round flat glass petri dish, surfaced with bacteria that penicillin destroys. The seepage of the sirupy solution creates an area of light around the base of the cylinder, the extent of this area determining the drug's strength.

Most designs in chinaware, figurines, plaques and garden earthenware come either from factory or studio artists. Quite a few studio designers, however, find artistic expression in creating art objects for art's sake. One of these is Frances Poe, a Chicago painter who models large American game animals as a hobby.

Miss Poe, who spent four years in developing her technique, defied authorities who told her that such fragile forms were incompatible with the nature of clay; yet she succeeded in producing the whitetail deer and other animals without a supporting base. Each piece is individually modeled, fired, painted and glazed by hand. Skeletal measurements from the Chicago Museum of Natural History insure anatomical accuracy.

Domestic excellence in quality and design of tableware got its first real send-off when, in 1918, President and Mrs. Wood-

(Continued to page 156)



Savage Model 745—Lightweight Automatic—Combines the speed of an automatic with the ease of handling and light weight of a 'double'.

DOUBLES AT DUSK...

"The birds had been sitting close . . . we'd been working heavy cover and I was dog tired. Toting a heavy gun didn't help any, either. The pay-off came late in the afternoon. A pair flushed, but before I could swing my old 'blunderbuss' it was too late. Then Bill's Savage *Lightweight Automatic*—pounds lighter and seconds faster—came up like lightning. His two shots were so fast they sounded like one. It was 'Doubles At Dusk' for Bill . . . one of the greatest thrills in upland bird shooting.

"If a fellow keeps his eyes open he can usually cash in on past hunting experiences. From now on, I'm off heavy field guns. I want a shotgun that combines the split-second speed of an automatic with the fast handling and light weight of a 'double.' That's why I'm buying a new Savage *Lightweight Automatic* when I can get one."

SAVAGE ARMS CORPORATION, UTICA, N.Y. • PLANTS IN UTICA, N.Y. AND CHICOPEE FALLS, MASS.



Savage Model 99—Hi-Power Rifle, a favorite with big game hunters. Streamlined, solid breech design, fast lever action, pulverizing power. A variety of styles and calibers, including Savage .300 and Savage .350-3000.

Savage Model 6—32 Caliber Automatic Rifle. Great for speed shooting at small running game. One of a great line of Savage .22's and medium power rifles.

Some SAVAGE Models Available Now . . .

The same skill and manufacturing "know-how" which enabled Savage Arms Corporation to produce more than 2,500,000 military arms during 5½ years of war production is now being applied to the manufacture of Savage Sporting Arms. Some models are available NOW . . . many more will be soon. See your dealer . . . and remember your new Savage is worth waiting for.



SAVAGE

WORLD FAMOUS FOR
DEPENDABILITY AND
ACCURACY

Manufacturer of Rifles and Shotguns, Lawn Mowers and Refrigeration Equipment.

NEXT TIME SAY BRIGHT STAR

and you will get a
FLASHLIGHT & BATTERIES
famous since 1909
for QUALITY,
STYLE and
SERVICE



BRIGHT STAR BATTERY CO. CLIFTON N. J.

row Wilson became the first occupants of the White House to choose a state dining service of American make—1700 pieces.

Each piece has a center of creamy white, an outer and an inner border of encrusted dull 24-carat gold separating a band of ivory tint. Each plate bears a seal of the President of the United States and the outer gold border has for its motif the Stars and Stripes.

No alien chinaware has been in the White House service since.

We Need More Soot

(Continued from page 41)

Tank trucks with these tires can dispense with the familiar dragging chain. Conductive rubber may well figure in postwar automotive products.

Another job for the technicians is further development of carbon black that resists heat. Tires made with this type of carbon black alone have been found to be cool running but have poor abrasion resistance. Continental Carbon Company workers have made recent advances in this field, and success may mean tires that are virtually blowoutproof.

Other industries have found many uses for carbon black. Paint makers employ it to add or subtract slight differences of color for hundreds of individual shades of paint. It's found in large volume in high grade black finishes such as automobile lacquers and varnishes. Carbon black in inks had an important role in developing modern high speed printing processes.

Total carbon black production for 1945 is estimated at 1,240,000,000 pounds in a survey by the United Carbon Company, Inc. This compares with 991,000,000 pounds last year and 477,000,000 pounds in 1938.

Paper manufacturers, who long have used carbon black in industrial paper products, found carbon black especially suitable for blackout curtains. Then came the paper shortage, with a dearth of bags and wrapping paper. Only waste paper was available for civilian needs, and it could not be used unless de-inked, a costly process. Why not try carbon black? Customer reactions were tested with black wrapping paper and bags. Results were surprising. People actually preferred the black paper, considered it more decorative and liked the way it withstood extra handling without soiling. Manufacturers now plan full production of black wrapping paper after the war. Black paper is important, too, for protecting photographic film from light.

Carbon black even fits into the concrete

(Continued to page 158)

"When I need a knife, I reach for X-acto!"

Expert Hobbycrafter Says X-acto Indispensable For Fine or Heavy Work

"Couldn't do without those handy little cutters," says Kenneth Whatmore, New York advertising executive. "Boats are my main hobby, and I find a hundred uses for my easy-cutting, non-slip X-acto knife, both in heavy building and fitting, and in carving the trim by hand.

"But believe me, X-acto is just as ideal for delicate jobs, too. Recently I designed a model post-war store, and cut the whole thing out of cardboard, in miniature, with tiny showcases, furniture, and even a merchandise display. I don't know how I could have done such a tricky job without those keen-edged, sharp-pointed X-acto blades to get in and around the sharp curves and corners."



Always Sharp, Always Ready —Blades For Every Purpose Quickly Interchangeable

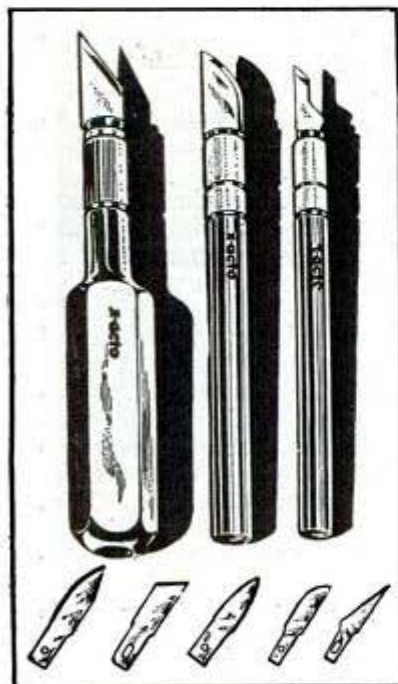


Take your choice of three firm-grip handle styles, designed to fit the hand perfectly, giving greater skill and control.

Then slide in the most suitable of the 10 assorted blade shapes. (This takes about five seconds.) Each designed for a special purpose. All of finest surgical

steel, ground to scalpel-sharpness.

See how effortlessly X-acto cuts paper, rubber, wood or plastics. How easy it is to get that expert touch. Whenever you need a knife, reach for your X-acto — you'll have a lot less trouble, and a lot more fun!



Christmas Inspiration!

X-acto De Luxe All-Metal Knife Chest, \$5. Three X-acto Knives, with an assortment of extra blades, in a handy wooden chest. Dream gift for hobbycrafters... man, boy, or girl.

*Reg. U.S. Pat. Off.

WHO USES X-ACTO?

Artists, photographers, draftsmen. Modelmakers, whittlers, woodcrafters. Botany and biology labs. Bookkeepers, taxidermists, tree nurseries. How do you use X-acto? We like to hear of new uses for this most versatile of knives.



X-ACTO TOOLS, TOO

Handy, sturdy, precise — Each perfect for its purpose



X-acto* KNIVES & TOOLS

X-acto Knives & Knife Chests From 50c to \$5.00

Buy where you see this sign. At better hardware, hobby and gift shops — or if not available write direct to

X-acto Crescent Products Co., Inc., 440 Fourth Avenue, New York 16, N. Y.

Send for these Helpful Booklets:

- (1) How to Build Scale Model Planes,
- (2) Boat Whittler's Handbook, 10¢ each.

Say you saw it in Popular Mechanics!



WHEN SPEED COMES EASY

Strong and swift the graceful greyhound covers distance with bullet-speed because the breeders developed fast action as his foremost quality. Plumb tools, too, are made for fast action—to do your work quicker and better.

But Plumb quality goes beyond getting your work done faster. The hang, the solid single-piece head of unblemished steel, the easy-grip handle of selected hickory, are the features that make Plumb outstanding wherever fine tools are known. Fayette R. Plumb, Inc., Philadelphia 37, Pennsylvania.



NAIL HAMMER



BALL PEIN HAMMER



HALF HATCHET

PLUMB

HAMMERS • HATCHETS • AXES • SLEDGES

industry. Traffic engineers sought an economical means of deadening light glare that reflected from pavements, causing accidents. Experimenting on newly paved roads, they found that one pound of carbon black mixed with 100 pounds of cement gave the road a neutral shade that absorbed light. Extra amounts of carbon black produced permanent black center lines in highways, eliminating constant repainting of dividing lines.

Army engineers overseas read of this with interest, for concrete landing strips flashed in the sun and were easily spotted by enemy aircraft. Carbon black added to the concrete now provides a satisfactory partial camouflage for new air strips.

All this with so commonplace a thing as soot! And the black stuff can be bought for as little as five cents a pound!

The Big Pit

(Continued from page 15)

254-day season. Usually the shipping season averages 6 to 6½ months.

Sometimes in early spring or early fall, freezing temperatures grip the North Country. Then ore in the ore cars hardens, and must be steamed to prevent it from becoming like concrete. This is done by running steam through hose lines from locomotives or special steaming plants to the cars and ramming the nozzles of the hose into the ore loads.

About 285 vessels make up the lake fleet, with numerous new carriers built by the United States Maritime Commission in operation. With the end of the war, 244 of these vessels were left in the ore trade as of Sept. 1, the others shifting to grain and coal transport. Tonnage of the fleet totals 2,940,090 gross tons. Leaving the Lake Superior ports, the boats head for the docks around Chicago, where the iron ore is unloaded in stock piles directly opposite the blast furnaces, or on to Conneaut, Ohio, where it is loaded into ore cars again for transport to the giant mills in the Pittsburgh area.

The overwater journey to Conneaut is about 900 miles, with another 200 to 300 miles of rail travel from mine to dock and dock to mill. It is this long overwater haul that permits economical transportation to the Pittsburgh mills of Bessemer ore containing as low as 45 percent iron. Of the 81,874,930 tons shipped from the Lake Superior district last year, 80,674,930 tons went by the water route, 1,200,000 tons going all rail.

Ore boats are unloaded swiftly with me-

(Continued to page 160)

On the Spot

...ABOUT WHAT BATTERY TO BUY?



TUNE IN THE AUTO-LITE radio show starring Dick Haymes, with Helen Forrest and Gordon Jenkins' Orchestra, Every Saturday Night -8:00 P.M., E.T., on CBS.

GET AN AUTO-LITE BATTERY

You can have the help of experts when you buy your next battery. Follow their example. They choose Auto-Lite batteries for service in the million-mile ocean-spanning Clippers, for service with our fighting forces in jeeps, tanks, and half-traes.

The qualities experts look for in a battery are the same you need in your car battery—long life, quick starts, dependable power and low-cost operation. That's what you get when you buy an Auto-Lite battery—specified as standard equipment by leading automotive engineers.

AUTO-LITE BATTERY CORPORATION • TOLEDO, 1, OHIO

Manufacturing Plants at: Niagara Falls • Indianapolis • Atlanta • Oakland • Oklahoma City • Toronto

AUTO-LITE BATTERIES

ENGINEERED AS A BALANCED UNIT OF THE ELECTRICAL SYSTEM

USE Snap-on TORQUEMETERS

COMPLETE RANGE
OF TYPES AND SIZES
FOR PRODUCTION
ASSEMBLY
MAINTENANCE

WHEREVER ACCURATE
BOLT TENSION
IS REQUIRED

FROM ZERO TO 30 INCH
POUNDS
— UP TO 2000
FOOT POUNDS



DISTORTION caused by inaccurate tensioning of studs and bolts wastes power, promotes wear and is often the cause of mechanical failure. With Snap-on Torquemeters precision tensioning is done more quickly and easily than "guesswork" tightening. Even inexperienced workers pull to specified tension every time . . . they see the torque reading as pressure is applied . . . they work swiftly, confidently, accurately.

In many plants Snap-on Torquemeters are standard wrench equipment for a wide range of assembly operations. *Wherever Torquemeters are used in the factory, it is equally important that they be used in service and maintenance work.*

The full range of Snap-on Torquemeters is covered in the 1945 catalog of 3000 Snap-on tools for production, assembly, maintenance. Mailed on request. Write, SNAP-ON TOOLS CORPORATION, 8062-K 28th Avenue, Kenosha, Wisconsin.



chanical unloaders, including the Hulett unloader in which the operator sits directly over the bucket and rides down into the hold with it. Mechanical bridges running at right angles to the vessels to be unloaded are fitted with automatic "grabs" which run over a trolley-train attached to arms of the bridges, and, after scooping up the ore from a ship's hold, deposit it in railroad cars or stockpiles at the furnaces. The bridges themselves move backward and forward along the unloading dock.

The ore boats don't return empty to Lake Superior, but carry coal and other material which isn't obtainable in the North Country. Though the ore fleet never fired a shot, it delivered the stuff that blasted the Axis out of existence.

Bringing the Atom Down to Earth

(Continued from page 6)

power we now have at hand we clear the channels of rivers of snags and hazards and we take out of harbors the natural menaces to traffic. Now with atomic explosive power, there is every reason to believe we will move out and conquer similar major dangers of the high seas.

That isn't all. As we may clear old channels, we may well make new ones. Remember reading how the French spent decades in trying to dig the Panama Canal and then failed? We took modern machinery and modern science (primarily to conquer yellow fever and malaria) and did it. At that, it required years of arduous toil. With atomic power controlled, as it will be just as other natural forces have been harnessed, a new Panama Canal is possible in weeks instead of years. One foresees such a channel charted, with calculations showing the exact amount of explosive power needed to remove rock or soil; then tiny holes dug, and a string of atomic pellets buried along the right-of-way. The switch is thrown—a deafening roar and clouds of dust and smoke follow. When they clear away, the rough channel lies before you, the major job done. Significantly, the atom-bomb explosions in New Mexico and Japan were outward and upward, not downward, thus making such power immensely effective for channel purposes.

From time immemorial, water transportation has been rated as ideal, both in smoothness and in cheapness. That is why even hand-dug canals are to be found the world over. Now that undreamed-of energy has been tapped, one may reasonably believe that atom-dug systems of canals will interlace every continent of the world.

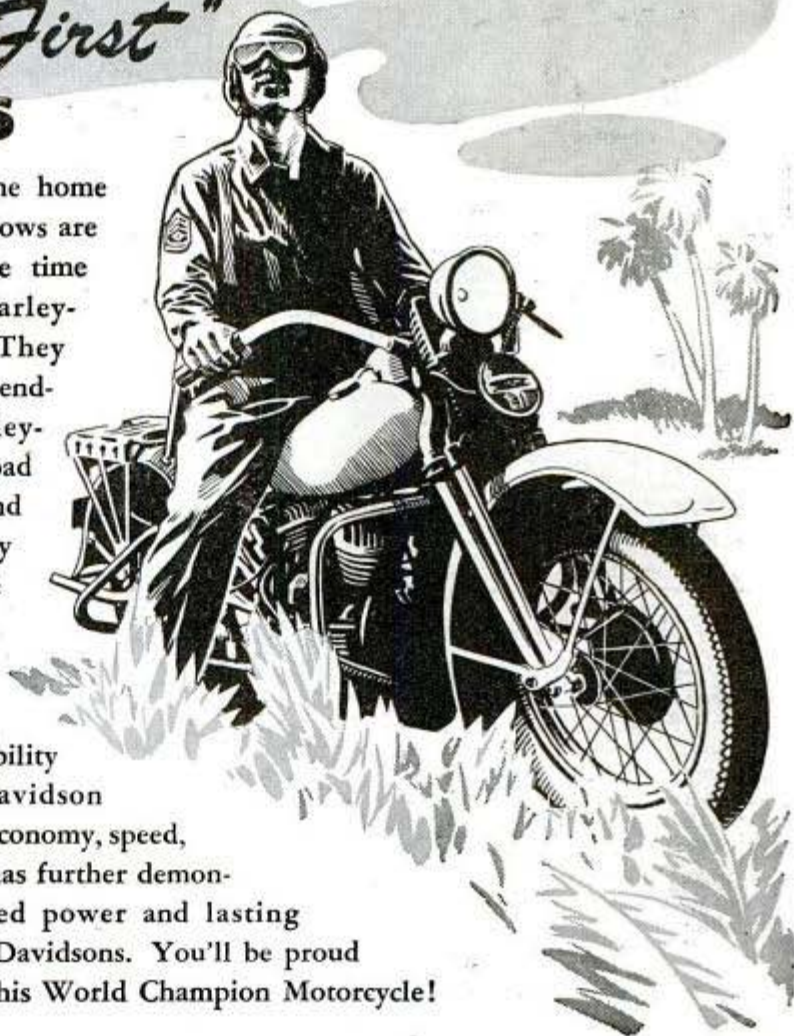
(Continued to page 162)

HARLEY-DAVIDSONS ✓ ON THOUSANDS OF

"Want-First" LISTS

On war fronts and the home front, thousands of fellows are looking forward to the time when they can own Harley-Davidson Motorcycles. They know plenty about the dependable performance of Harley-Davidsons under toughest road and weather conditions — and in the deluge of letters they send in, they keep saying, "I've got a new Harley-Davidson on my want-first list."

Thanks, fellows — and you'll get that time-proved dependability that has made Harley-Davidson Motorcycles famous for economy, speed, and stamina. The war has further demonstrated the unmatched power and lasting qualities of Harley-Davidsons. You'll be proud to own and ride this World Champion Motorcycle!



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Special attention has been given to proper rake and clearance. Correct curve provides a double-shearing action that makes it easy to prevent file running off line. Nicholson hardening methods keep the teeth cutting longer.

Use Nicholson Curved Tooth Files on cast iron, sheet steel, commercial annealed tool steel; on aluminum, magnesium, babbitt, brass, lead, soft alloys; on plastics, hard rubber, wood. *Standard, Fine and Smooth* cuts—for fast metal removal down to fine-finishing; for lathe, die and tool work. Rigid and flexible types.

FREE BOOK, "FILE PHILOSOPHY"—48 illustrated pages on kinds, use and care of files. For master mechanics, production and purchasing heads.

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(In Canada, Port Hope, Ont.)



Inland pleasure travel by boat may then come into style again.

Land benefits are foreseeable the same as those of water. Prehistoric animals made their trails across mountains, and buffalo and Indians followed them. Next came twin lines of steel and finally ribbons of concrete. All have followed the few mountain passes available, such as through the Rockies. Unlimited explosive power, as revealed by the atom bombs, throws wide open the possibility of cutting mountain passes down further, even blasting small peaks out of the way—in short, of making massive cuts for transcontinental roads.

Many portions of America are spotted with lakes, such as Michigan, Wisconsin and Minnesota; others, such as Kansas, where I came from, hardly know what the word means. Yet standing bodies of fresh water are rated high as both a health and agricultural benefit. I have seen scores of places in my rambles where a little variation of the topography would have made a beautiful lake, with all of the attendant benefits and pleasures. A controlled atomic blast might easily in such a case serve a double purpose—deepen a natural basin and throw up an earthen dam or barrier that would hold the water back and produce a lake.

One may see another variant of the use of atomic energy in earth removal. That is in strip-mining. In many coal and iron ore regions the veins lie only a few feet, maybe 15 or 20, below the surface. Stripping off the top dirt is a tedious job. Atomic explosives can be visualized as performing this task in minutes.

Time will be required, of course, to refine atomic power to the point where it can be used for precision jobs. But that will come, sooner perhaps than many of us think. As to what the splitting of the atom will make possible, estimates range all the way from fantastic conceptions by dreamers to remarkable ideas by scientists, whose sober judgment has always made them cautious. A few glimpses will be of interest.

On the seemingly fantastic side, a compendium of scientific opinion, issued more than a decade ago, contained the prediction that enough heat could be generated by smashing the atoms in a pound of water to raise the temperature of 100,000,000 tons of water—as much as flows over Niagara Falls in four hours—from freezing to the boiling point. It asserted that a breath of air contains enough atoms which, if split, would yield the energy to keep a plane flying for a year, or that a heavy train could girdle the globe several times on the atomic

(Continued to page 164)

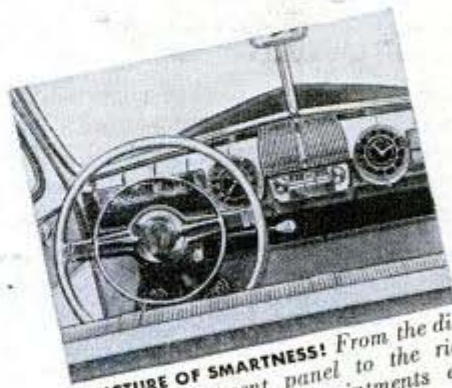
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gines. The spirited V-8, now 100 horsepower—or the lively 90 horsepower Six . . . Production of these new cars is fast hitting its stride. Keep in touch with your Ford dealer.



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During the present shortage of tools, owners of Disston saws have been particularly fortunate. The fine quality of their saws has kept them serving well through the emergency, and assures many more years of dependable service.

Many hardware retailers and saw repairmen provide a special saw sharpening service. They will be glad to help you keep your Disston saw—or other quality make—in good, serviceable condition. If you need a new Disston saw or other tool for *essential* work, discuss your problem with your Hardware Retailer.

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energy from a railroad ticket; again, that a puff of cigarette smoke could run a tractor for a year, while from a shovelful of coal could be taken enough power to run all of New York's machinery for five years.

We also look back to 1931 and find the Berlin Institute of Physical Research claiming one gram of water contains \$125,000 worth of energy—it would cost that much to produce it by ordinary means. Two years later W. D. Harkness of the University of Chicago estimated a pound of hydrogen to be equal to 10,000 tons of coal; the atomic energy in a handful of snow would heat a large apartment house for a year; a trip around the world could be made on the energy generated from a teaspoon of water; a gram of matter would send an airplane around the world without stopping to refuel. And now, by way of variety, we have the chief of the U. S. Rocket Society saying that a trip to the moon by way of atomic power is not only possible, but one may before long go joy-riding among the planets!

On the other hand, within recent days Dr. Samuel K. Allison of the University of Chicago, another great scientist foremost in atom-bomb development, said that we may be heating whole cities with atomic energy within a few years. None less than the National Advisory Committee for Aeronautics has just affirmed that "it is not fantastic to visualize a fuel supply the size of a brick with sufficient power to fly around the world many times." The best and most authoritative picture of all is contained in the authorized release on the atom bomb, which spoke of it containing the explosive force of 20,000 tons of TNT.

The main point is, we are at the gateway to a new world, the world of unlimited power. As to the time required to reduce atomic energy to efficient use, one can only guess. Some great minds say a few months to five years, others say a generation, and a few assert it will take a century. A Gallup poll showed people generally believe that "atomic energy will be harnessed to supply power for industrial and other uses within the next 10 years." Bearing that out is the statement by Prof. M. E. Oliphant of Birmingham, England, University, one of the scientists responsible for the development of the atom bomb, that inside of the next decade atomic energy will replace all forms of power for large-scale production.

If the atom can be split, it can also be mastered, in the view of most authorities, particularly those associated with the bomb development. High regard must be given to the affirmation of Dr. J. R. Oppenheim-

(Continued to page 166)



Be "All Set" For '46

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er, credited by the War Department with being as much responsible for the atom bomb as any other scientist, that world changes by 1965 will be more marked than those which took place in the two decades following Faraday's revolutionary work with electricity.

There is good reason to expect quick action. We live at a feverish pace as the result of the war, and this pace cannot be expected to slacken much. Reconversion is only the prelude to swift action of many kinds at hand. And so great is the realization of the import of the discovery of the means to harness atomic energy that we can expect the greatest peacetime scientific race against time in all history.

We read comparisons of the time it took the auto and the airplane to come into general use. The first gasoline auto was invented in Europe in 1882, but widespread use did not begin until about 1910. The plane was two decades reaching general acceptance. When Marconi sent his first wireless waves across the English Channel, he was gravely informed by "experts" that radio waves never would cross the ocean. Yet Marconi did it in just two years!

One would stick his neck out if he attempted to set a minimum time limit on the commercialization of atomic energy; he is wiser if he points to the astounding genius which split the atom, and to other unbelievable attainments of science and industry in recent years, and simply says: "Any time!"

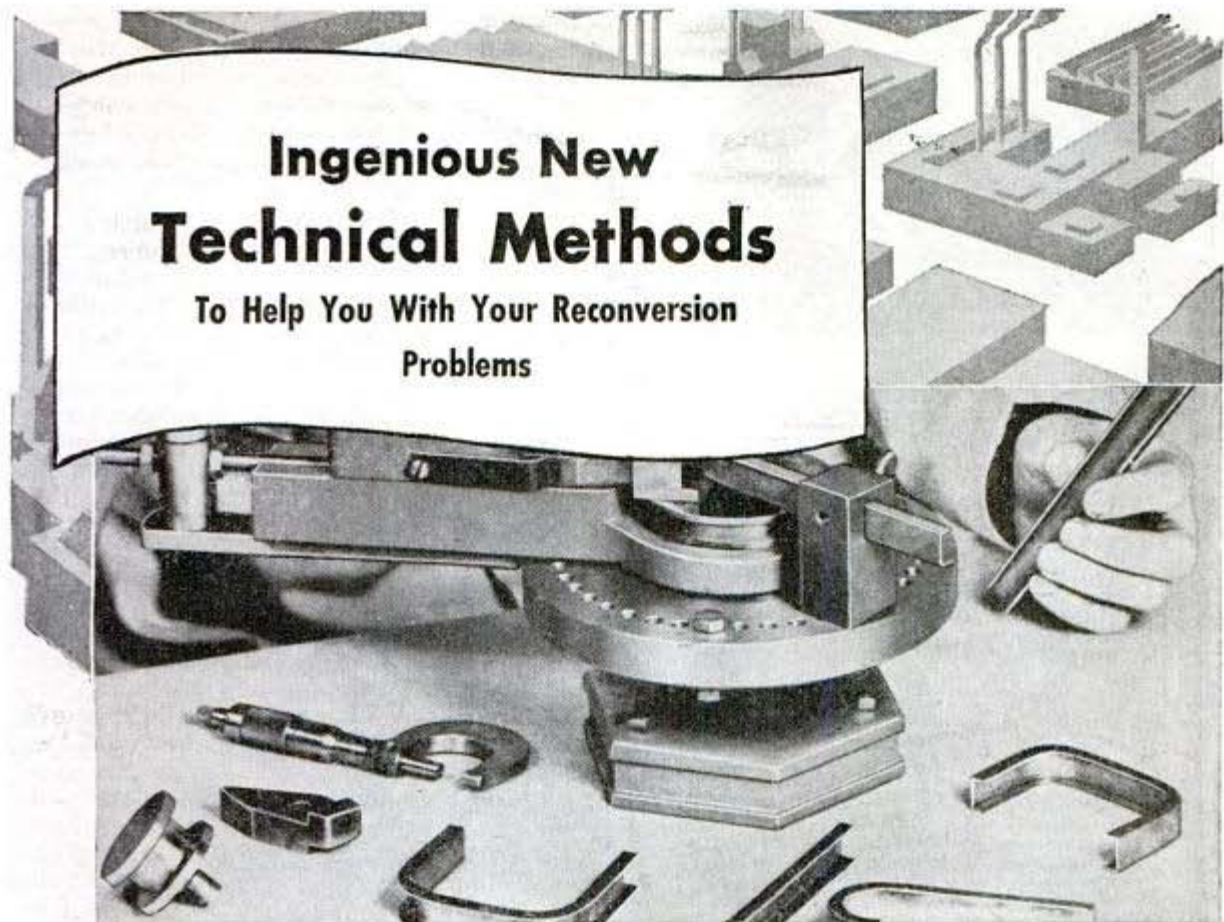
Most authorities to date do not envision early atomic energy plants in autos or airplanes using pinpoint supplies of atoms for power; rather they foresee, at first, atomic energy developed and capitalized in vast generating plants for electricity or direct power, which will be available for every purpose where distributed energy is used. In the case of big ships, of course, atom fission may supply the power direct—in fact, back in 1939 the Navy allotted \$2,000,000 for atomic power experimentation for just such a purpose.

Even with such restricted use as that, one can see an incredibly thrilling era ahead. Although each one of us now has something like 113 mechanical slaves working for him, as Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, affirms, that may be multiplied countless times. Homes heated and lighted for a cent or two a day, or by power possibly furnished free as a public utility. Highways across the nation lighted as bright as day will make night travel a delight. Planes of 2000-miles-an-hour speed are foreseen,

(Continued to page 168)

Ingenious New Technical Methods

To Help You With Your Reconversion
Problems



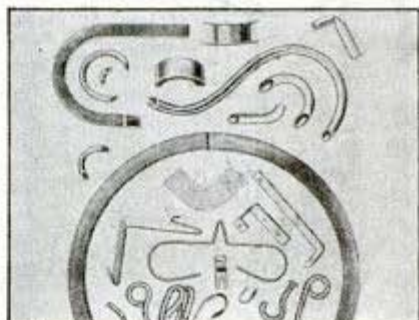
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6 shots as fast as you can pull the trigger. Ideal for fast-moving small game, vermin.

If you're lucky enough to get a new Marlin, treat it well. It will repay your care with many long years of service.



THE
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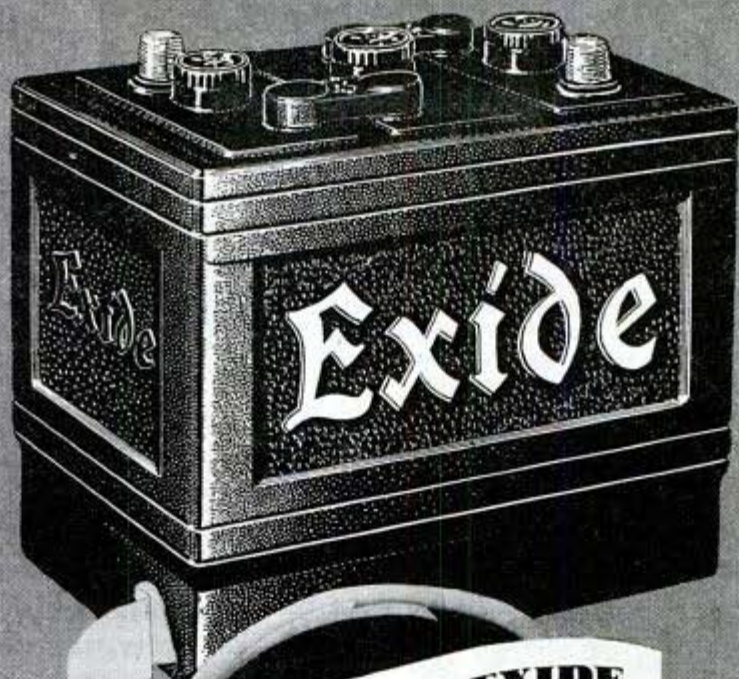
with any spot on earth only six or seven hours from one's doorstep. Cities will be scattered because there will be no need for congestion at the source of power. Coal mines will become a curiosity like the dodo. One can have controlled agriculture in his back yard, growing the finest vegetables and fruits as he desires. He need never want for the daintiest and rarest delicacies direct from the garden.

Unlimited power will mean the production of ample food, clothing, housing and other necessities as well as myriad luxuries, for everyone. Poverty and famine, slums and malnutrition will disappear from the face of the earth. Diseases will be attacked with fresh vigor because there is to be an ample margin of time for the cultivation of health and superb care of the body. Abundant time for study and research will make a game of mental development, and intelligence and education will reach a new high. Wars will fade out as an amplitude of production of all things necessary to adequate and enjoyable living anywhere and everywhere will remove the fundamental economic and material rivalries that provoke war. Just as America, with an abundance of resources and with high standards of living, is a peaceful nation, so the spread of wealth over the poorer sections of earth, where wars breed, will destroy the swamps where such evils generate. A new and excellent culture, the like of which the world has never before glimpsed, is likely to come into being.

As to healing, eminent scientists point out that X-rays, radium and atomic energy are links in the same chain of radioactive substances and forces, and therefore an astonishing new era of success in the treatment of disease which X-ray and radium now effectively treat, particularly cancer, may be expected.

The by-products of solving the mystery of the atom will doubtless be as valuable as they will be intriguing. One very intelligent financial editor suggests that unlimited atomic energy may so increase our production that a corresponding enhancing of the national wealth will be so great that it will "outrun our public debt"—in other words, make the public debt relatively such a small item that it can be handled without a convulsion in the process!

No one can chart the future, but evidence is at hand that the greatest magic carpet of all the ages is being unrolled. It remains for man to use it for his own good rather than his ruin. But we need not fear. In the long run, man usually chooses the thing that will keep him going and improve his lot—at least an atomic trifle!



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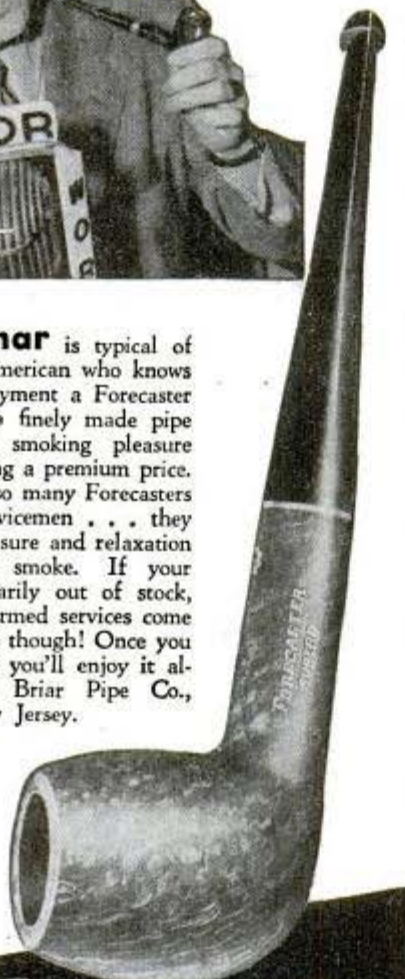


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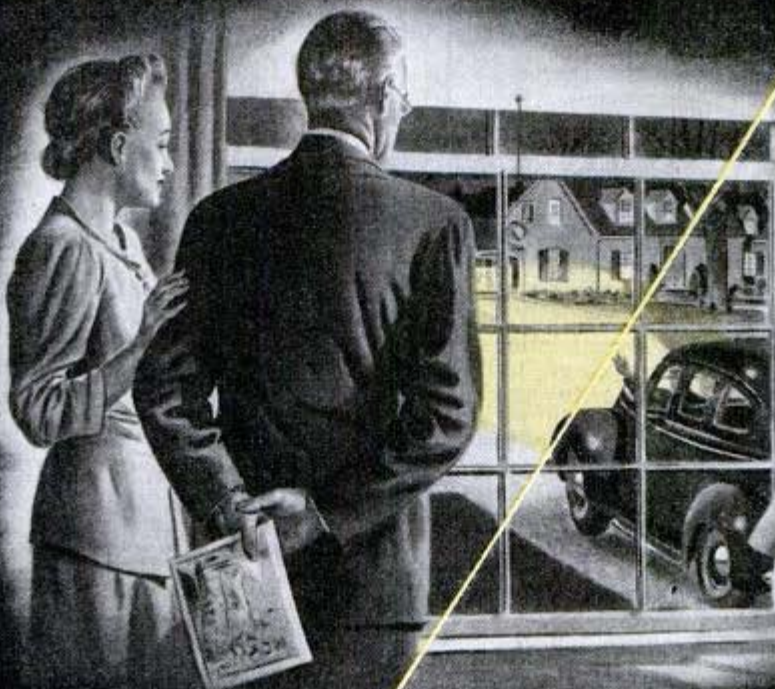
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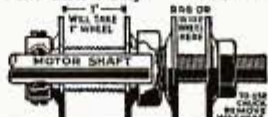
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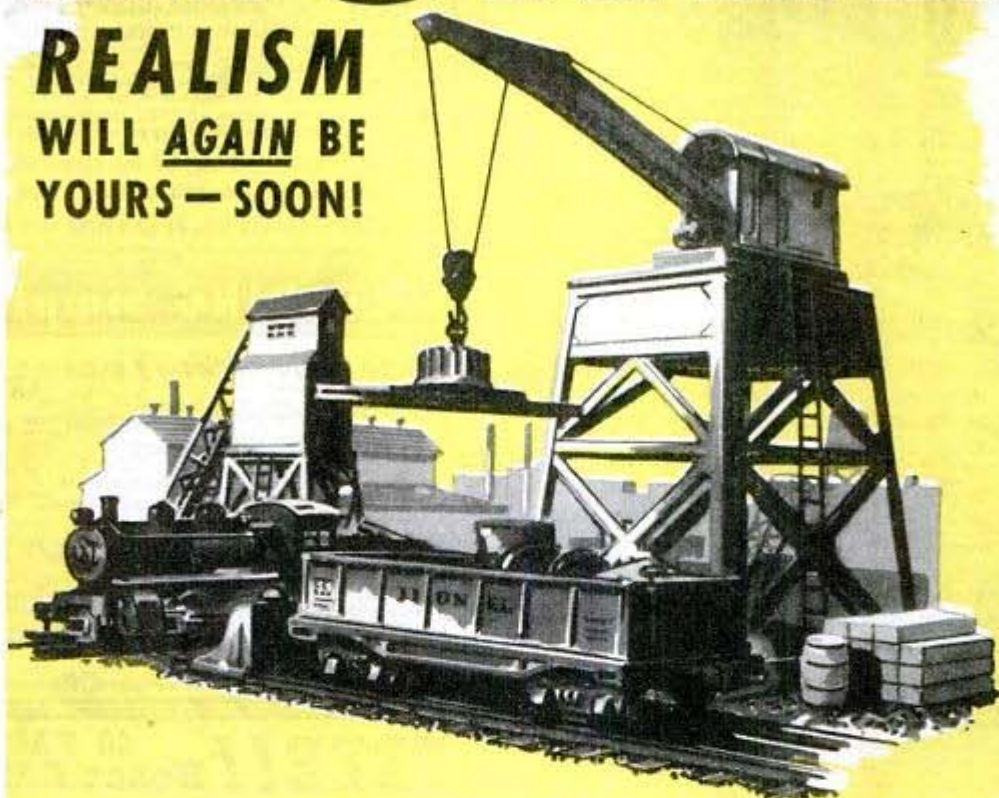
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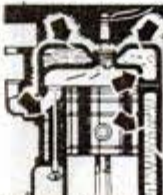
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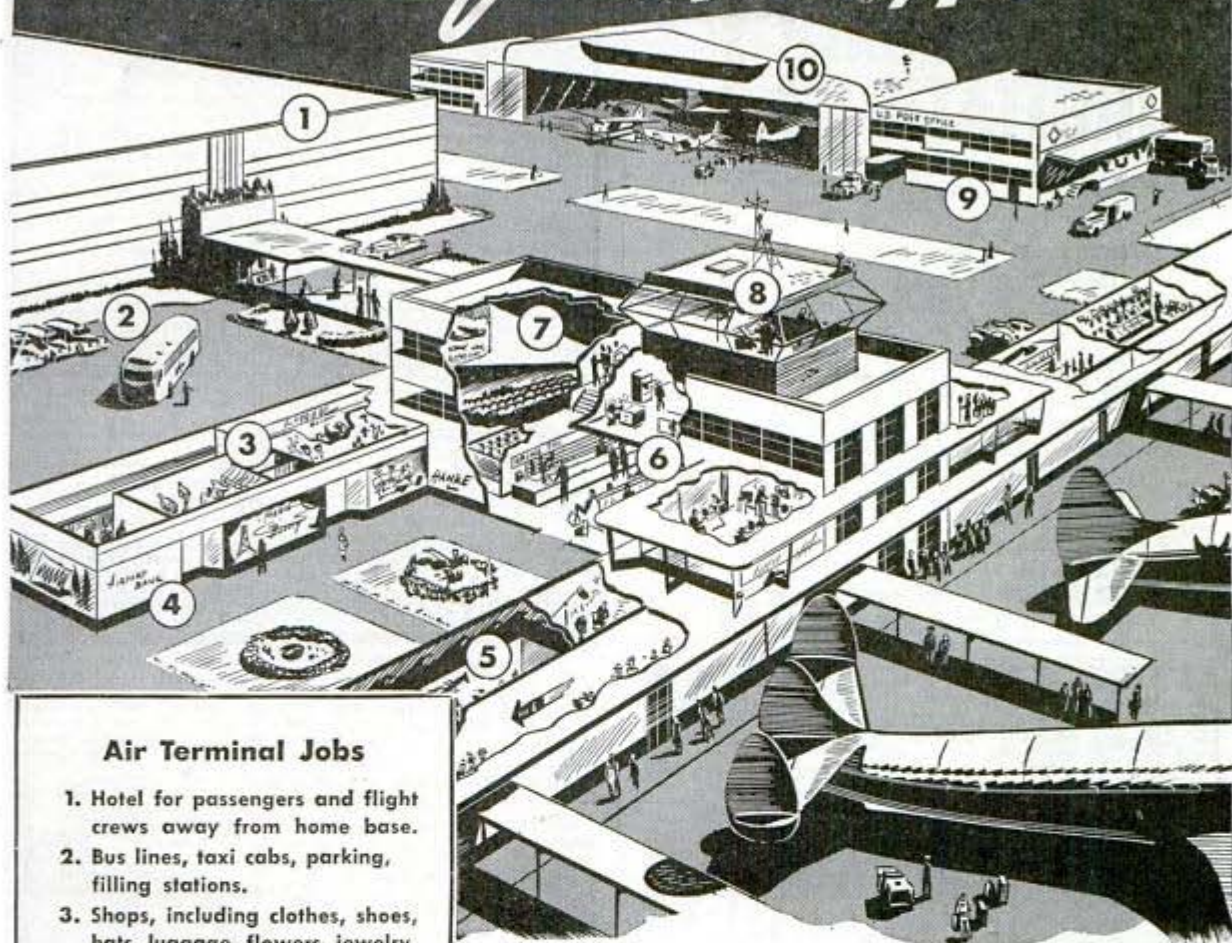
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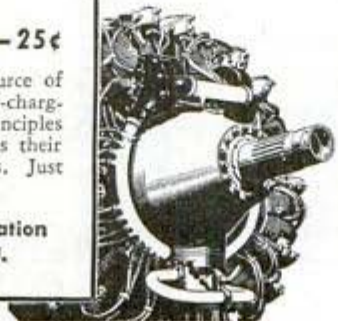
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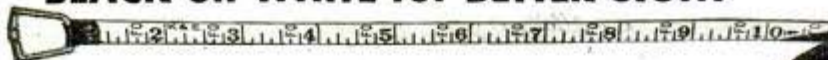


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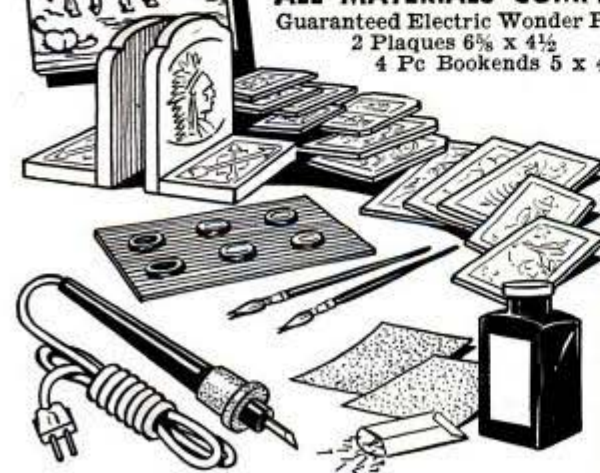
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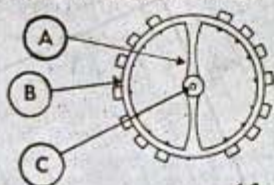
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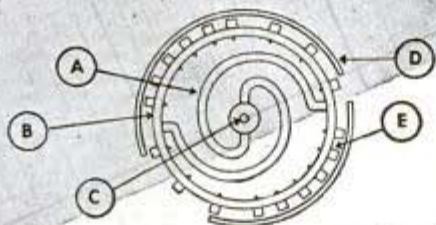
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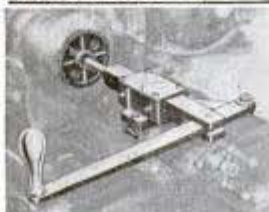


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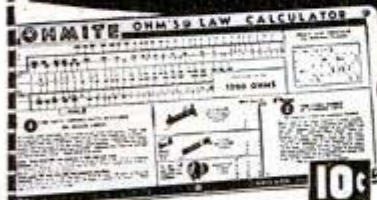
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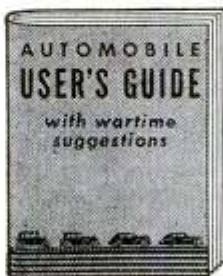
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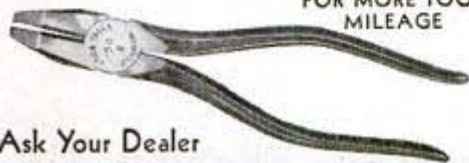
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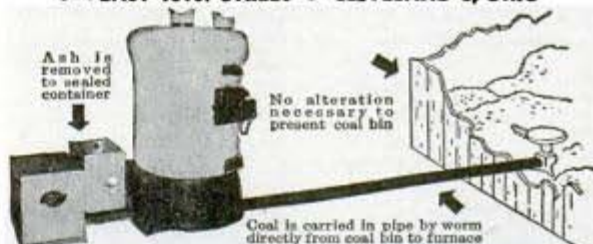
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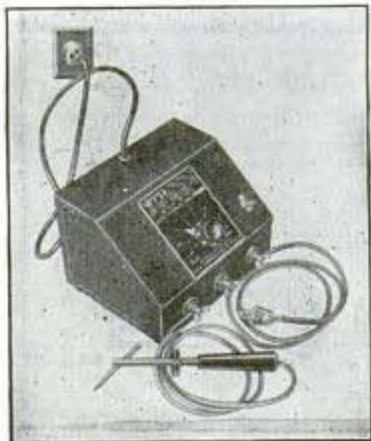


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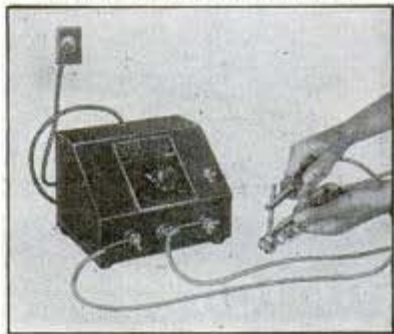
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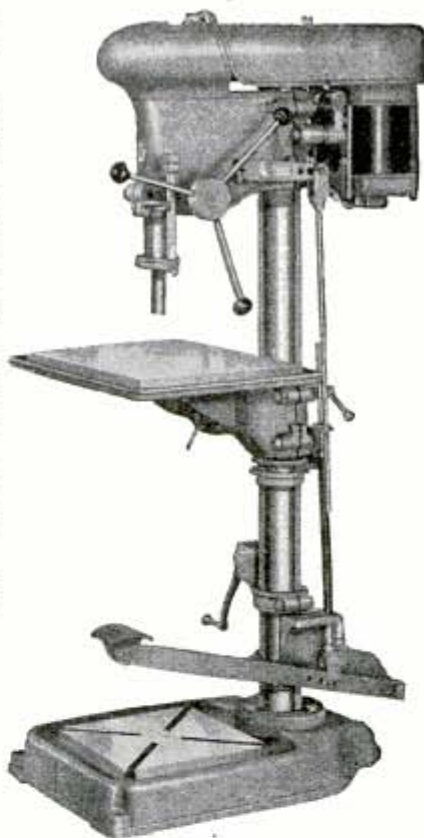


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Model 2 Illustrated

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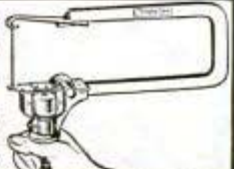
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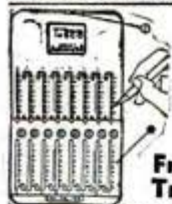
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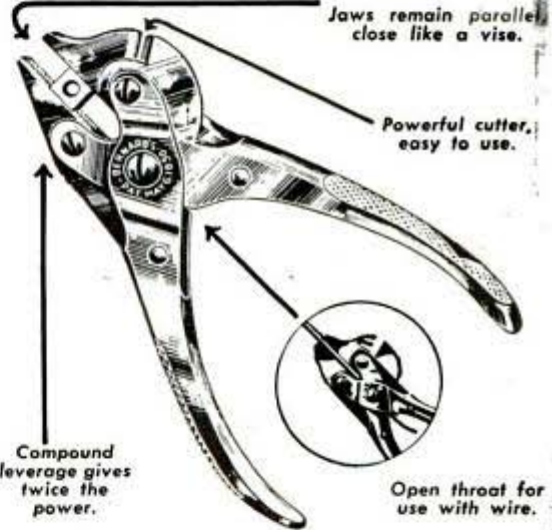
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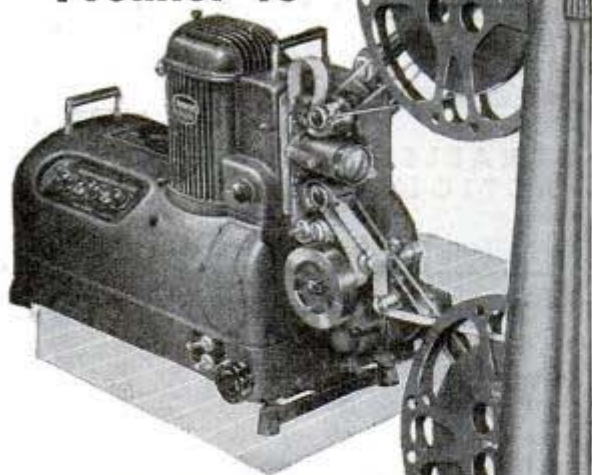
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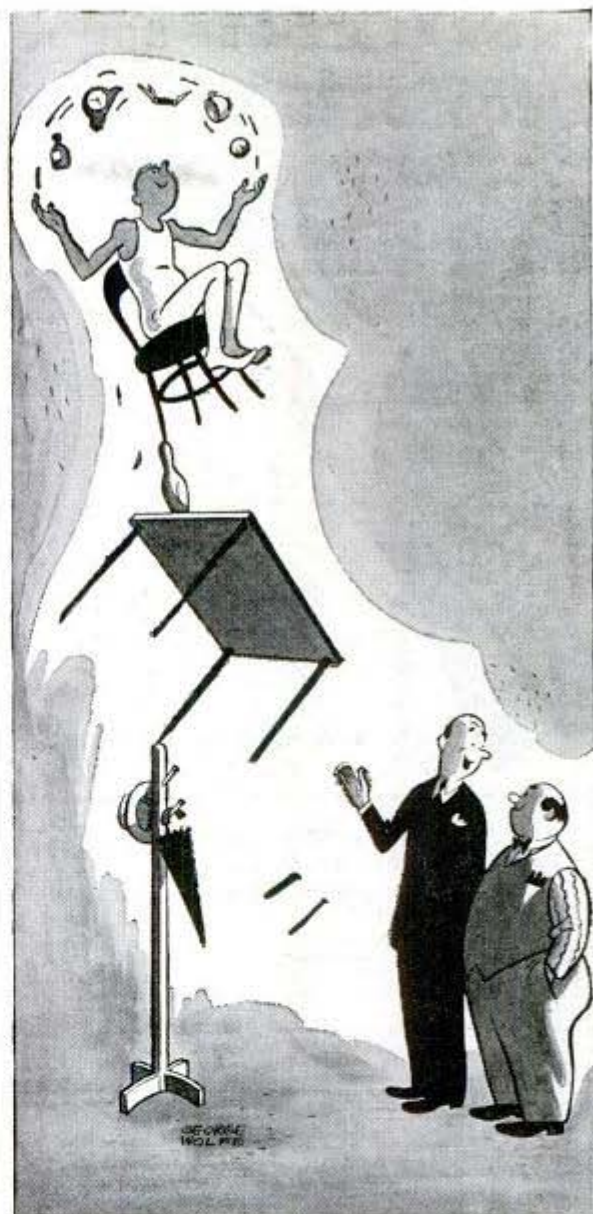
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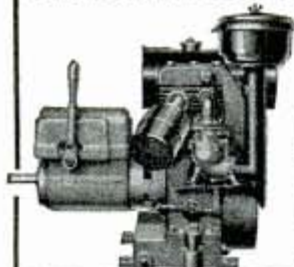
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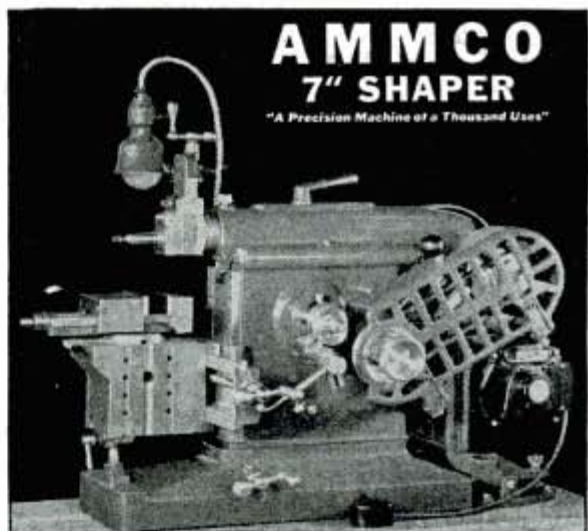
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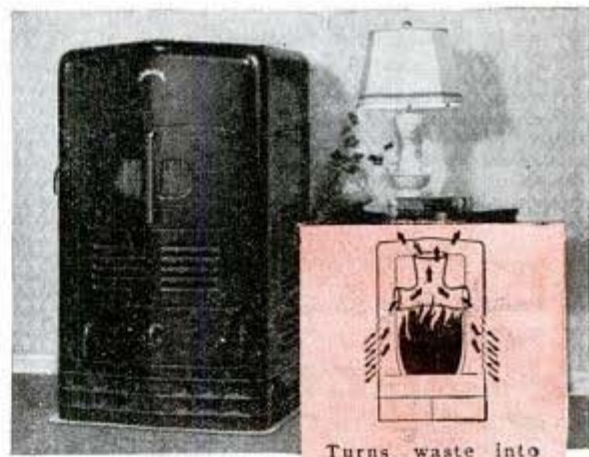
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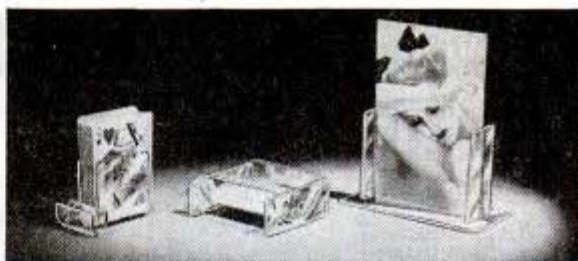
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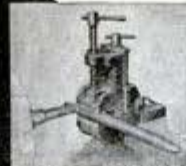


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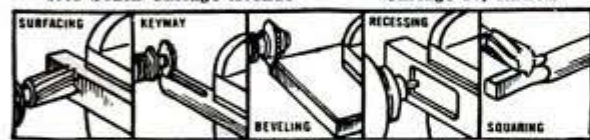
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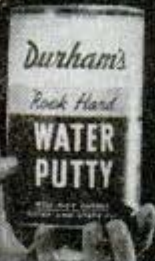
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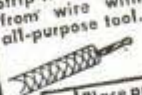
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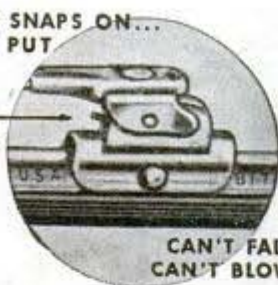
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Extra heavy. For farm, home or jungle use. Blade of Gov't. Formula cutlery steel. Walnut riveted handle. 3 1/2 inch hill, 10 1/2 inch blade. You'll find hundreds of uses for a Bolo knife. Blade will take and hold a keen cutting edge. Wt., 2 lbs.

A112-with Army Sheath..... \$4.95

A212-Leather Sheath, extra..... \$1.50



PUP TENTS

Regulation Army Pup Tents of durable, brown canvas. Used, but in good condition. Fine for campers, outdoorsmen, boy scouts, etc. Grand Xmas gift for children.

A100-Tent Only..... \$4.95

A101-Ropes, wooden poles and stakes for above. Per set..... \$1.00



SHIPS BELLS

Purchased from U.S. Maritime Comm. Measures 10 inches high, 9 3/4 inch flare. Big 8 inch clapper. Weight 15 lbs. Fine for arms, clubs, ex-states, etc. All new.

A541, ONLY... \$9.85



HEAD NETS

Real protection from insects, etc. Fits over hat. Draw strings in net. Celluloid window. For campers, fishermen, etc.

A509, ONLY.. 89c



BLITZ CAN

Standard Gov't. blitz cans. Used and scuffed but guaranteed leak-proof. Measures 1 1/2 x 1 1/2 x 1 1/2 inches. Welded seams. Screw cap. Capacity 5 gal. One of a bargain.

A542-EACH..... 85c



CAVALRY SPURS

Genuine wishbone type cavalry spurs. Nickel plated.

A102, Pair... 98c

A103-Spur straps per set of four..... 50c



CATHODE RAY TUBE

Purchased from U.S. Gov't. for experimenters in electronics, radar, etc. Slightly used for test work. Guaranteed perfect. Tubes are standard No. 5BP1 or 5BP4 with 5 inch screen. Each tube tested before shipment. Specify number when ordering. Tube list on request.

EACH, express collect..... \$12.00



RUBBER CUP WITH LID

Measures 3 1/2 x 3 1/2 inches—of genuine live rubber. Snug fitting lid. Makes fine tobacco humidifier, etc. All guaranteed perfect.

A503-EACH..... 59c



RADIO HEAD PHONES

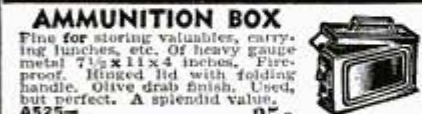
Extremely sensitive with 4000 ohms resistance. Brand new and fully guaranteed. With moisture-proof cord and phone plug. A splendid value for the radio serviceman and experimenter.

A106-PAIR..... \$2.95

7-LB. RADIO PARTS ASSORTMENT

A "gold mine" for the radio serviceman. Hundreds of valuable radio parts, including rivets, soldering lugs, sockets, coils, resistors, trimming condensers, etc.

A1308-7 LBS. \$1.79



AMMUNITION BOX

Fine for storing valuables, carrying lunches, etc. Of heavy gauge metal 7 1/2 x 11 x 4 inches. Fire-proof. Hinged lid with folding handle. Olive drab finish. Used, but perfect. A splendid value.

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In sheet form. Good workable sizes. Transparent. For costume jewelry, etc. Easy to work and polish.

A280-5 LB. \$4.75

ASST. \$4.75

27 LENSES, ALL NEW, PERFECT.

For experimental work in optics. Consists of 27 precision ground and polished prisms and lens elements in assorted diameters and focal lengths. Big variety, positive, negative, etc. Actual value over \$100.00.

A519-27 PIECES \$7.95

50 LENSES, SEMI-FINISHED

Lenses similar to above but not polished. All are blanked and formed ready for polishing. Negatives, positives, and prisms in Crown and Flint glass. Worth many times this low price.

A520-50 LENSES, ONLY..... \$1.95



BICYCLE DUFFLE BAG

Heavy canvas pouch. Attach to bicycle for lunches, shopping, books, etc. Has three 11 x 12 inch pockets. Used, and slightly soiled, but in good usable condition. Has oversize flap with two straps.

A113-EACH..... 98c

CATALAN-ASST. COLORS

Extruded shapes, rounds, half rounds, etc. Easy to machine. Furnished in assorted colors, shapes and lengths.

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ASST. \$4.75



COMB. AIR PILLOW-LIFE BELT

Every outdoorsman, hiker, camper, boy scout, etc., should have one. Made of air tight, waterproofed, rubberized khaki 10 x 40 inches when deflated. Swimmers, boatmen, etc., use them as life-belt or beach raft. Quickly inflated or deflated. Folds compactly for storage. Used, but guaranteed perfect.

A127-EACH..... 98c



SADDLE BAGS

Made of finest top grain leather. Rivet reinforced seams. Bottom and side gussets. Each canvas lined bag measures 12 x 13 inches. Fine for motorcyclists. May be separated to make two duffel bags. Used, but perfect.

A151-EACH..... \$7.95



OFFICERS WATCH COMPASS

Brand new gov't. surplus. Army-Navy model. Single jewel mounted needle. Silver colored dial. A splendid value.

A174-EACH... \$3.35



AVIATORS GOGGLES

U. S. Aviator Goggles. Over-size design with sponge rubber shock lining. Curved lenses, elastic head band. Fine for industrial use, motorcyclists, etc. Hinged nose arch. Slightly used, guaranteed perfect.

A159-PAIR..... \$5.95



"MIKE" BUTTON

Microphone button for experimenters in electronics and other electrical apparatus. Used in telephonic amplifier and telephone circuits. Measures 2 1/2 in. Brand new.

A512-EACH... 98c

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Values galore! Hundreds of hard-to-find items for home, shop and outdoors. Make remittances by money-order, bank draft or personal check. Send 25% deposit on C.O.D. orders. No C.O.D.'s on orders for less than \$5.00. Include sufficient postage on parcel-post orders—any overage will be promptly refunded. All quotations F.O.B. Chicago. Used items and materials are guaranteed serviceable and as described. Your money back if not more than satisfied.



SHIPS LANTERN

Purchased from the Navy. Stands 2 1/2 inches high, 9 3/4 inches wide. Of heavy sheet metal. Windproof ventilation. Mounts on any wall. Burns oil—may be wired for electricity. All new.

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CAMERA TRIPOD

Purchased from U.S. Gov't. For cameras up to 5x7 in. Extends to 39 inches, folds to 23 inches. Has 5 1/2 inch brass head with extended threading screw. Extra sturdy design. Adjustable. Brand new.

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Maintenance men, farmers, mechanics, machine shops, foundries, auto, general repair and job welding shops using the DYNAMIC WELDER find it so indispensable and useful that they cannot afford to be without it. If inexperienced you can easily learn to do a variety of high-grade welding jobs by following the practical, simplified operating and welding instructions furnished.

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It's the Greatest Portable Outfit

"Now I am equipped for all kinds of welding and I must say it's the greatest portable outfit for welding any man could ever wish to own. I wouldn't sell mine for the cost of plenty welders I have seen which were very high in cost but not in convenience. You may put me on file as a booster of your wonderful welding product." W. J. B., St. John, N. B., Canada

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"I have done quite a little welding with my welder and will say it is better than I expected. The price, convenience, and variety of work that can be done with the Dynamic are the attractive points." W. R. P., Portland, Ore.

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AUTOMOBILE REPAIRS



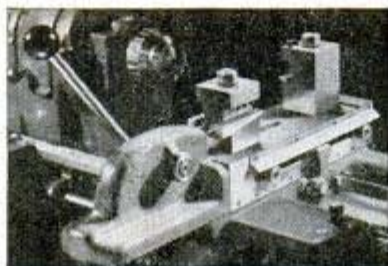
AN IDEAL AND PRACTICAL GIFT FOR ANY MAN!

MORE VERSATILITY

FROM SOUTH BEND LATHES WITH THESE ATTACHMENTS



Handlever Bed Turret for 9" or 10" lathes multiplies their versatility through multiple tooling for repetitive operations.



Handlever Double Tool Cross Slide for 9" or 10" lathes speeds up successive operations through the use of three cutting tools.



Screw Feed Double Tool Cross Slide for 16" lathes has both manual and power cross feed. Large graduated feed dial.



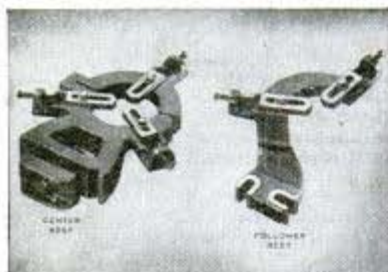
Handlever Draw-in Collet Attachment saves time on bar work. Collet can be operated and stock fed without stopping spindle.



Handwheel Draw-in Collet Attachment is ideal for production and toolroom work that requires extremely close tolerances.



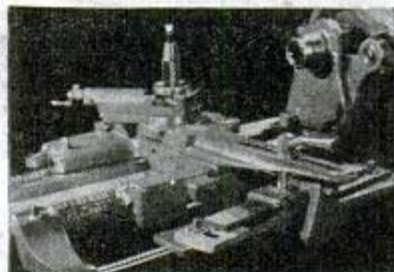
Collets from 1/16" to 1" in 1/64" steps. Complete sets of collets will save time.



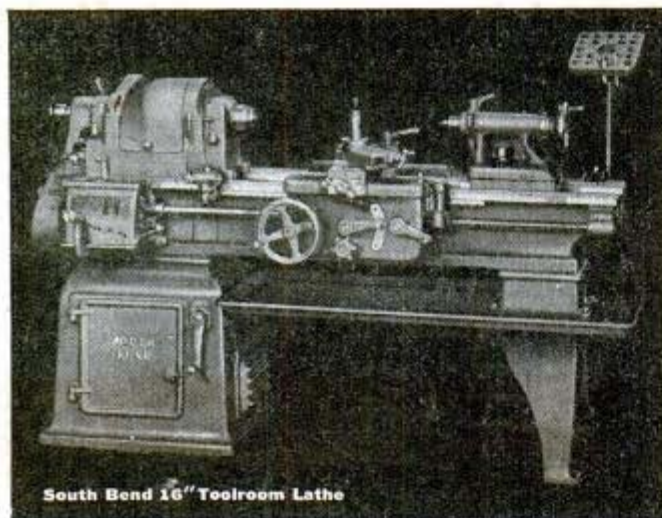
Center Rest and Follower Rest for supporting long bar work while turning, threading, drilling, boring, etc.



4-Way Turret Tool Block permits use of four cutting tools which simplifies tooling for repetitive operations.



Taper Attachment for accurate taper turning and boring. Quickly engaged. Graduated in both degrees and taper per foot.



South Bend 16" Toolroom Lathe

These and other practical attachments greatly increase the capacity of South Bend Lathes for a wide variety of operations. They simplify difficult set-ups, save time and effort, and often eliminate delay and expense of making special fixtures.

Write for Catalog 77R in which all South Bend Attachments are illustrated and described. Also, state size and type of lathe for which required. Attachments only available for use on South Bend Lathes.



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FLASHLIGHT BATTERIES

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If you ask for
"PRESTONE"
ANTI-FREEZE

and he says **SURE**



**you're safe...
 and you know it!**

Your dealer may not be able to say "Sure." There's an even more limited supply available than last year, because the Armed Forces still require so much non-boil-away anti-freeze.

But if he *can* supply you with "Prestone" anti-freeze, you're all set for the cold weather. "Prestone" anti-freeze can't boil away, evaporate or foam off. It protects against rust and corrosion. One shot lasts all winter—you're safe and you know it!

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 Unit of Union Carbide and Carbon Corporation



The registered trade-marks "Eveready" and "Prestone" distinguish products of National Carbon Company, Inc.

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 OUR ARMED
 FORCES
 STILL NEED
 ONE-SHOT
 ANTI-FREEZE**

Vast numbers of our tanks, trucks, planes, warships, etc. remain at various points throughout the world. This tremendous investment of the American people must be protected—and protected properly. That is why our armed forces still require quantities of one-shot anti-freeze.

Time Too Short

Even though the requirements of the services have been reduced, not enough "Prestone" anti-freeze can be made to meet both military and civilian needs this Winter.



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