

*Planes of Tomorrow*

By Glenn L. Martin

# POPULAR MECHANICS

## MAGAZINE

WRITTEN SO YOU CAN UNDERSTAND IT



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WAR SAVINGS  
BONDS AND STAMPS

SEE PAGE 1





*"Now, mother, don't be a back-seat pilot . . . I'm only going 150!"*

**W**ILL ordinary folks own a family plane? No question about it! You could buy one today but for the war. That's only part of the story. There'll be super-luxury liners for air travel. Fleets of flying freighters! You'll see them all in the new America that is just around the corner.

This will be a land that's even more wonderful than the one we're all fighting for today. Its birth is scheduled for the day after Victory. From blueprints already drawn . . . from factories already producing . . . from the hearts and minds of men already building toward it, will come a way of life to dwarf anything we've ever known.

If you had been as close to aviation as we of B. F. Goodrich have been for three decades, you too would realize that miracles are becoming commonplace. From our own laboratories, we've seen developments which helped to give a new concept to flying. Developments such as the first low-pressure airplane tire, a Silvertown that could take the impact of a plane's landing again and again. The first De-Icer, which makes possible year-round flying. Brakes to bring giants-of-the-air to safe, smooth stops. The list of B. F. Goodrich aviation products numbers 80 now . . . and it's still

growing, still improving, still probing the future.

Right now, of course, we have that other job to do. The planes we equip today must destroy before they can create. Uncle Sam's bombers, fighters, and trainers have first call on our Silvertown Tires, Expander Tube Brakes, De-Icers, Bullet Sealing Fuel Cells. But, when that famous birthday arrives, the planes of peace will also be supplied with B. F. Goodrich equipment. The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.





## Bombers from the bottom of the Deep Blue Sea

**T**HERE'S a fabulous amount of magnesium in every cubic mile of sea water.

Enough magnesium for more than *four million* Flying Fortresses. Enough to lay a continuous ceiling of bombers . . . a hundred miles wide and stretching all the way from London to Berlin!

Now magnesium can't be dredged out of the ocean . . . for every ounce of this rare metal must be produced by electrolysis. This necessitates the conversion of vast amounts of alternating current to direct current, at the very water's edge.

The best means of converting power is the mercury arc rectifier. As long as ten years ago, Westinghouse Research Engineers began experimental work on a *new type* of mercury arc rectifier which would be more efficient . . . more economical . . . less costly to install and maintain than existing types.

These Westinghouse scientists realized that new untapped fields in metallurgy would be opened

by the perfection of an improved mercury arc rectifier. In 1937, they brought forth the *Westinghouse Ignitron*.

The Ignitron operates on the radically new principle of *starting* and *stopping* the mercury arc with each cycle. This means that electrodes can be placed much closer together . . . grids and shields reduced . . . arc drop voltage decreased . . . voltage control simplified . . . arc-back practically eliminated. And all of this assures higher efficiency and greater reliability.

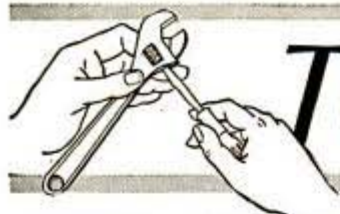
More than 1,000,000 kw of Ignitrons are now at work . . . in magnesium, aluminum and chlorine plants, in electric railway systems, in mines, in war industries of many types.

*And so, the germ of an idea . . . born ten years ago in the Westinghouse Electronics Laboratories . . . is now contributing its important share in winning the war today.*



# Westinghouse

WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, PITTSBURGH, PENNSYLVANIA



# TOOL NOTES

Maintenance  
and Repair  
Suggestions to  
Prolong Tool Life

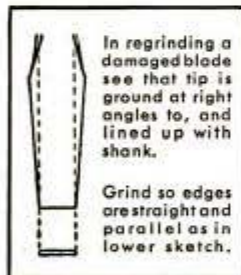
## No. 2 HOW TO USE, AND KEEP CRESCENT SCREWDRIVERS IN GOOD WORKING ORDER

The common screwdriver is one of the most mistreated tools we have. You see inexperienced hands using it as a chisel, prybar, punch and, sometimes, the handle as a hammer. This kind of abuse will quickly ruin the best screwdriver made. Moral: Use screwdrivers only for the purpose for which they are made, driving screws.

### USE THE CORRECT SIZE SCREWDRIVER PROPERLY

The first rule is to use the *right* size screwdriver for the job. In other words, a screw with a large head requires a large screwdriver. Don't use a small screwdriver to drive a large screw. For example, you'll quickly ruin a cabinet screwdriver if you try to drive #10 screws with it. Don't try to use one corner of a large screwdriver to sink a small screw. In this case, the screw is usually damaged.

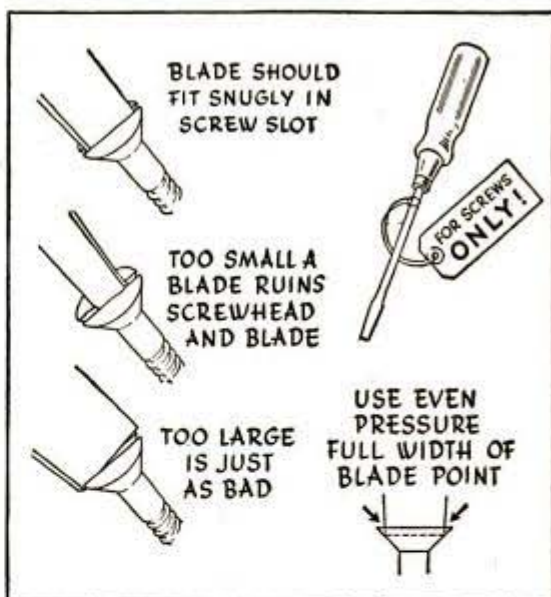
### USE CARE IN REGRINDING



When the blade tip of a screwdriver becomes damaged, it should be re-ground to its original shape (see diagram). Grinding must be done carefully to prevent overheating and drawing the temper out of the blade.

### CRESCENT FERRULES STAY TIGHT

The ferrules on Crescent Screwdrivers are turned from solid bar steel and are forced on the blade under high pressure. They will not come loose. On most types of Crescent Screwdrivers, the blade rod goes clear through the seasoned hardwood handle and can be loosened only by breaking the handle. Remember, always treat your Crescent Tools well—they're worth it.



CHARACTERISTICS OF A GOOD SCREWDRIVER



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September, 1942

Vol. 78, No. 3

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## Frozen Billions

**I**F YOU could slip into your pocket a little pellet of radium about the size of a pea, you'd be carrying a million dollars. You couldn't, of course. Radium is too dangerous to handle, too precious. It is precious to war industries for photographing flaws in steel, to medical science fighting cancer, to fliers reading luminous dials. "Frozen Billions," the October Colorado feature with eight pages of color pictures, tells the fantastic story of the discovery in arctic Canada of the ore that providentially gives the United Nations a radium monopoly.

## Uncle Sam's Trump Card

**I**T IS a tribute to our engineers that American war-planes—built in a land committed for years to a policy of peace while other nations directed their full national effort to war—are superior to those of the enemy. Aeronautical engineering is America's "trump card," writes E. E. Wilson, president of United Aircraft Corporation, in an article next month.

## Next Month

**S**UNDAY morning after the war, you decide to move to that new subdivision. You spend that day choosing exteriors and interiors from an array of model houses shown by a mass-production builder. Monday the pre-constructed foundation piers are set in and utility pipes extended. Tuesday a truck delivers your house and a half dozen workmen erect it. Wednesday you move in. A year later you can trade in an unused bedroom for a darkroom if you like. That's a taste of "Your Home of the Future," an October article.

## Minutemen of 1942

**T**HE West is still wild. Cow punchers and hard rock miners, ranchers and aircraft workers are out in the woods and hills along the Pacific, their rifles oiled and ready for a guerrilla ambush. A thousand armed "minutemen" rally in one Oregon town. California is calling for 100,000 snipers to prepare a welcome for any Japanese suicide ventures on our shores. An October feature pictures these American guerrillas.

## Meet the Bombardier

**A**T THE instant the pilot announces "On course and level; your ship"—the bombardier takes over the plane. Antiaircraft may be exploding outside his glass window, interceptors swirling around. He is absorbed in picking the split second to drop his deadly load. "The Most Dangerous Man in the World," in October, takes you up with the bombardier.

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**Until Victory is Ours . . .**

## KEEP YOUR CAR WELL PROTECTED WITH PYROIL

- **Get Extra Mileage per Gallon of Gasoline**
- **Get Protection from Scuffing Wear on Metal Parts**
- **Get Safer, Better Operation**

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Pyroil users tell of the extra mileage they get using Pyroil. You can gain this, too. You will be amazed at the benefits of driving and of car conservation that Pyroil gives you.

So, until the victory is ours and you can then buy a new car, take the best possible care of the one you now have. That means, use **Pyroil every mile you drive!** Manufactured and Guaranteed by Pyroil Company, W. V. Kidder, Founder, 59 Pyroil Bldg., LaCrosse, Wisconsin, U. S. A.



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Please send me a listing of Service Stations in my locality, where I may obtain Pyroil Protection for my car, regularly.

Send Details of Plan for Distributors.

Name.....

Address.....

City..... State.....

**"KEEP 'EM ROLLING!"**

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You may worry  
about your  
old garden hose



...but here is one worry you can avoid

**Y**OU can still use a worn-out, patched-up hose . . . but *not* a broken-down automobile!

That's why king pins, tie rods, drag links, bearings and other vital friction points require the *extra* care, the *superior protection* of stem-to-stern Marfak chassis lubrication every 1,000 miles.

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SEPTEMBER, 1942

This One



A8J1-KZH-57L9

5A

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**SIMONIZ YOUR CAR**

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THE SIMONIZ COMPANY, CHICAGO, U.S.A.

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**Do you really Want to  
get ahead in business?**



## Then here is a valuable tip for you . . .

The problem of winning promotion—of achieving the better job and better pay—is not easy. Competition is keen and the demands are high. But it is much easier—simpler—if you understand one important fact.

Business and industry always need men and women who can take on larger responsibilities—give more valuable service. Those who step up into the bigger jobs are those who have an objective and definitely prepare for it—who not only give their best to today's job, but who also plan and prepare for the jobs on ahead and train themselves to meet the greater responsibilities of the bigger job.

### **Pick Some Growing Field and Prepare**

If you really want to get ahead, pick some field of opportunity—either your present field or some other. Find out its opportunities, and its requirements—decide whether you are fitted for it—then get busy.

Train thoroughly for it. Make yourself expert in it. Then you can compel success.

For 32 years, LaSalle has been helping ambitious men and women prepare for advancement. Hundreds of thousands now in good jobs and on the way up to better ones, owe their success to LaSalle training.

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(Any other)

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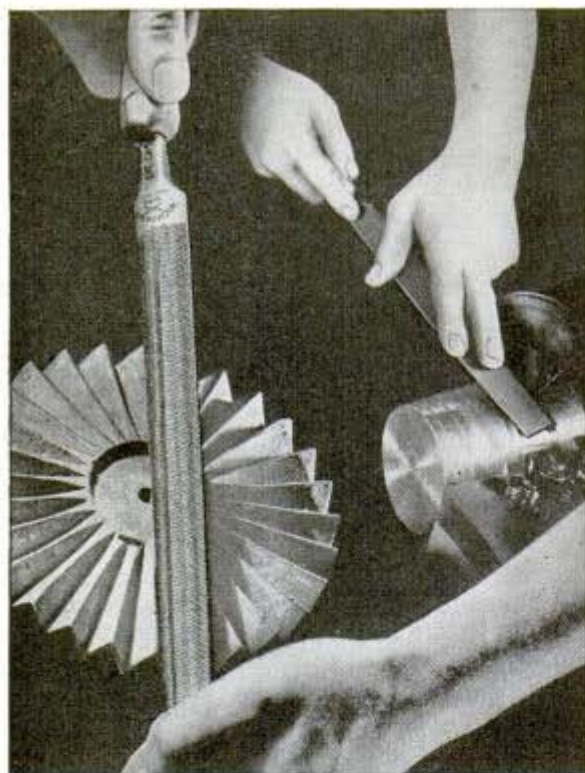
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## Educated Hands...

WE HAVE long been the greatest mechanically talented nation on earth. And war industry is increasing the competition among skilled workers. Take filing. New hands are becoming adept in the use of files. Older ones are obtaining still more efficient filing results.

In Nicholson and Black Diamond brands, Nicholson makes every practical kind of file—more than 3000 types, cuts and sizes. And in the highest quality. Nicholson is also interested in helping to "educate" the hands that use files. Two of the many Nicholson aids are:

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| <input type="checkbox"/> Boilermaking  | <input type="checkbox"/> Highway Engineering                          | <input type="checkbox"/> Radio, General   | <input type="checkbox"/> Telegraphy <input type="checkbox"/> Telephony         |
| <input type="checkbox"/> Bridge Engineering                                  | <input type="checkbox"/> House Planning                               | <input type="checkbox"/> Radio Operating  | <input type="checkbox"/> Textile Designing                                     |
| <input type="checkbox"/> Chemistry <input type="checkbox"/> Coal Mining      | <input type="checkbox"/> Industrial Metallurgy                        | <input type="checkbox"/> Radio Servicing  | <input type="checkbox"/> Toolmaking <input type="checkbox"/> Tool Design       |
| <input type="checkbox"/> Civil Engineering                                   | <input type="checkbox"/> Locomotive Engineer                          | <input type="checkbox"/> R. R. Section Foreman                                  | <input type="checkbox"/> Welding, Gas and Electric                             |
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|--|---|--|---|
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| <input type="checkbox"/> Business Correspondence                           | <input type="checkbox"/> Commercial Illustrating                | <input type="checkbox"/> Good English                                | <input type="checkbox"/> Secretarial <input type="checkbox"/> Spanish |
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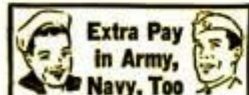
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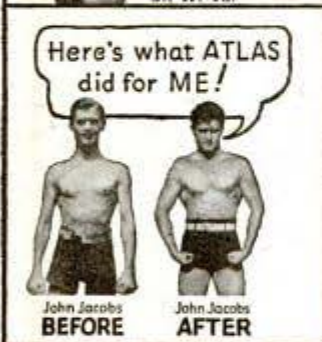
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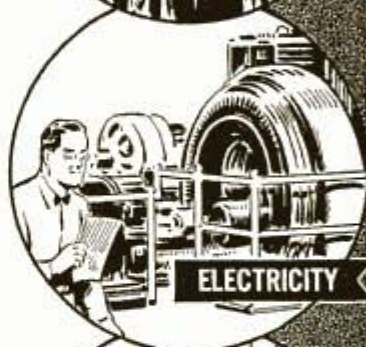
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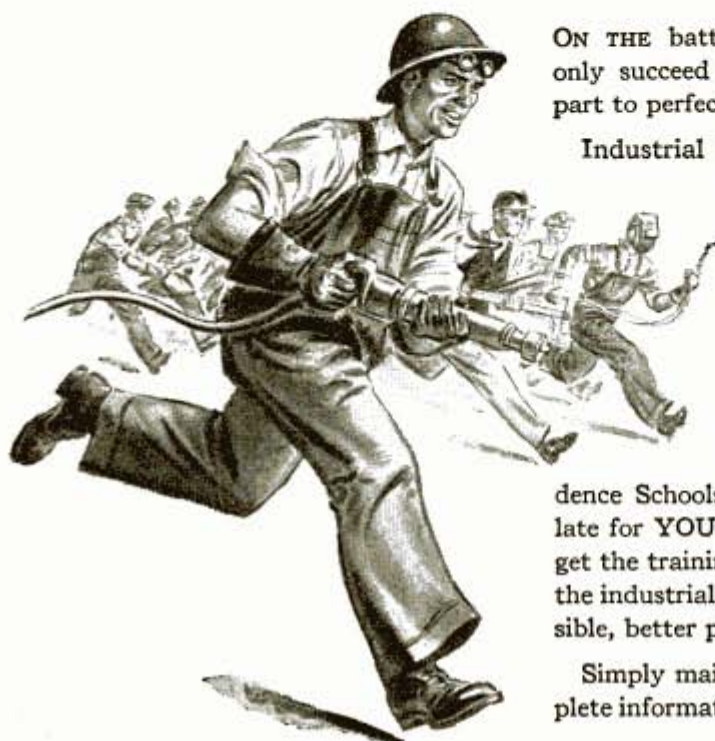
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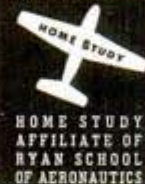
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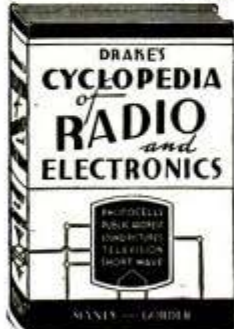


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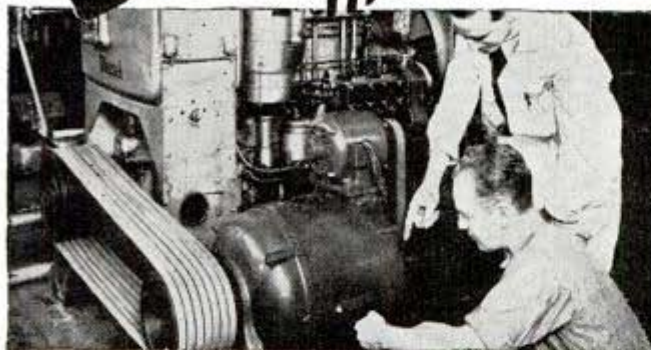
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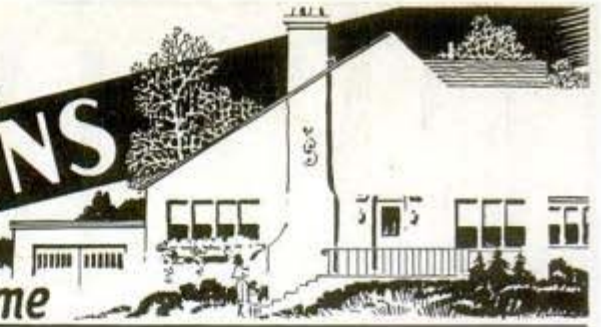
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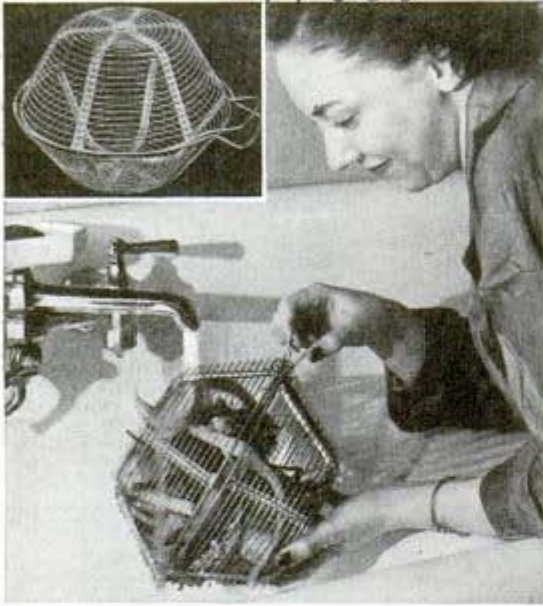
# POPULAR INVENTIONS

For Your Home



## Wire 'Cage' Holds Salad Vegetables for Washing

M 558

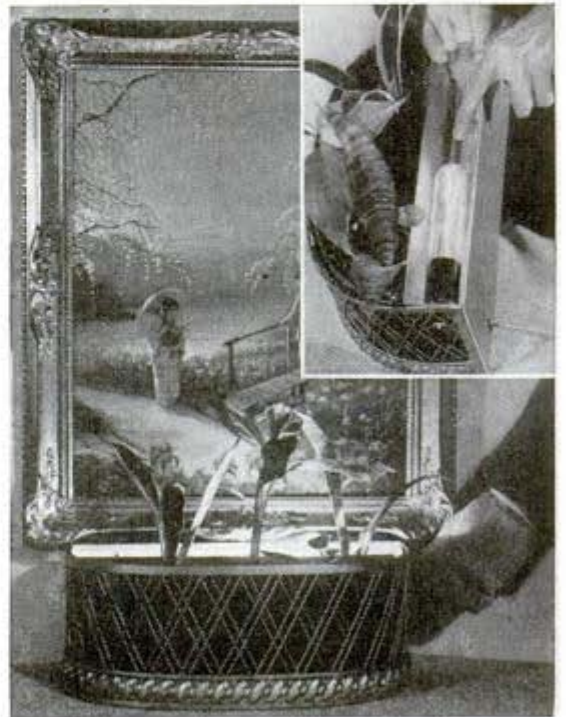


Salad vegetables can be washed quickly by placing them in a handy wire container and shaking them under a faucet. The container is shaped like a ball and has hinges for easy opening and closing.

## Light in Decorative Plant Tray Brightens Picture or Mirror

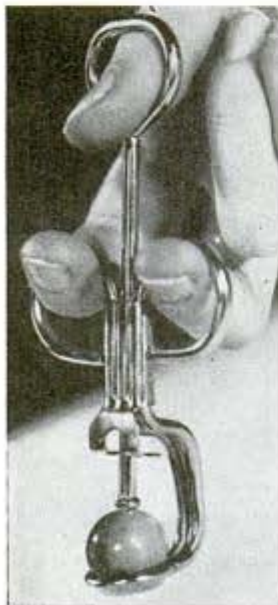
L 1261

Light lends a cheerful glow among the flowers and leaves of plants growing in a decorative metal tray fitted with an elongated electric light bulb. The tray can be placed near the wall where its beams will brighten a painting or mirror above it.



## Thumb-Operated Cherry Pitter Speeds Handling of Fruit

M 260



Held by two fingers through rings and the thumb in another ring to operate the plunger, a cherry pitter provides fast action in stoning cherries. The device may be held in the right hand while the left feeds cherries into it. Pressing the plunger forces the pits through, and releasing it withdraws the plunger so the fruit may fall into a bowl.

### WHERE-TO-BUY-IT INDEX OF POPULAR INVENTIONS

**Wire cage for washing vegetables**  
Mandel Brothers, State and Madison Sts., Chicago

**Thumb-operated cherry pitter**  
Goldblatt Bros., State and Van Buren Sts., Chicago

**Plant tray with light**  
Oliver Eldridge, Merchandise Mart, Chicago



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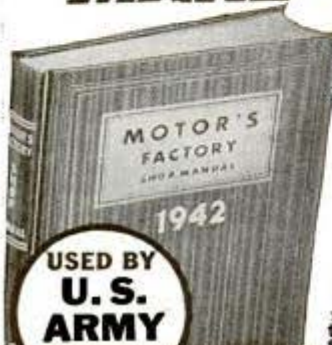
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**LEARN** Popular piano! Write Magic Key, 111-A Broadway, Glendale, Calif.

**SONG** Poems wanted for musical setting. Submit for immediate consideration. Five Star Music Masters, 630 Beacon Building, Boston.

**SONGWRITERS:** Send poems for offer and free rhyming dictionary. Phonograph records made. Vanderbilt Studios, Box 112-D.F., Coney Island, N. Y.

**SONGWRITERS!** Have us compose music to your words. Write for information about Rhythm Patterns, Melody Music Publishers, Box 928, Dayton, Ohio.

**SONGPOEM** Writer! Hold everything 'til you get my offer! Ahlstrand, Comptor, Lake Stevens, Washington.

**LYRICISTS!** You can benefit by criticism. Postal sends you my personal letter on lyric criticism. Gordon Solle, Omena, Michigan.

**SONGS—**Song poems wanted. No charge for melodies. Free examination. Hollywood Recording Studios, 87G20 Preuss St., Los Angeles.

**SONGS,** Poems wanted. Newark Song Publications, 1207 Carbon, Syracuse, N. Y.

**SONGWRITERS!** Amazing outstanding offer. Hibbler, C5, 2157 No. Avers, Chicago.

**SONGWRITERS.** Write for free booklet, profit sharing plan. Allied Music, 204 East Fourth, Cincinnati, Ohio.

**SONGWRITERS:** Write for free instructive booklet concerning song poems. United Music, Dept. 14, Salem, Ind.

**SONGWRITERS—**Send poem for immediate consideration and free rhyming dictionary. Richard Brothers, 24 Woods Building, Chicago.

**GOOD** Music composed to good words. Reginald Belcher, Chatham, New Jersey. Established 1910.

**MUSIC** Composed to words. Rhyming pamphlet on request. Phonograph recording of completed songs. Send poem for consideration. Keenan's Studios, Dept. PM, Box 2140, Bridgeport, Conn.

**WANTED!** Lyrics, melodies for songs. We arrange, publish, sell. Superior Song Studios, Passaic, N. J.

**MUSIC** Composed to words. Wonderful proposition. Bauer Bros., Oshkosh, Wis.

**LEARN** Sing piano! Postal brings free folder. Christensen, 451 Kimball Hall, Chicago.

**WRITE** Songs. Big money and reputation. Write for information. J. Gordon Pub. Co., 201 N. Hoynes Ave., Chicago.

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**LEARN** Metascience. Remarkable drug-less healing. No manipulation. No apparatus. Unbelievable simplicity and results. Inexpensive correspondence course. Write Metascience, De Land, Florida.

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**PLASTEX** Industries offers industrious men an opportunity to start a business of their own, manufacturing art goods, novelties, souvenirs, etc., in Plastex and marble imitation. 5c material makes \$1 articles. Rubber moulds furnished for speed production. Small investment brings good returns. We are now placing big chain store orders with manufacturers. Write for interesting booklet mailed free. Plastex Industries, Dept. A, 1085 Washington Ave., New York.

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**CHRISTMAS Card money makers.** Free samples outstanding 50 for \$1 name imprinted cards. Quick selling \$1 assortments cost 50c. Other boxes 25c up. Howard P. Ellis, Dept. PM, Pitman, N. J.

**COMIC Clever Xmas greeting cards.** List 10c. Straley, 1015 Mulberry, Springfield, Ohio.

**EXTRA Money quick!** Sell super-value personal Christmas cards, 50—with name—\$1. Finest 21-card assortment, \$1. You make 50c. Complete line. Samples on approval. Waltham Art Publishers, 160 N. Washington, Dept. 587, Boston, Mass.

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

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**SELL Season's Christmas card hit!** America's finest 21-card assortment, \$1. Up to 100% profit. Big selection assortments; personal Christmas cards 50 for \$1, up. Free samples. Wetmore & Sugden, 748 Monroe, Dept. 75, Rochester, New York.

**AGENTS—Whirlwind profit opportunity.** Finest silk Nylon, and Rayon hosiery. Big selection. Very latest styles and colors. Replacement guarantee. Your own hose free with large outfit. Rush home size, name today. Wilknit, Dept. CK-37, Greenfield, Ohio.

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**AGENTS:** New line religious, patriotic, scenic pictures and mottoes—20c to \$2.75. Liberal discounts. Old Rugged, 603 So. Main St., Telford, Penna.

**MAKE Money!** Show exclusive Christmas cards with name, 50 for \$1, up. Large selection. 21-card "Janet Art Box," \$1; other big profit assortments. Samples on approval. Janet Art Studios, 1225 Clifford, Dept. 529, Rochester, New York.

**AMAZING Magic purse unfolds** into roomy shopping bag. Sensational seller. Samples sent on trial. Kristee, 120, Akron, Ohio.

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**DON'T Be a job hunter**—Start your own business on our capital. No hard times; no layoffs; always your own boss. Hundreds average \$3,000 to \$5,000 annual sales year after year. We supply stocks, equipment on credit, 200 home necessities. Selling experience unnecessary to start. Wonderful opportunity to own pleasant, profitable business backed by world wide industry. Write Rawleigh Co., Dept. I-U-PPM, Freeport, Ill.

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**NEED Money quick?** Sell friends 50 for \$1.00 personal Christmas cards—free samples. Also 17 box assortments 30c up. Sensational 21 box on approval. Up to 100% profit. Special offers. Tom-Wat Studios, PM, Bridgeport, Conn.

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**WHOLESALE Sources.** 500,000 articles. Free directory. Maywoode, 1133 Broadway, New York.

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**NEW Air raid shoe sweeps country.** Zips on—zips off. No fumbling or breaking of laces in blackouts or when alarm sounds. Huge profits for direct salesmen and women. Hundreds of other fast-selling shoe styles. Write for free sample shoe outfit. Victor Thomas Shoe Co., 610 W. Van Buren St., Dept. V-50, Chicago, Ill.

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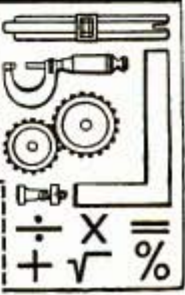
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Vol. 78

SEPTEMBER, 1942

No. 3

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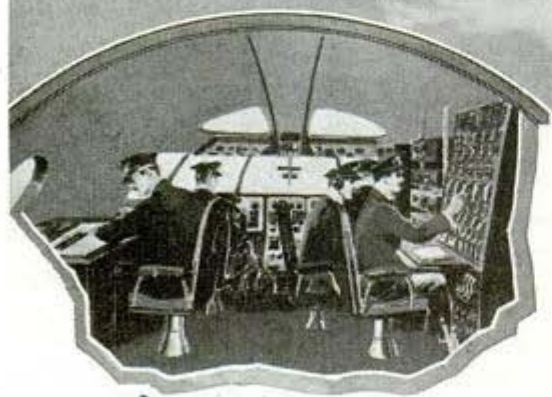
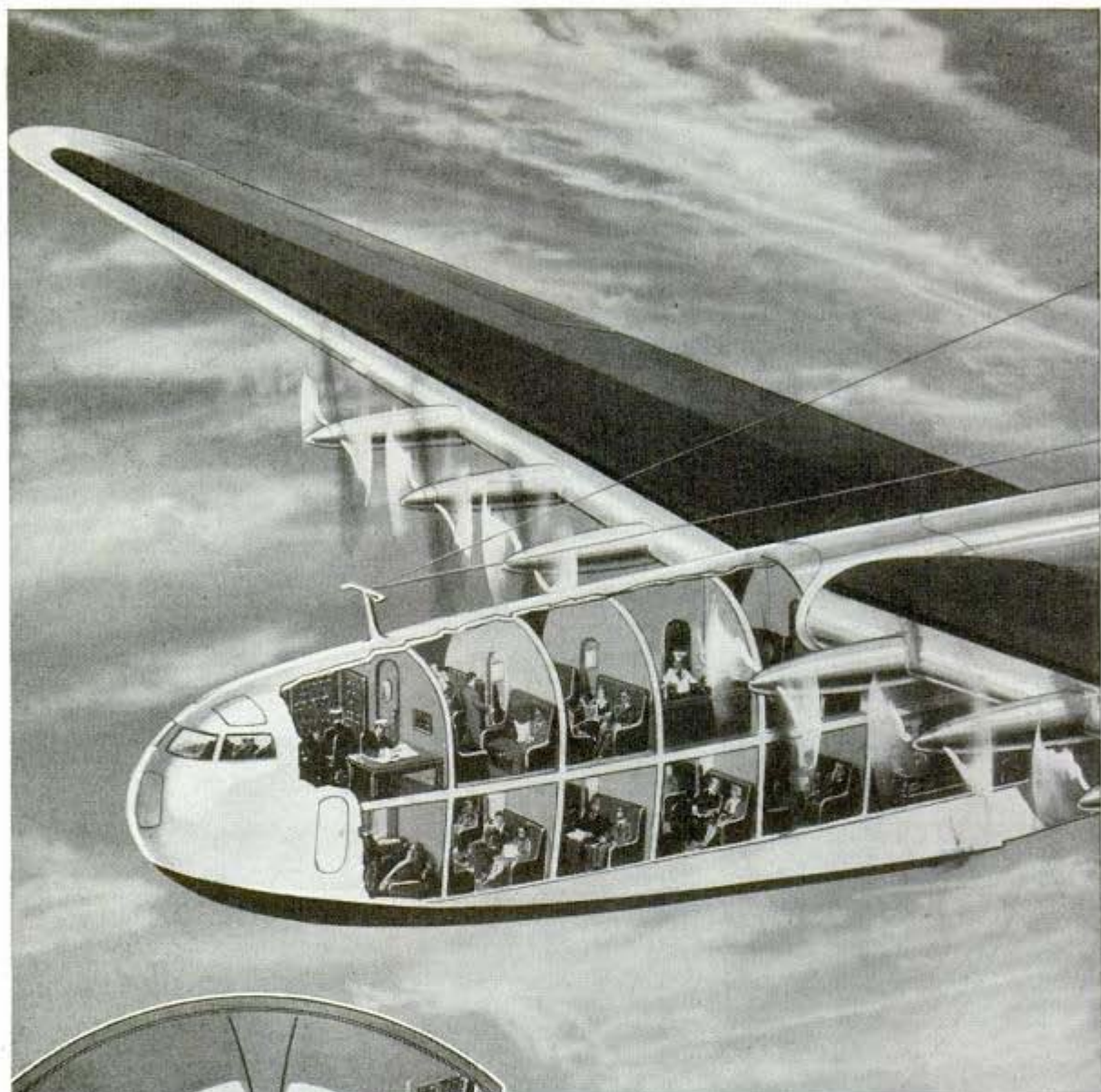
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I am not a military expert. But I have spent a lifetime in the design and production of military aircraft. In 1913 it was my privilege to help conduct the Army's first bombardment experiments at San Diego. So fascinated was I with the airplane's demolition possibilities that I made this statement, culled from newspapers of August 7,

1914, which were headlining the beginning of World War I:

"The aeroplane will practically decide the war in Europe. Veritable flying death will smash armies, wreck mammoth battleships and bring the whole world to a vivid realization of the awful possibilities of a few men and a few swift aerial demons. For the old-time war tactics are no more. The generals who realize this quickest and



Drawings and photos from Glenn L. Martin Co.

Across the pages is a sectional drawing of the six-engine transoceanic hotel, which would fly from New York to London in less time than you ride a train from Chicago to New York. Left, the huge flight deck

fight first with the flying death, will win."

I was one war too early on that one. But today we find air forces the most powerful influence in victories; lack of them, the outstanding cause of defeats. No armed force can be successful in any major project without air supremacy in its theater of war.

Few stop to consider the versatility of

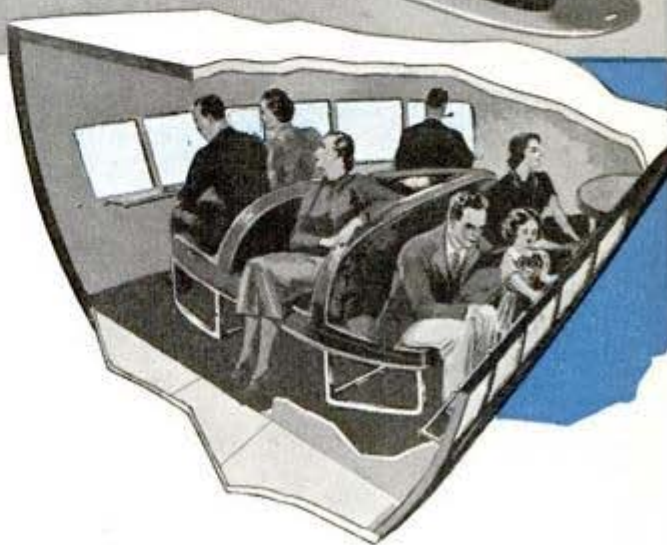
aircraft in this war. In addition to its more spectacular functions of bombardment and defense, the airplane is maid-of-all-work for the armed services. It performs long-range reconnaissance, patrol and scouting work for Army and Navy. It transports troops and heavy loads of supplies at high speed. It is a moving and elusive machine-gun nest. In some situations it is a basic supply source for soldiery.

Too few understand the power of the airplane—rather, the fleet of airplanes—as long range artillery. Let me excite your imagination with a hypothetical mission.

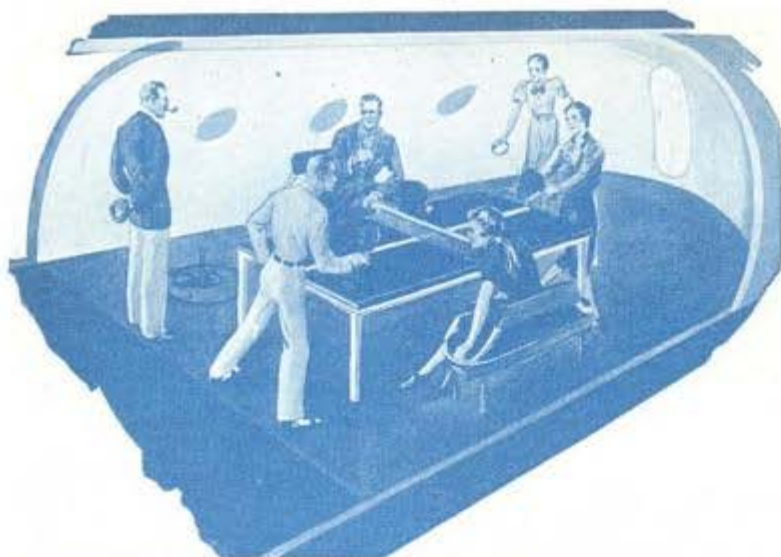


Word arrives at a battleship station that a hostile force has been sighted 1,000 miles away. The battleship is stocked with supplies and ready for battle. In 38 hours, if the target has not moved too far, the first salvo of nine tons of explosives will be fired at the target.

Now a fleet of 150 bombers, costing about the same as a battleship, gets word of the force 1,000 miles away. In six and a half hours these planes discharge 750 tons of explosives on the target; in 38 hours, 2,250 tons of bombs will have fallen on the objective. Even a continuous cannonade from the battleship could not ap-



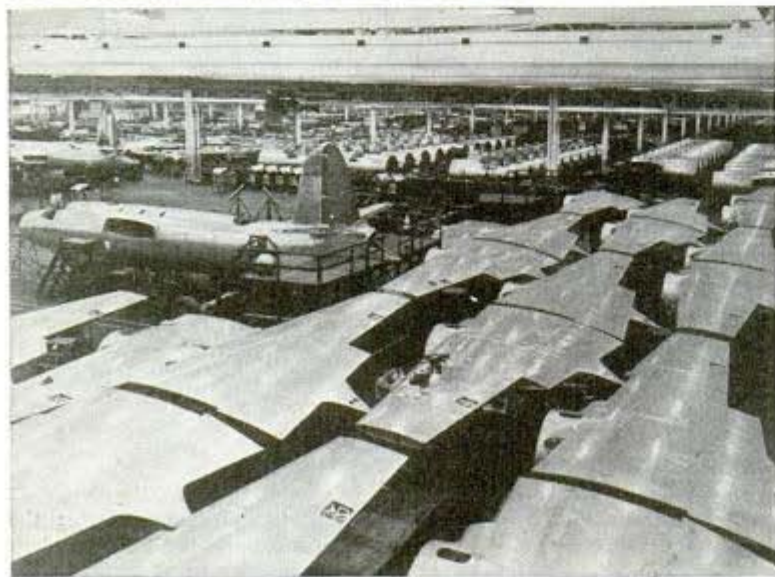
Observation rooms will offer a spectacular view during the ocean crossing. Except for swimming pool and open-air deck the plane will compete with the luxuries of a surface liner



Lounge space will be ample to provide the hundred air travelers such games as table tennis. Showers and baths are planned

It takes 11,500 parts to build center fuselage section (left) and nose of a Martin medium bomber, a toy beside a 125-ton ship

Below is a glimpse inside the Glenn L. Martin plant where bombers are built on a gigantic scale for the United Nations



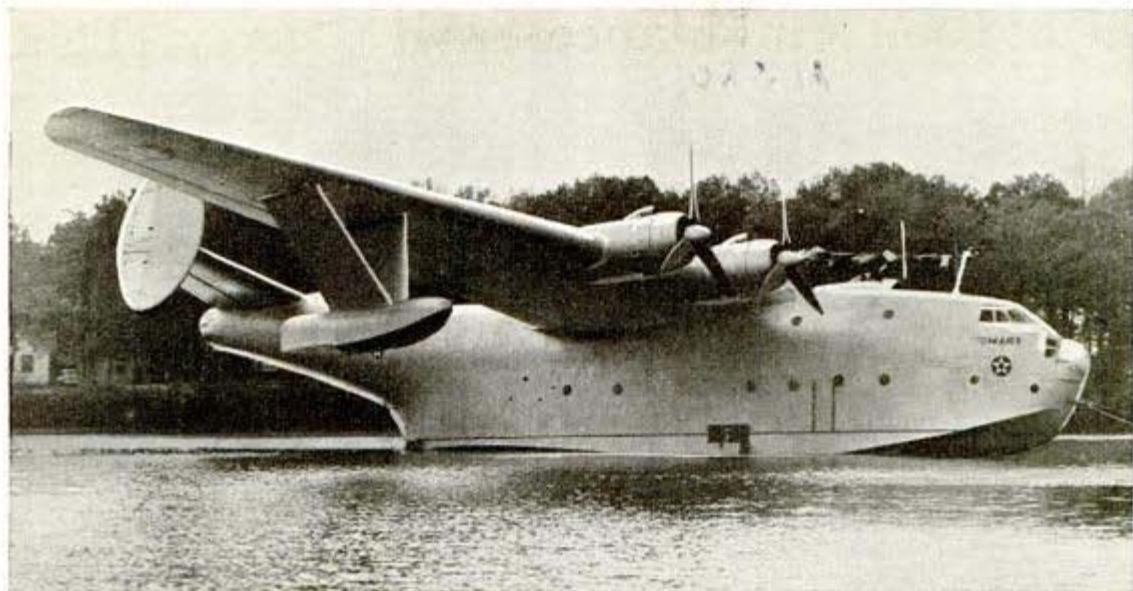
proach the destructive power unleashed by the air fleet.

Again, the extreme mobility of great naval air forces would answer in large part the desperate need for a two-ocean navy. A powerful air force can serve in either ocean in full strength on short notice, without worrying about the Panama Canal.

I have no hesitation in predicting that when peace comes, every nation that preserves its integrity will see that strong air forces will be an important part of its permanent military establishment. Never again will any country risk the swift thrust of the blitzkrieg.

Let us turn now to the very large airplane—a subject dear to me because my company made the first transoceanic Clippers, which are still going strong with service records unapproached by any other airplane. Just now we are testing the world's largest flying boat, the 140,000-pound Mars—three times the size of the China Clipper. Such ships have a definite place in naval and military plans; they carry extremely heavy bomb loads, they can patrol vast areas of ocean at high speed, they carry large numbers of men or large cargoes and have unbounded landing and takeoff areas that are unassailable. You can't bomb holes in water.

Commercially, the extremely large air vessels have a great future. Bad though war is, it is contributing to the great future of world air trans-



The bridge of the "Mars," flying battleship of the U. S. Navy, is larger than interior of a 21-seat air liner

port. Already this war has sold ocean air transport to the world. Today people—those who can get passage—step aboard the Clipper with a perfect feeling of security. They board surface ships with fear and trembling of skulking submarines. Organized airline travel not only has been the safest means of transport since the war began, but it was safer for several years before the war. In the future it will be safer yet, largely because of developments during the war.

We are heading for winged vessels larger than we have yet dreamt of. Transoceanic operations are presently based on aircraft having a gross weight between 82,000 and 84,000 pounds. These flying boats can carry a payload of about 4,000 pounds for 3,000 or 4,000 miles, depending on head winds and fuel reserve needed—a technical achievement considered impossible a very few years ago.

But these aircraft are inconsiderable indeed compared with the flying ships we are already planning. My company has plans for a 250,000-pound commercial air vessel—plans which recently won for us the American Design Award.

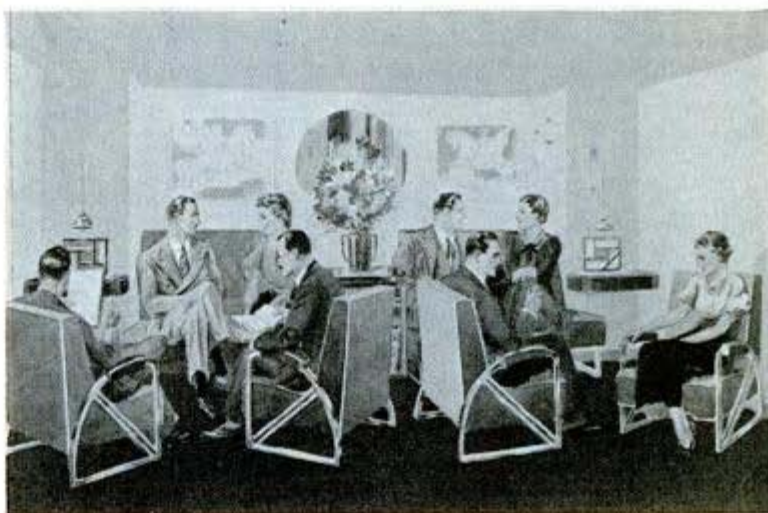
Tomorrow's air liners not only will offer such luxuries as this lounge, but safety developed by aircraft engineers for warplanes

As a matter of fact, there is no technical limit to the size of airplanes; the only limit is the amount of payload available. We should be able to build 500,000-pound airplanes in a few years.

Let's look at the economics of air travel in one of these flying ships between New York and London, a non-stop distance of around 3,500 miles. Prevailing winds are eastward, averaging around 20 miles an hour at low altitudes. It is sound commercial practice to provide sufficient fuel for the head winds forecast for a given flight, plus four hours of reserve fuel. On the London-New York span, against the wind, we would need fuel for 4,700 miles in still air to cover the 3,500 ground miles, with four hours of fuel remaining at the end.

Under the conditions assumed, the 250,-

(Continued to page 178)



*Aeronca Aircraft Corp., Middletown, Ohio.*

## Lightplane Ambulance Stages Mercy Flights

M 580



Doors in side of fuselage swing wide open, above, for ease in transferring patient. Left, patient in ambulance ready to go

hour, the ship has a range of 350 miles, sufficient for darting quickly between its base and points remote from adequate hospital facilities. It is capable of landing in small fields or even on a highway, and in cooperation with the Civil Air Patrol the plane can perform emergency errands such as delivering medical supplies and first aid

Filling a gap in ambulance service existing between the short-haul automobile and long-haul air transport, a low-priced lightplane ambulance is being produced by Aeronca after months of designing and experimenting. Powered with a 65-horsepower engine and cruising at 100 miles an

equipment. The stretcher contains a rubber foam mattress and has special safety straps to hold the patient securely. A hatch opens at the left side of the craft to receive the stretcher, and the pilot, seated at the controls, is in position to administer simple aid to the patient while in the air.

## Forging Cuts Engine Weight to Pound Per Horsepower

M 531



Cooling fins, left, are cut into forged head at right

Cylinder heads made by forging—a revolutionary process in engine manufacture developed by the Wright Aeronautical Corporation—reduce the weight of airplane engines to less than one pound per horsepower. This will make U. S. combat planes superior to others in speed, operation at high altitudes, load and range, according to experts. The forging process will also increase production by eliminating nine drop-hammer operations in mak-



ing cylinder heads. After they are pressed into final shape by dies, cooling fins are cut into them by specially designed milling machines. Forged heads for big 2,000 horsepower engines for bombers can be made as well as those for smaller fighter craft.

*M 568*  
**'Party Line' Chutes Are Jerked Open In Mass Jump**

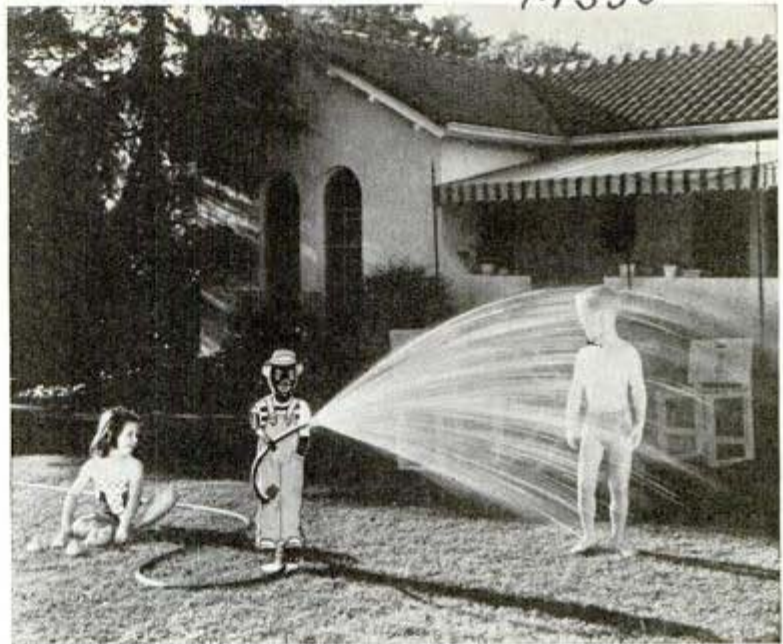
It's rapid-fire jumping when the U. S. Marines go overboard in mass parachute leaps, using their automatic "envelope opener." The paratroopers line up inside the transport plane awaiting the "go" signal from the "jump master" at the door. Each man has hooked his ripcord to a cable installed in the plane, and as the chutists leap out in quick succession the cable jerks the cord, opening the parachute. The line is arranged so the soldier is certain to clear the plane before the chute opens.



Marines ready for mass parachute jump snap their ripcords to long line stretched through the ship, so 'chutes open uniformly as each man leaps

SEPTEMBER, 1942

*The Tirestone Tire & Rubber Co.  
Akron, Ohio*  
**Animated "Sprinkling Sambo"**  
**Rotates and Wiggles Hose**  
*M 550*



Although children may let "Sprinkling Sambo" give them a cooling shower on hot summer days, his primary purpose is to spread water over the lawn

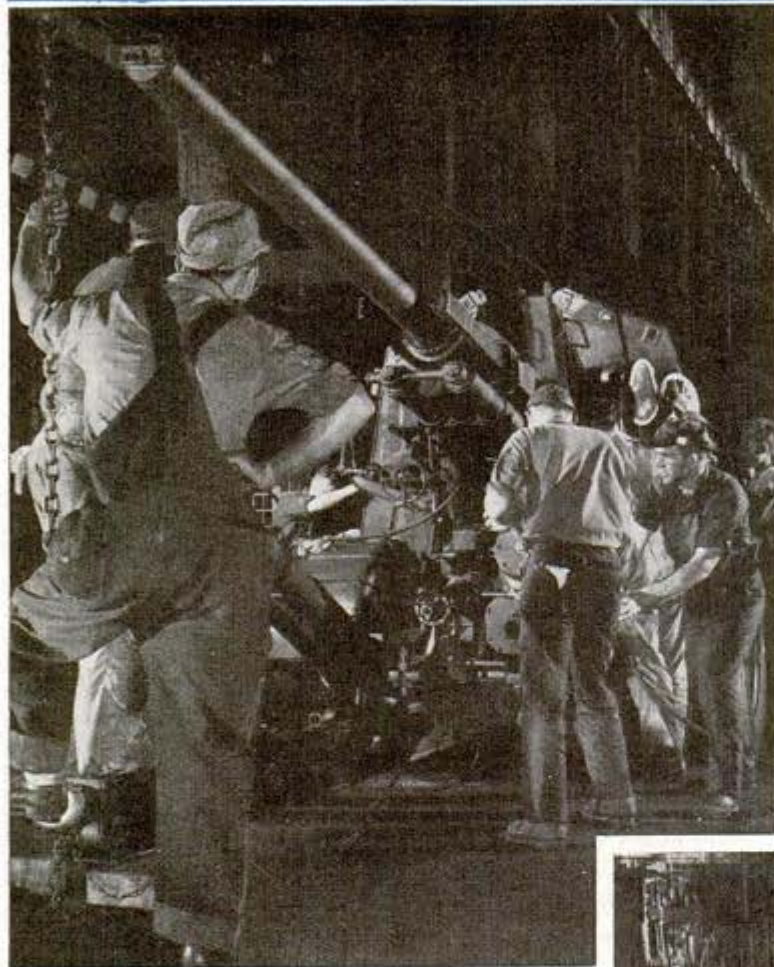
Silent, black-faced comedy has been introduced into the serious business of lawn sprinkling with a wooden colored boy who holds the nozzle and distributes water evenly about the lawn and garden. The smiling midget, powered by the force of water, turns round and round, while his double-jointed right arm swishes the nozzle in rhythmic motions. Occasionally the animated comedian reverses the direction of his rotation as if to spray extra water on a spot he had

missed. The tempo of his gyrations can be stepped up or diminished by varying the water pressure. Standing 33 inches high and wearing a patched red, blue, yellow and black costume, the whirling figure can be anchored to the ground in any part of the lawn by two spikes inserted through a flat base.

Powered by six batteries driving a 1½ horsepower motor, an electric tricycle just introduced in Sweden travels up to 38 miles on one charge, at a top speed of 25 miles an hour.

*Dept. of Commerce  
No. info.*

# MODERN MIRACLE



The workman came back, halted, and his jaw dropped. He looked like a man who has walked into the wrong house. When he could talk, he said: "Hey! Somebody stole my machine!"

Things like that happened all through the automobile industry. Lumbering tanks all but pushed the last Chryslers out of the way. One Friday evening the army inspectors in a Detroit plant left for their homes. The plant at that moment was still turning out cars as well as armament. When the officers came back Monday morning they couldn't find their desks.

"What hit this place? A cyclone?" one asked. The whole factory had

← A midwestern plant works 24 hours a day building 90-millimeter antiaircraft gun mounts

Multiple drill converted from automotive work combines 20 different operations in one  
↓

**W**HEN Buick builds Pratt & Whitney engines for Consolidated bombers from a Ford factory, that's miracle enough.

But the swiftness of the change was a greater miracle. It was like a reincarnation. The automobile industry died—or was put to sleep for the duration—and a vaster war industry was born.

Before the last glittering sedan rolled off the production line, acetylene torches were remorselessly burning away the conveyors that had carried an endless parade of new cars through an era. Pneumatic hammers were tearing complex and beautiful tools from concrete floors. Funny things happened. One workman left his machine for a few minutes. In those minutes the moving gang arrived, uprooted the machine, hoisted it into a truck and hauled it away.





Photo from Firestone

Scores of Swedish-designed Bofors anti-aircraft gun mounts roll from assembly lines of a five-acre plant built by Firestone in 50 working days

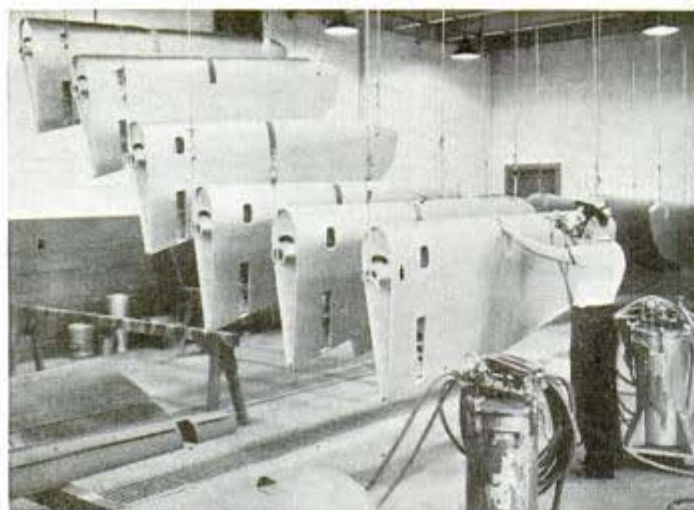
been transformed for war over the weekend.

At the outset, of course, the automotive industry took a licking. Besides the complete deflation of sales of automobiles and refrigerators and air conditioners and whatnot, besides the blow to sales and dealer organizations and the temporary unemployment of factory workers, millions of dollars worth of tools and dies went to the graveyard. They saved what they could. Engineers marched miles through the factories tagging the machines that could be converted for airplane and tank and gun manufacture, tagging others for the limbo of an open-air graveyard. Dies of the 1942 model cars were

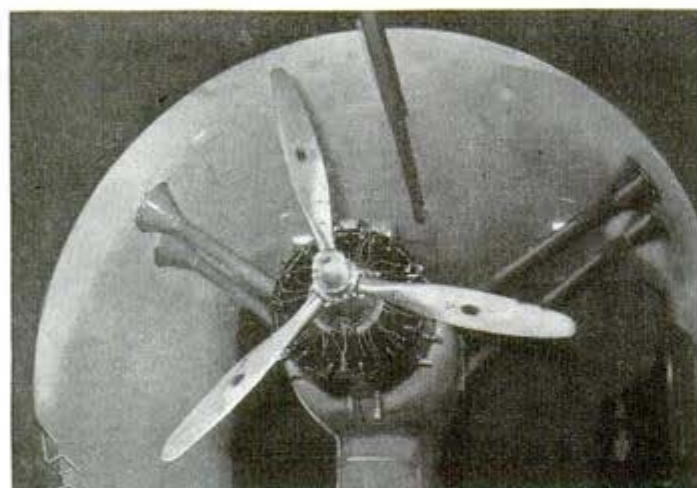
A 50-ton crane hoists a 28-ton M-3 tank aboard flatcar in Chrysler plant



OEM photo

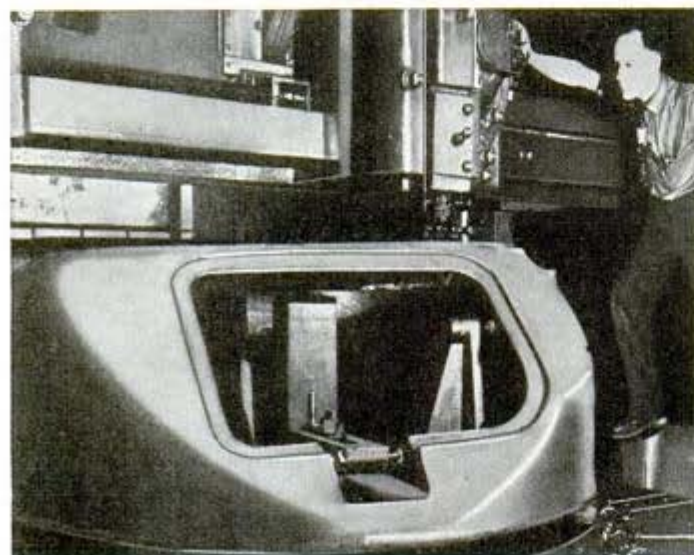


Control surfaces for the Army's B-26 Martin bomber are finished at a Goodyear plant that was once a great airship dock



Propeller goes on test at Buick factory building Pratt & Whitney engines for bombers. Production is far ahead of schedule

Here tools that once built automobiles are on war duty; machining 4,000-pound turret casting for Chrysler M-3 medium tank



stored in hope they would be put to work again, but even these are threatened; they may be scrapped to recover the precious nickel-alloy steel. If they must, \$60,000,000 worth of dies will go into the melting pot and it would mean perhaps a year's delay in getting back into automobile production after the war.

Many automobile tools, through engineering magic, could be converted to new jobs. Huge rotary, multiple-spindle milling machines that once milled tops and bottoms of cylinder blocks were adapted to replace dozens of smaller machines turning out cannon parts. But some simply weren't adaptable. Conveyor lines that auto workers went lyrical about were sliced up into junk. Above them, in the rafters of one factory, you might notice clusters of big moistureproof paper bags; inside them is valuable but momentarily useless electrical apparatus, put away in bags to keep the sparrows from nesting in it. Among the saddest of men are those who worked around the big "merry-go-round" where tires and tubes were once assembled on wheels. It was a marvelous contraption, gathering rims and rubber from conveyors and putting them together with little assistance from the men. At the last stop on the circle, the tire was inflated and the wheel dispatched on the conveyor to the final assembly line. But the merry-go-round is worthless now.

To facilitate tooling up these factories, the industry formed the Automotive Council for War Production, and under it a Tooling Information Service was set up. If Packard had an idle tool and Hudson needed it, the tool was found and exchanged. One Michigan plant making 20-millimeter projectiles ordered 287 different jigs, fixtures and gauges through the Information Service. If a Chrysler engineer



Tanks stream in endless procession from automotive factories to flatcars and on to training camp and war front

U. S. Signal Corps photo

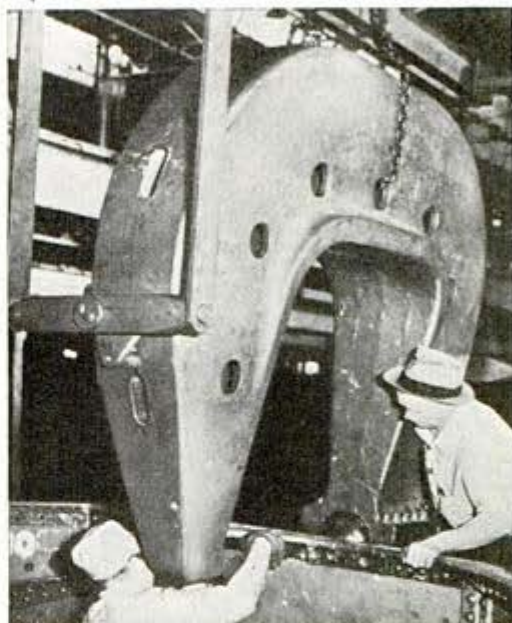
developed a new trick for adapting a machine or speeding production or saving material, it was passed on through the industry.

Tooling was an initial bottleneck, but it's not there any more. The American tool industry reported a jump from a normal output of \$150,000,000 worth of tools to \$800,000,000 in 1941 and an expected \$2,400,000,000 in 1942.

Bombers are driven by gasoline engines, they're made of metal and wear rubber tires. Other than that, they aren't much like automobiles. One cylinder of an aircraft engine delivers as much power as an automobile engine. Bomber engines are air-cooled, and made of light metal. A Consolidated B-24, the bomber they're building at Ford's 37-acre Willow Run plant, consists of 300,000 rivets and 188,193 other parts—without the engine.

It didn't take long for the brains of the automobile industry to turn up some new tricks the aircraft builders, with their hitherto small, hand-tailored production basis, hadn't thought of. Ford cut production time on a bomber wing section from 99 man hours to 64 by substituting a spot welding process for riveting. Fisher Body engineers had to design some special machinery of their own and draw their own blueprints for a welded tank hull, but they turned out a 30-ton tank on its own power in 47 days—from scratch. One of the giants they built for this job was a 30-ton fixture that grips the entire tank hull and revolves it in two directions for assembly. A Chrysler technician sug-

(Continued to page 168)



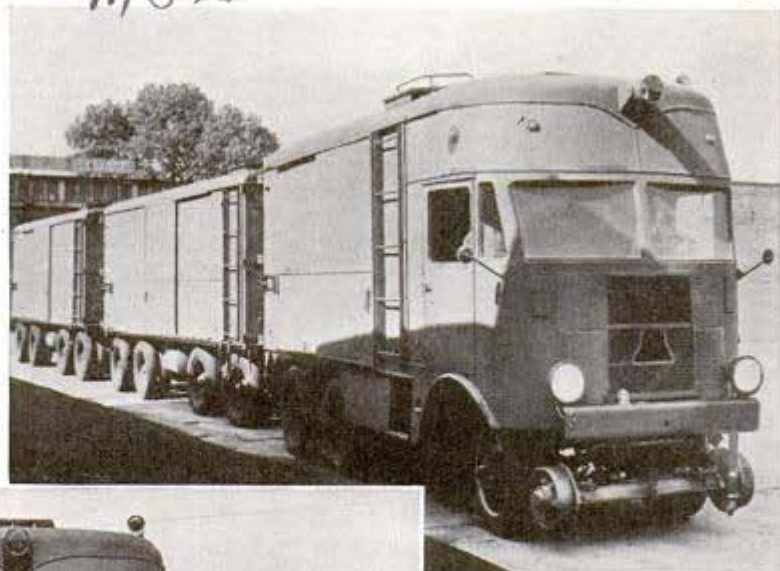
A giant 4-ton riveter with 200,000 pounds per square inch "squeeze" cold-rivets M-3 tank parts  
The last Plymouth rolled off the line January 31. Three weeks later guns and tanks were rolling



Evans Products Co., Tullerton at Greenfield  
Detroit, Mich.

## "Bomb" Train Operates on Rails or Highways

Two sets of wheels—rubber-tired and steel-flanged—enable a train built by the Evans Products Company of Detroit to operate with equal facility on rails or highways. The auto-train, which will be used in a U. S. ordnance plant to move bombs and other explosives, has retractable steel wheels. When operated on rails the



Leaving the rails, this train will roll along on 42 rubber-tired wheels

Small retractable steel wheels are lifted for travel on paving

wheels are let down to act as pilot wheels while 42 rubber-tired wheels carry 80 percent of the load. The train consists of a locomotive and two double-end express cars having a gross capacity of 90,000 pounds. The pilot wheels are raised and lowered by compressed air and the train can be converted from rail to highway use quickly.

## End of War to See Plastic Car With a Transparent Body

Looking into the future and a return to peace, industrial designer Raymond Loewy of New York City foresees the coming of plastic-bodied cars with transparent top section and opaque under part. But plastic windshields, he says, will depend on the development of materials resistant to abrasion. Such a body would be strong and

rigid enough to protect occupants in case of a roll-over collision. Light metal alloys, now in course of development for aircraft, will help improve the power-to-weight ratio, resulting in smoother performance and reduced maintenance costs. Streamlining will get a boost from non-projecting door handles, hinges and headlights, as well as flush-type windows and doors. Motors may be smaller and more efficient, probably using high-octane gasoline. Cars may even have pancake-type motors, which would permit their placement at the front,



Designer's conception of automobile built from plastics and lightweight metals now being developed for use in construction of airplanes and tanks

Ref: Bayshore Bus Lines  
 Goose Creek, Texas

# Auto Carriers Given a New Job Hauling War Workers

M 625

rear or center. Another new material, non-reflecting glass, may be available for the post-war auto, and air-conditioning may also become standard equipment.

Firestone '1 eye' & Rubber Co. Akron, Ohio  
 Reclaiming Plant

## Mountains of Tires Yielding Rubber For Defense

M 621

Great stacks of worn-out automobile tires, spread like mountain ranges over 20 acres of ground near the Firestone company's reclaiming plant in Akron, are dwindling rapidly because scrap rubber is being salvaged faster than motorists are throwing away their old tires. Millions of miles of carefree travel are represented in these casings, which rolled during an era when there was little thought of conserving treads or impending rationing. In contrast, the average driver of today treats his tires gently, as they may have to serve years without replacement.



Bus, bottom, was converted from an auto transport trailer like the one above, opening a useful life for trailer that had lost its regular job

Forced to retire from their former task of carrying new automobiles from factory to showrooms, the familiar transport trailers are being converted into busses for the more vital duty of hauling defense workers. This idea was originated by the sales manager of Jackson Brothers, of Beaumont and Orange, Tex., whose fleet of transports stood idle

while workers in nearby shipyards had difficulty getting to and from their jobs. The bus, operated by the Bayshore Bus Lines between Lake Charles, La., and Orange, seats 88 men and stands about 25 more. Only a few slight alterations were necessary in the conversion of a transport to a bus, as the trailers have a large amount of framing.



Eating into the great piles of cast-off auto tires is a crane used for loading cars that shuttle between the storage yard and reclaiming plant

SEPTEMBER, 1942

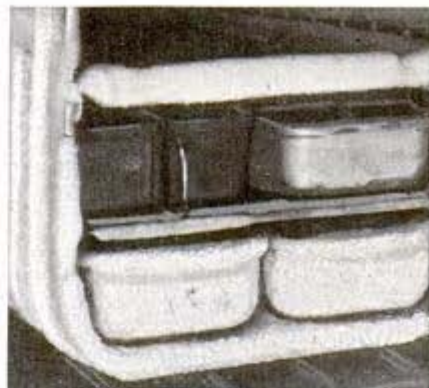
Four-fifths of the annual 4,000 grade crossing accidents occur at crossings specially protected by flashing lights, gates or watchmen.

*taken from*  
 Railway Age 13

3/7/42 - P.493

# THAT'S ALL THERE IS - -

M-511



An overdose of Ol' Man Winter comes to this neglected refrigerator, coated with excess frost. Defrost often to keep the formation less than  $\frac{1}{4}$  inch thick

America's skies are heavy with the smoke of industries producing goods for the Army, the Navy, the Air Force and the Marines—but not for civilians. Factories that once manufactured washing machines, refrigerators, vacuum cleaners, radios, automobiles and scores of other consumer goods are now turning out planes, tanks, guns and shells to smash the Axis. Until the war is won the civilian consumer must take a back seat and do his part to help win battles by conserving present equipment—knowing that when it is worn out there will be no replacement. The pictures on these pages contain a few tips on conservation. Above is something to try on your refrigerator. Close the door on a slip of paper. If you can pull it out you are wasting valuable electricity and should have the door strip repaired at once



Above, cleaning the brush of a vacuum cleaner frequently will prolong its life. See that it is not forced to inhale pins, bits of wire and metal and make sure the rubber thong that keeps the brush in place is free of hair and strings. Empty the dust bag at least once every week and consult instructions that came with it for oiling. Left, this man's mood—bad news or indigestion?—is playing havoc with the electric cord. Don't jerk it from the wall socket, but dislodge the plug gently and firmly if you'd have it last

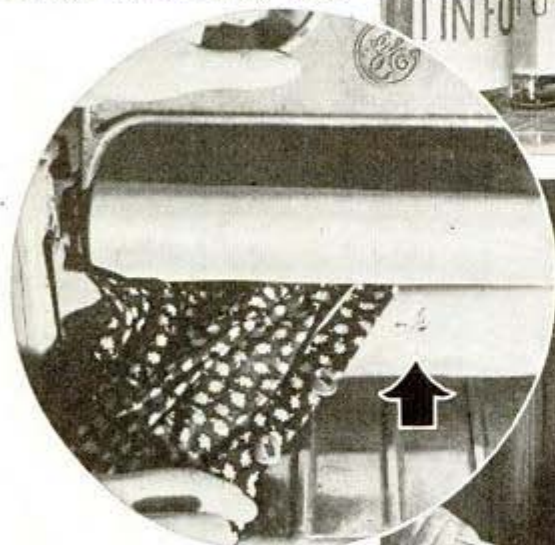




# THERE ISN'T ANY MORE



Keeping the stove clean is part of "home defense" because there will be a long wait between new stoves. Soap and water or steel wool will help. The young lady, at right, does her bit by saving tinfoil and empty tubes



The clothes wringer, above, made of precious rubber, is scarred for life by a sharp button. If this and other accidents should happen to yours, you'll be out of luck—and wringers—for the duration. Ornaments and all buttons should be covered with cloth and turned slowly through the machine. At right, the small boy is proud of the bundle of old newspapers he collected to help his Uncle Sam win the war. When the pile is broomstick high there'll be 100 pounds of waste paper and he will sell it to the junkman or give it to the Red Cross, Boy Scouts or other agencies in the neighborhood. All members of the family can help save scrap and conserve goods



## Bantam Sub-Machine Gun Fires 510 Shots a Minute

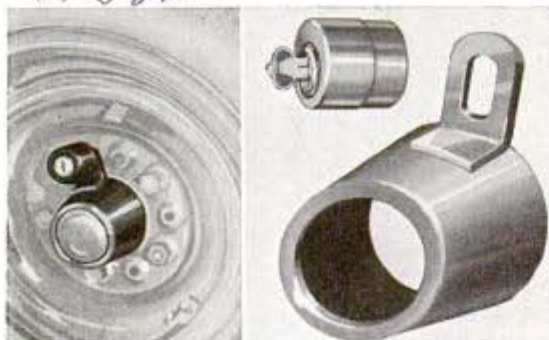


Heavy firepower packed into light sub-machine gun

Rapid fire, light weight, small size and low cost of manufacture are claimed for a sub-machine gun invented by William D. Hammond, Los Angeles mechanical engineer. The gun weighs 6½ pounds (lighter than other guns of its type), is only 29 inches long, and can shoot 510 bullets a minute. It has only 31 parts and fires a 45-caliber standard bullet.

## Wheel Lock Clamps Over Hub To Guard Axle Shaft Nut

Double security against theft of wheels and tires is offered by a front wheel lock



Note how lock covers hub so wheel can't be removed

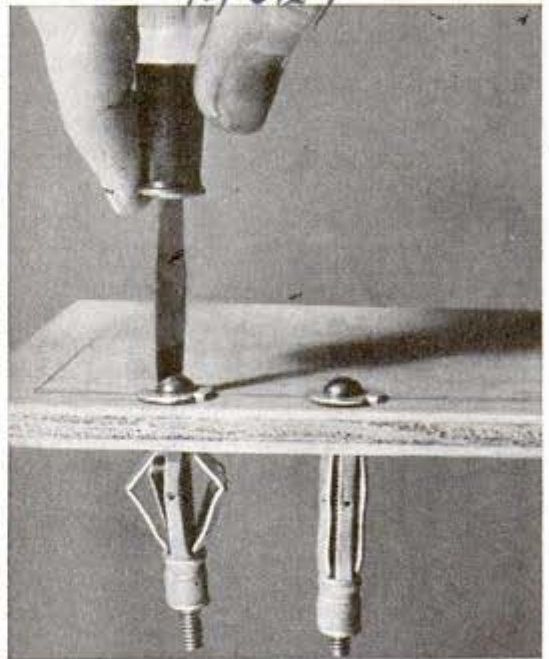
*Winkenevelder & Ladd, Inc.*  
16  
14 21 S. Michigan, Chicago, Ill.

*Cressant Machine Works*  
39 Moss, Reading, Pa.

that guards both the axle shaft nut and wheel nut against removal by unauthorized persons. Covering the inner hub is a flanged and slightly tapered cylinder, equipped with a lip at the base having an opening that permits it to be secured to one of the wheel bolts. A cylinder lock, applied after the large cylinder is in place, prevents access to either the axle nut or wheel nut without a key.

## Threaded Anchor Holds Screw In Any Kind of Wall

Shelves, cabinets and fixtures of all kinds can be fastened securely to any wall material with a combination anchor and screw. The anchor, made in several sizes, is a slotted tube threaded at the inner end to receive the screw, or bolt. When the bolt is tightened, the strips between the slots bend outward forming fingers that grip the inner side of the hole in which the



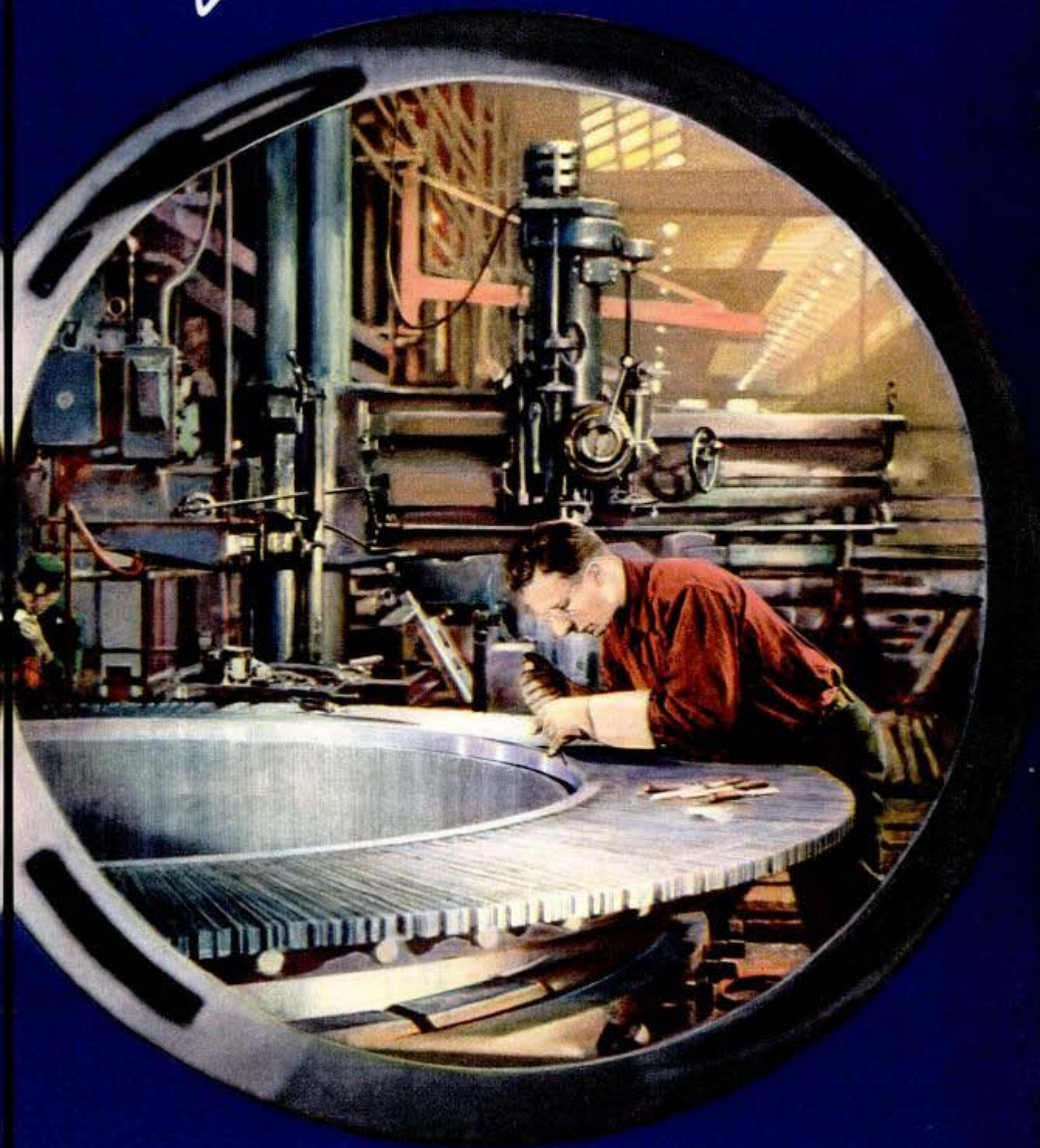
Anchor spreads within wall as screw is tightened

anchor is lodged. In concrete or thick blocks, the hole should be enlarged on the inside so the "fingers" may hold firmly by outward pressure. In thinner walls, such as tile, plaster on wood or metal lath, or any kind of composition board, the fingers may be expanded fully. Once it is in place, the threaded portion of the anchor behind the wall surface acts as a fixed nut so the screw may be removed and replaced as many times as desired.

POPULAR MECHANICS

# BIG MACHINES

*for the* **BIG TASK**



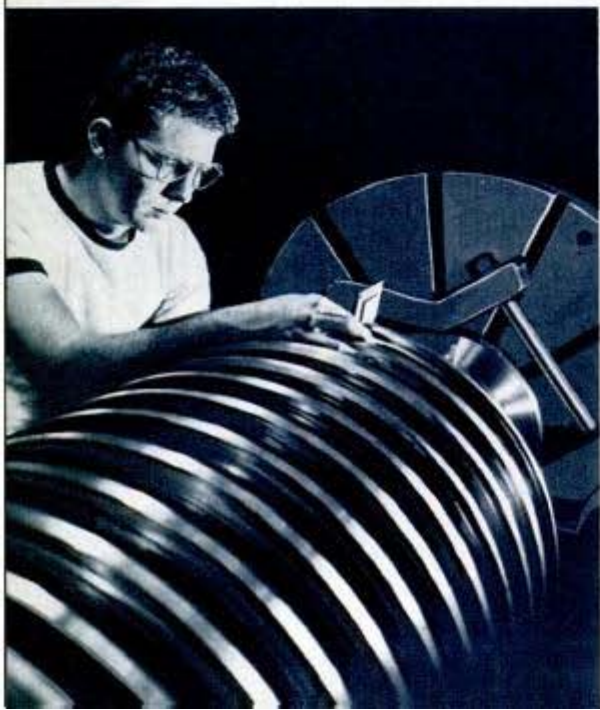
Assembled with a watchmaker's precision, this commutator and its twin will form a 10,000-horsepower unit to roll 48-inch steel slabs in an electrically powered mill



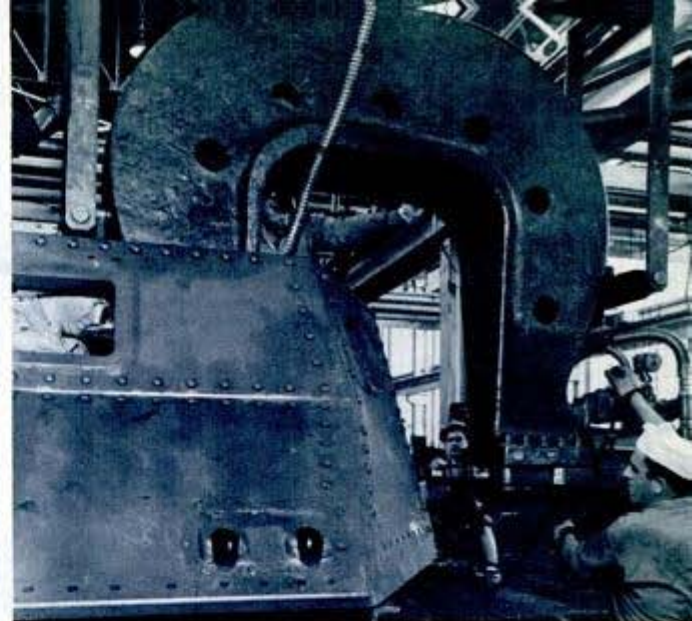
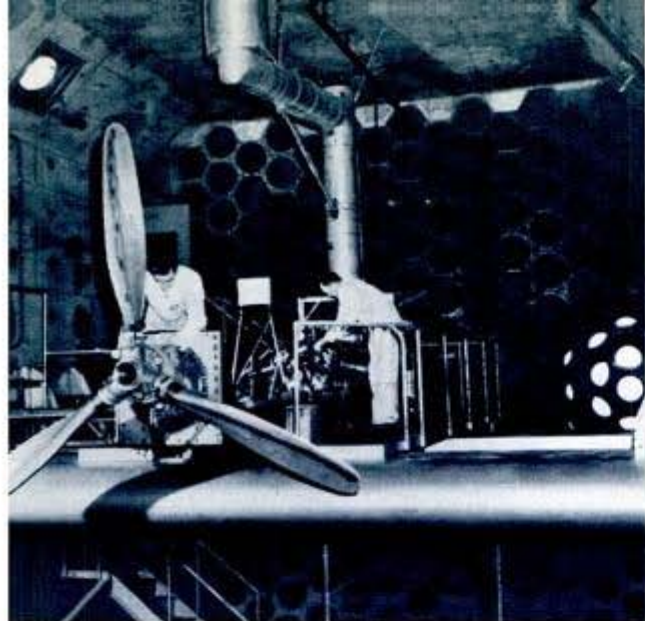
*M 348 - Mr. Leggett.*

Multiply this by unknown hundreds and you have a picture of industry gaining mastery of the air for America. This is one of the moving assembly lines for 4-engine Consolidated bombers

Once a machinist's helper at a Westinghouse plant, this man took a "learner" course and became a full-fledged engine lathe operator. Here he gauges the cut on a marine equipment part



Ford Motor Company men, from engineers and designers down to the last plant worker, had to learn a new industry in a matter of days. This engineer is literally and figuratively "wrapped up" in a wing section of a bomber to examine structural details. Now Consolidated B24D's are rolling off the line



Advanced type hydraulic airplane propeller, above, is prepared for a vibration test with an Allison engine. Vibration stresses will be measured and eliminated at all speeds in the propeller's operating range

It takes big industrial machines to build big machines of war. Above, at the right, a gigantic riveter in a Chrysler factory pounds away on a tank for the Armored Forces. Welders can now do the job faster

Sheet steel that once rolled into automobiles and stoves rolls now into tanks and ships. Right, a steel ribbon comes from three-stand tandem continuous cold-reduction mill of Carnegie-Illinois Steel Company

Twenty-eight-ton monsters ready to crawl out of the Chrysler Tank Arsenal—America's largest—for 75-mile test run. They will be armed with 75-millimeter guns. This factory was a cornfield a few months ago





↑  
 Biggest of their kind are the two 5,000-horse-power electric motors built to power a plant producing aluminum for fighting planes. One of these powerful twins is shown here on test at a Westinghouse factory where it was completed months ahead of schedule as rush job for war program



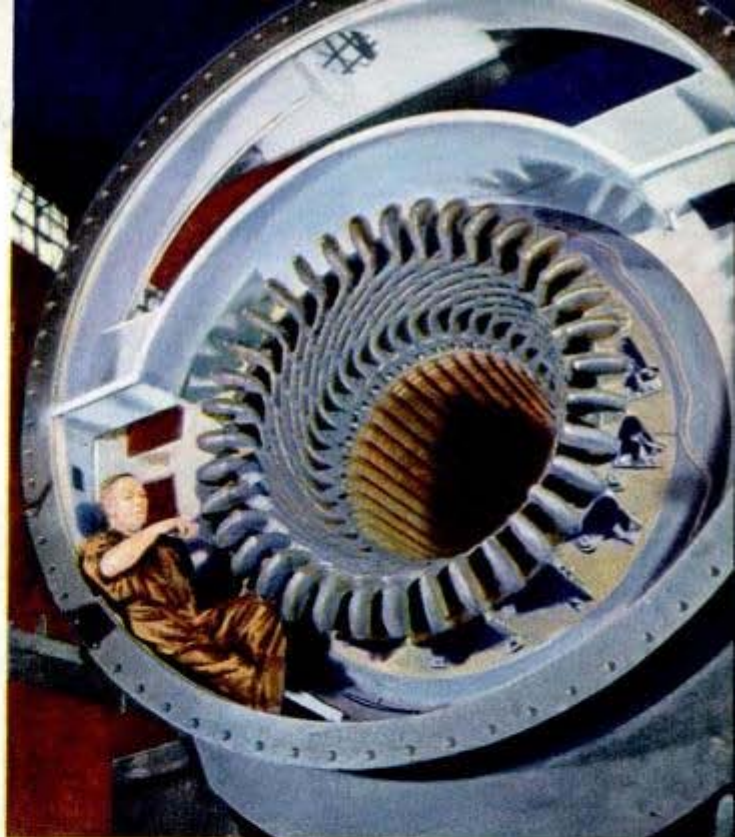
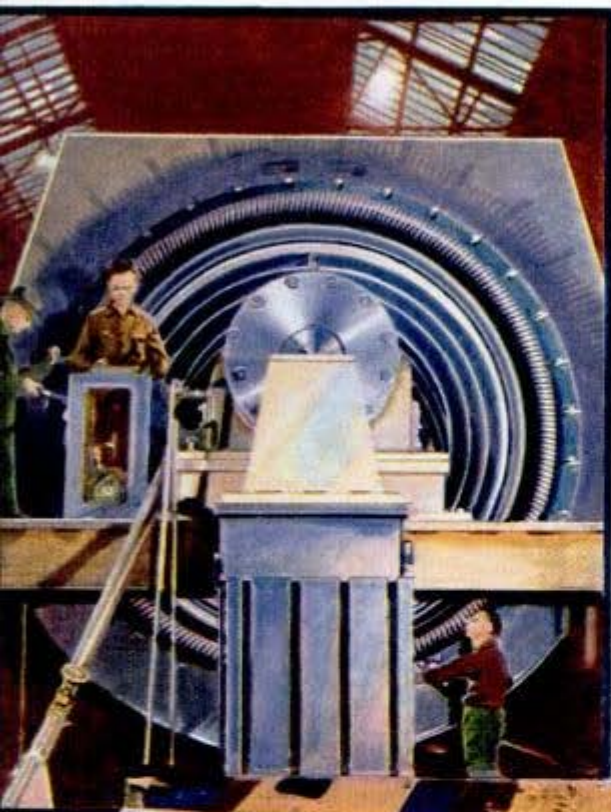
←  
 This is another giant of the power industry—an Ignitron, the "traffic cop" that changes alternating into direct current required for the manufacture of aluminum and magnesium. The mechanic is lowering the anode assembly into the Ignitron casing, which is cooled by encircling copper coils

→  
 Another big machine for changing alternating current into one-directional flow is this rotary converter, used by a chemical company in producing an important element in the gasoline that powers American war planes, tanks and jeeps. The process is electrolytic, and this converter is capable of supplying 5,400 kilowatts of electric power—enough to drive an electric railway train

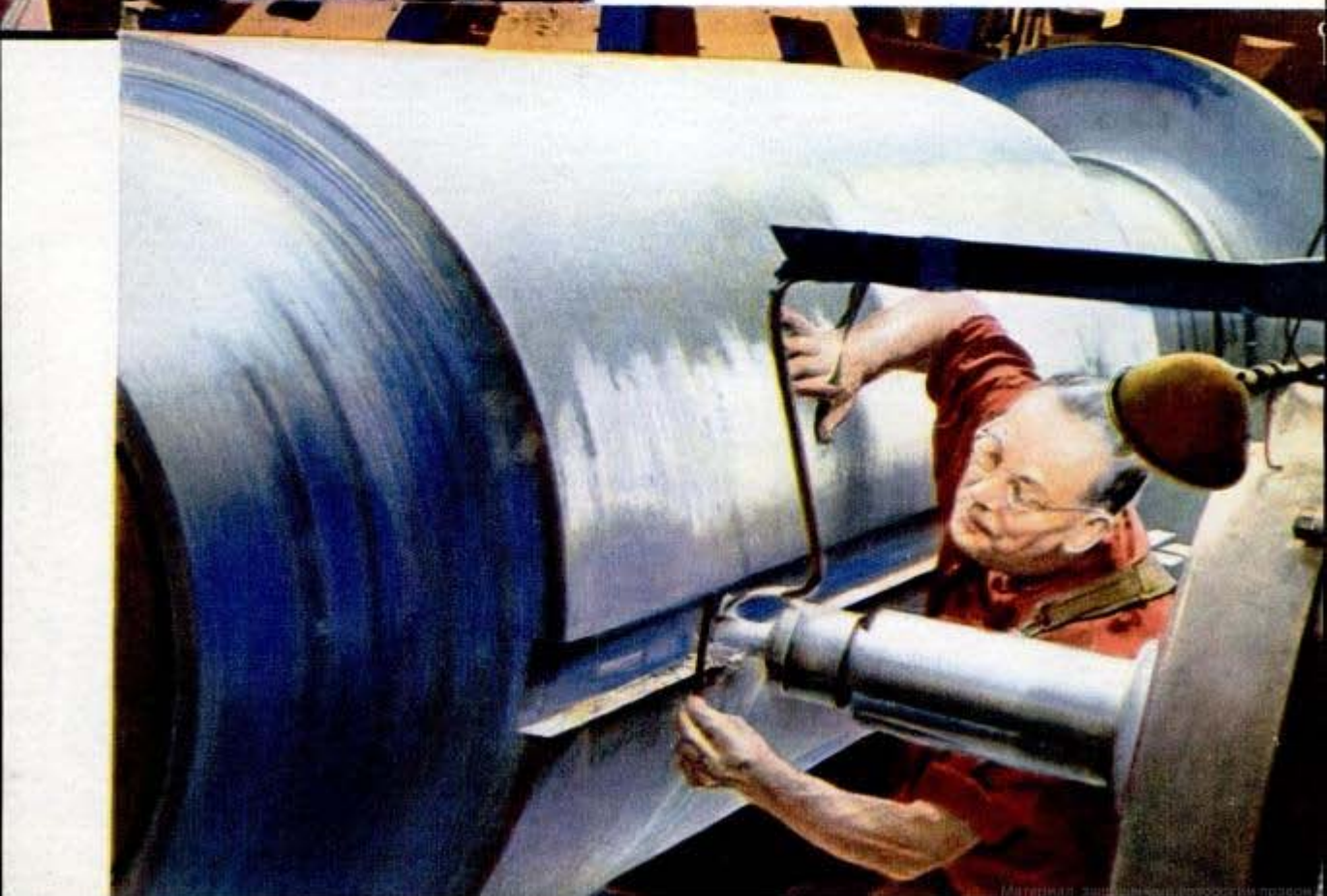


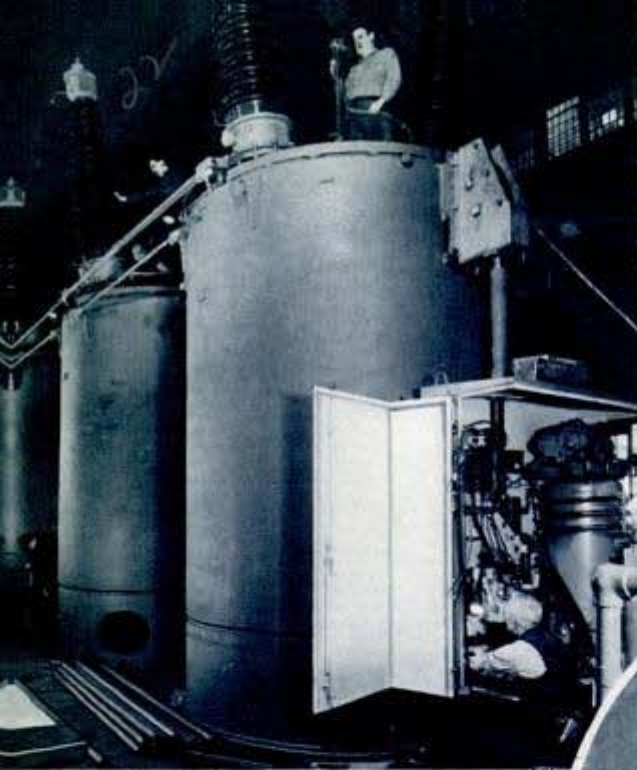
Inspecting coil windings for a hydro-cooled turbine generator to supply New York 50 million watts. Its 90-ton outer and inner frames surround rotor spinning 3,600 times a minute →

Below, final tests are given a 40,000-horsepower motor built to fan 400-mile-an-hour gales through a wind tunnel at Wright Field, where models of Uncle Sam's planes are tried



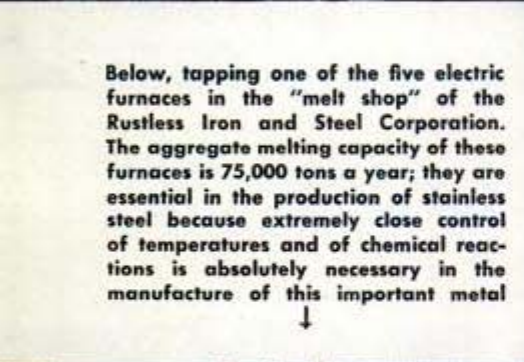
Under the guidance of a skilled craftsman, a machine bites its way into a solid steel shaft that weighs 60,000 pounds. It is cutting a keyway to hold in place the spider-shaped rotor of a waterwheel generator ↓



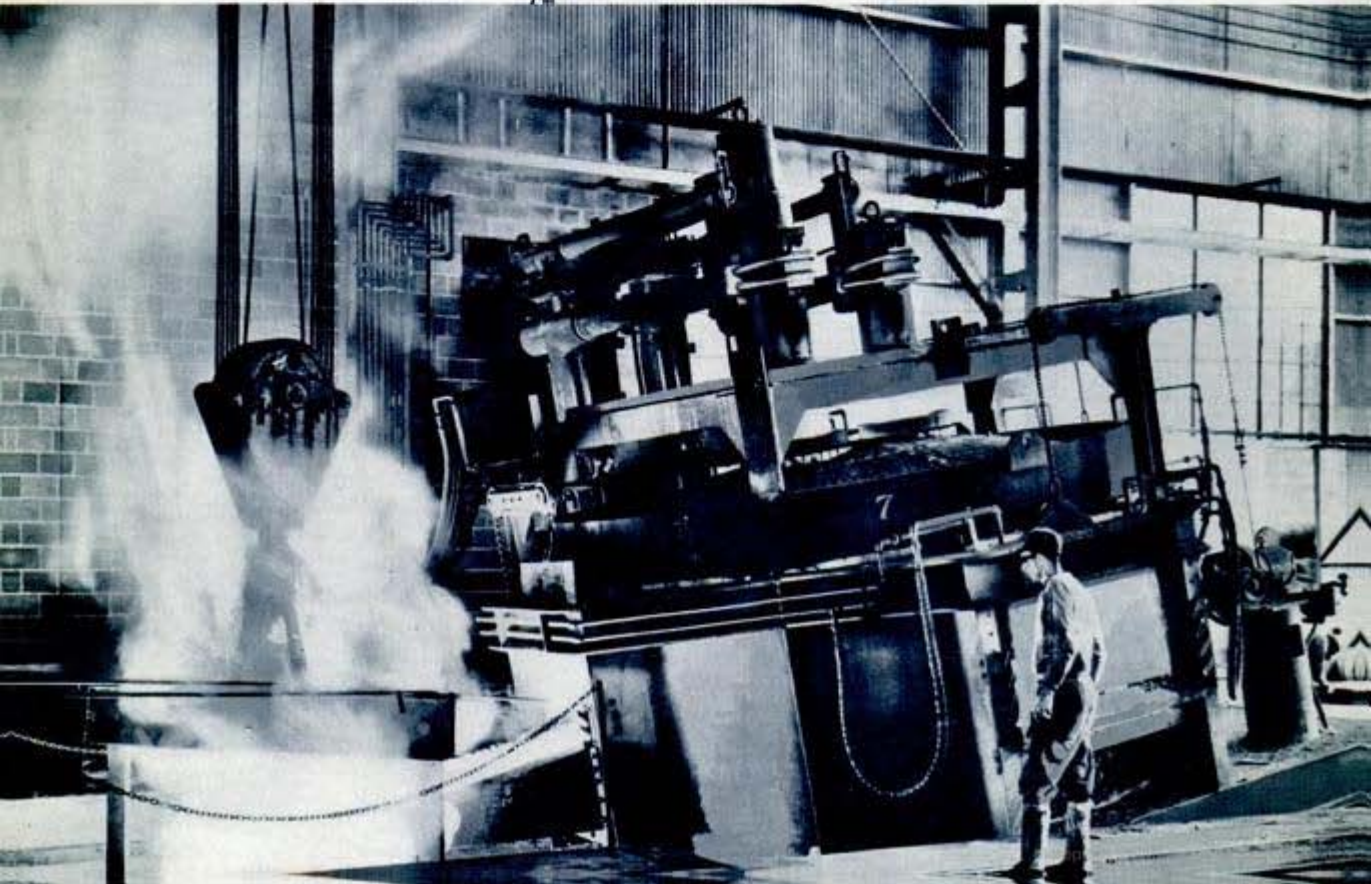
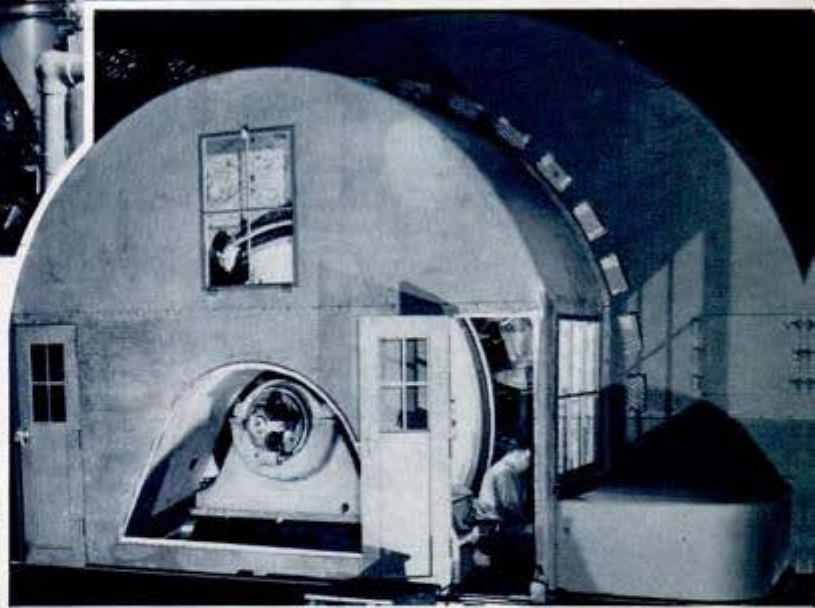


← These three tanks protect generating equipment at a large hydro-electric plant against short circuits by lightning, flood, earthquake or sabotage. Capable of interrupting 2,500,000 kilovolt amperes in 5/100 second, the automatic circuit breakers extinguish electric arcs in oil

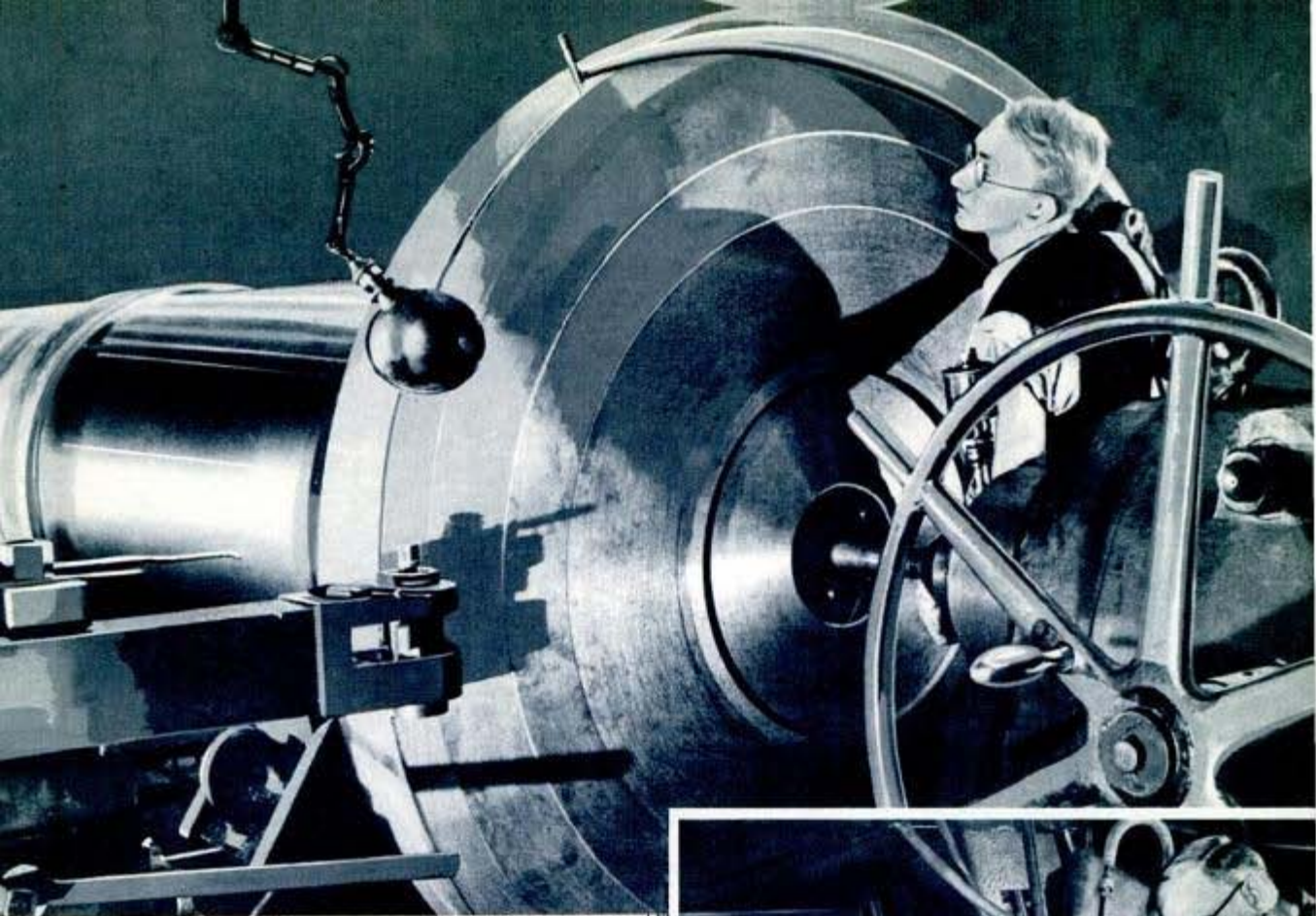
This is another view of the metal-clad rotary converter with which a chemical factory translates its "a.c." electricity into direct current for producing a vital element of aviation gasoline. The metal trailer-shaped housing prevents chemical fumes from reaching the converter



Below, tapping one of the five electric furnaces in the "melt shop" of the Rustless Iron and Steel Corporation. The aggregate melting capacity of these furnaces is 75,000 tons a year; they are essential in the production of stainless steel because extremely close control of temperatures and of chemical reactions is absolutely necessary in the manufacture of this important metal



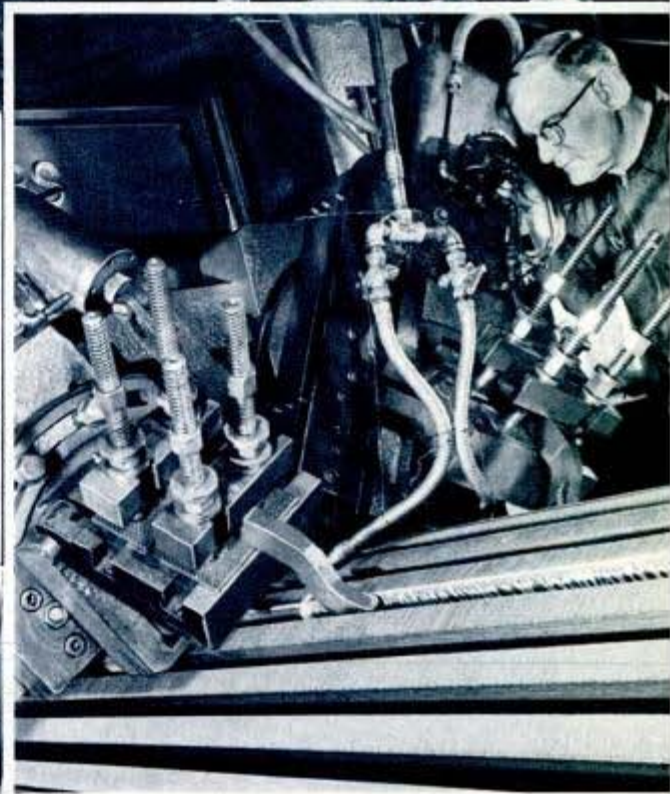




↑  
Three of the largest waterwheel generators ever constructed were shipped from the Westinghouse plant at Pittsburgh to the Grand Coulee power project in Washington. Here a machinist is checking the flange diameter of the shaft for the first of the generators

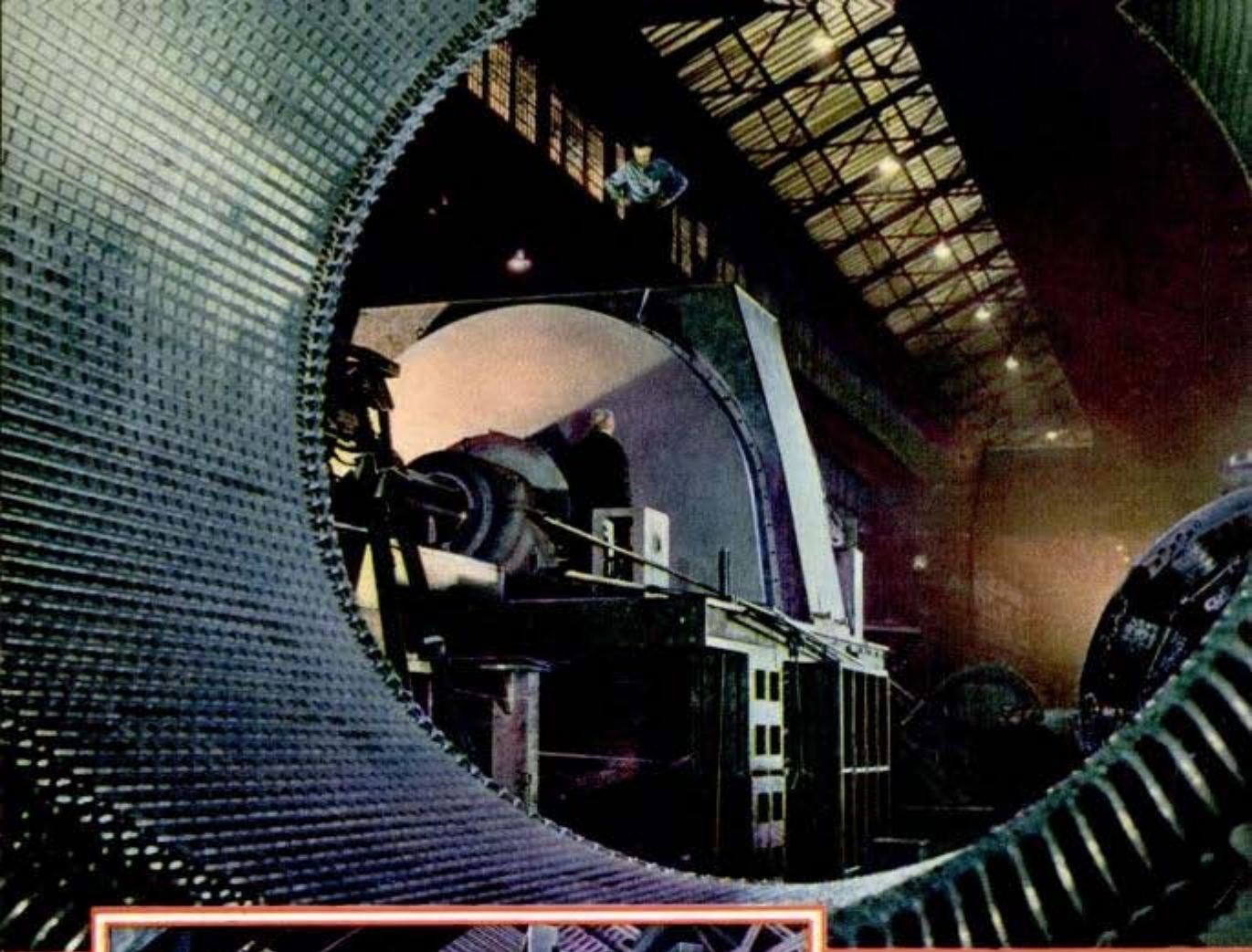
At control board the operator awaits a signal to start an Allison engine for a propeller test. Each type of propeller must pass three basic tests and meet rigid Army specifications. The tunnel and laboratory are equipped for both liquid- and air-cooled engines

↓

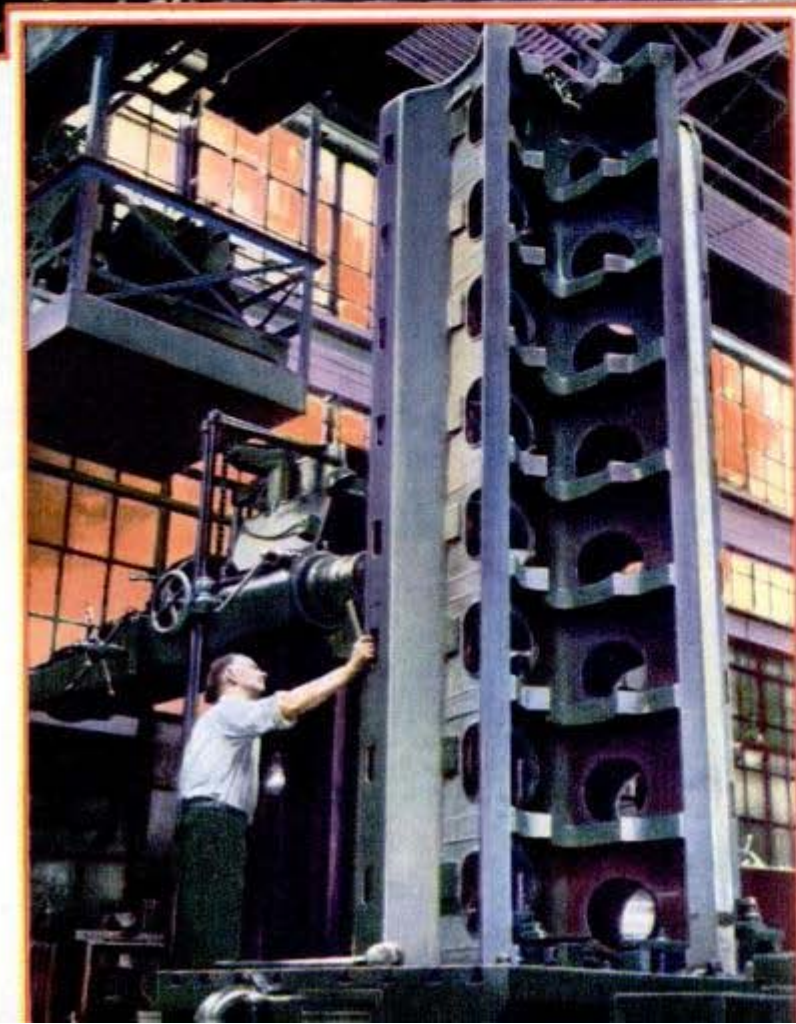


↑  
Steel cutting tool grooves slots in a rotor for large electric generator; slots in this steel cylinder are for insertion of coil windings. The operator, a veteran of 41 years service, speeded production 40 percent by suggesting a compressed air device that automatically lifts cutting tools while 14-ton rotor glides into place for next stroke





↑  
This is a wind-maker in the making. The fans powered by this 40,000-horsepower motor were designed to drive air at 400 miles an hour through the new wind tunnel for testing plane models at Wright Field

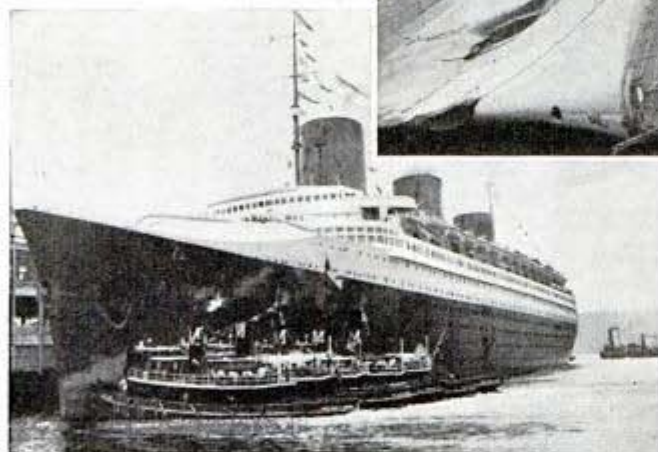
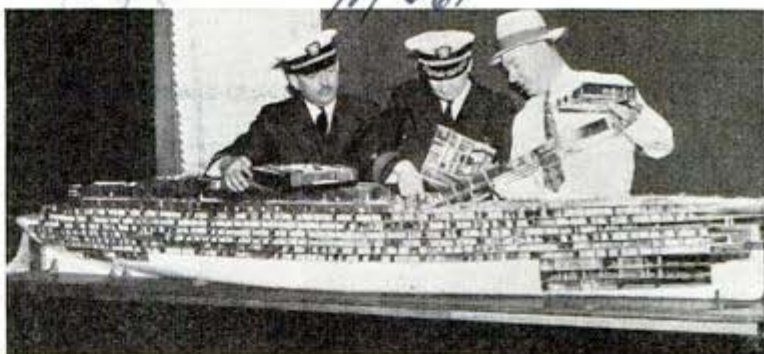


Dwarfing the men who build it, the enormous Diesel engine cylinder block at the left may already be at work in the engine room of some U. S. Navy vessel. Here it is being machined by a large horizontal boring mill in a General Motors plant where virtually the entire production is devoted to propulsion machinery for Uncle Sam's fleet. Diesel engines, too, are built in tremendous numbers to drive the Army's tanks, trucks, big guns and tractors

# Saving the Normandie Is a Tricky Balancing Act

Accustomed as they are to tackling the "world's biggest" jobs in building construction, electric power generation, factory production and dam building, American engineers have taken on a staggering task in salvaging the U.S.S. Lafayette, once the Normandie of blue-ribbon speed and fabulous luxury.

Her hull, about 54,000 tons deadweight, lies at an angle of 80 degrees in cramped quarters between two piers in the North river at New York, the keel at its stern



A model (top) of the flame-scarred Normandie, now on her side in New York harbor, aids engineers mapping salvage job. At left, the luxury liner in happier days

jammed under one pier where it has broken several supporting piles. Inside the ship lie 100,000 tons of water and silt so dense the most powerful submarine lamps cannot pierce it and divers must walk and work by sense of touch alone. The Navy board which appraised the job ahead said this of it: "The salvage of the U.S.S. Lafayette will undoubtedly exceed in both magnitude and complexity any salvage operation hitherto undertaken." It will require more than a year.

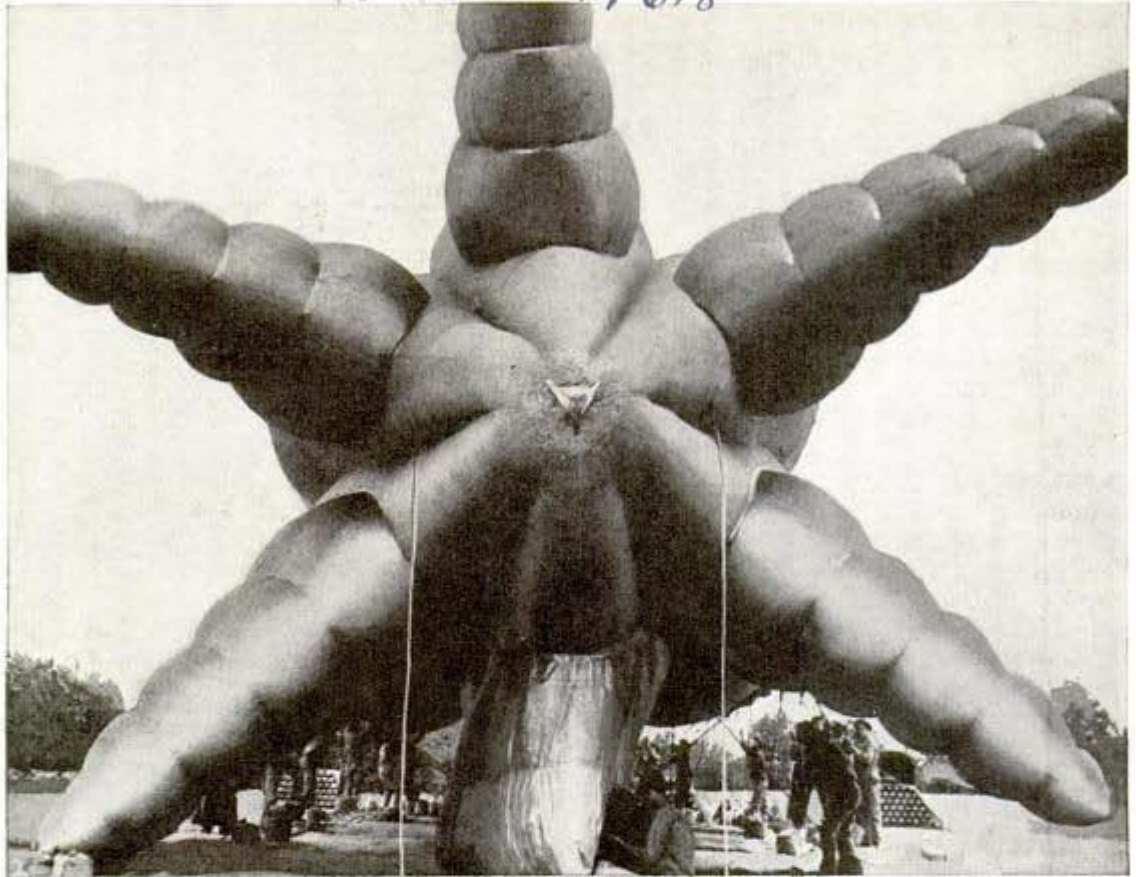
Ultimate objective of the salvagers is to pump air into the flooded sections until the ship rights itself by its own restored buoyancy. On paper it sounds simple. But first of all it entails the complete removal of all the superstructure above the promenade deck and cleaning out all inflammable ma-

terials above water. Ladders, staging and passageways must be provided for accessibility. Passages of ample height when the ship was on its keel are so confined in its present position that divers must crawl through them. About 375 portholes, 14 cargo ports and innumerable scupper and drain pipe openings on the submerged port side must be closed with concrete, timber or steel patches; hatches closed and watertight bulkheads built to prevent water shifting as the pumps begin their work. There are 10,000 cubic yards of mud to be expelled.

Extreme delicacy is essential in restoring buoyancy, for a sudden shifting of balance would probably have tragic consequences. The Lafayette rests partly on mud and sand, but toward the bow it is balanced on rock that acts as a fulcrum. Since the ship heeled over, it has been steadily settling by the stern with a corresponding rise of the bow, and one of the first tasks is to lighten the weight at the stern.

# "Aerial Octopus" Snares Enemy Sky Fighters

M 618



Barrage balloon swells to elephantine proportions as gas inflates the bag for its skyward journey

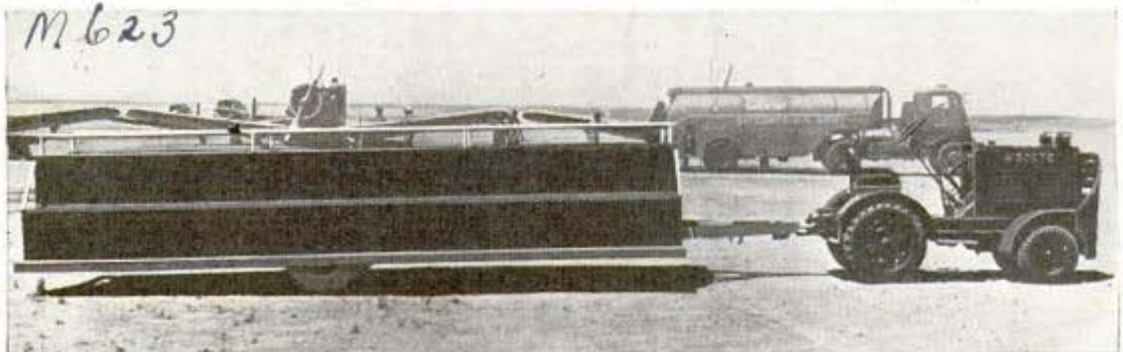
Six "hefty" arms outstretched at the tail end of a barrage balloon give it the appearance of some strange inhabitant of the sea, as an octopus or starfish. The lower fin, shown collapsed in the picture, is the

last one filled with gas as the balloon begins to rise slowly from the ground. Crews in training at Camp Tyson, Tenn., are learning how to send these gas-bags aloft as protection against raiding bombers.

## 30-Passenger Army Trailer Carts Men About Air Field

Large groups of cadets can be moved quickly around an air field in an open carry-all wagon drawn by a small "peep-like" tractor. Affectionately called "The

Drip" by the flyers, the trailer has room for thirty men and their equipment. Similar units are expected to be used widely on air fields and in military camps.



Trailer "bus," towed by tiny tractor, saves time of cadets when large groups are moved long distances

# 'Chutists Drill in Storm Kicked Up by Blower

M 692



Wind machine creates artificial storms for paratroops learning the tricks of handling their 'chutes

Parachute jumpers of the U. S. Army know how to keep themselves from being blown along the ground when storms whip viciously at their cavernous "envelopes,"

because of early training received at Fort Benning, Ga. When a windstorm is needed for training purposes, the army uses a wind machine that creates a powerful blast.

## Flame Thrower Attacks Pillbox Under Rifle-Fire Cover

M 639

"Fight fire with fire" is advice taken literally by United States Army forces. Having observed the successful use of flame-throwing technique against pillboxes during the fighting in Poland, France and Russia, our army is producing highly skilled flame throwers in order to keep pace with Axis methods. During recent chemical warfare maneuvers, soldiers set up a covering fire while one of them carrying a flame thrower on his back poured a lethal stream of fire into a concrete pillbox.



While one of their group approaches pillbox with flame thrower, infantrymen among logs in foreground cover him with protective rifle fire

# SHORTCUT *to* TOKYO



Caterpillar Tractor Co.

Big "Cats" like this are moving mountains of earth to pave a way to Alaska for caravans of army supplies

By Roderick-M. Grant M581

WHEN they started building America's "Burma Road," the army engineers dropped from their vocabulary the word "impossible." They say, with the infinite reserve of a war communique, that it's "difficult."

That's putting it mildly. Travel is at its

best along the route of the new highway to Alaska when it's 30 degrees below zero and the snow trains can lay their own tracks. Over the frozen rivers and through narrow forest lanes the Caterpillar tractors drag sled trains laden with supplies, some of them resembling a caboose on skids. At

a clearing in the woods one train turns off the trail to await the down-bound train like a freight on the railway siding.

In summer certain difficulties arise. Man-eating flies and mosquitoes swarm. Thaws send ice floes down the rivers, and floods spill into marshy pockets. Bulldozers and scrapers crash through thickets and saplings, skim the crust off the muskeg and are swal-

The Corps of Engineers built this trestle on the pioneer road that precedes the permanent highway





U. S. Army men lay planks across a frozen river in northwest Canada to help support the loads of road building material rushing north before the ice thaws

lowed up in ooze 15 feet deep. You might describe the country as impassable, but that word is also stricken from the vocabulary of the Corps of Engineers. The army wants a short cut to Alaska the worst way, and it's getting it with impossible speed. A short cut to Alaska is a short cut to Tokyo.

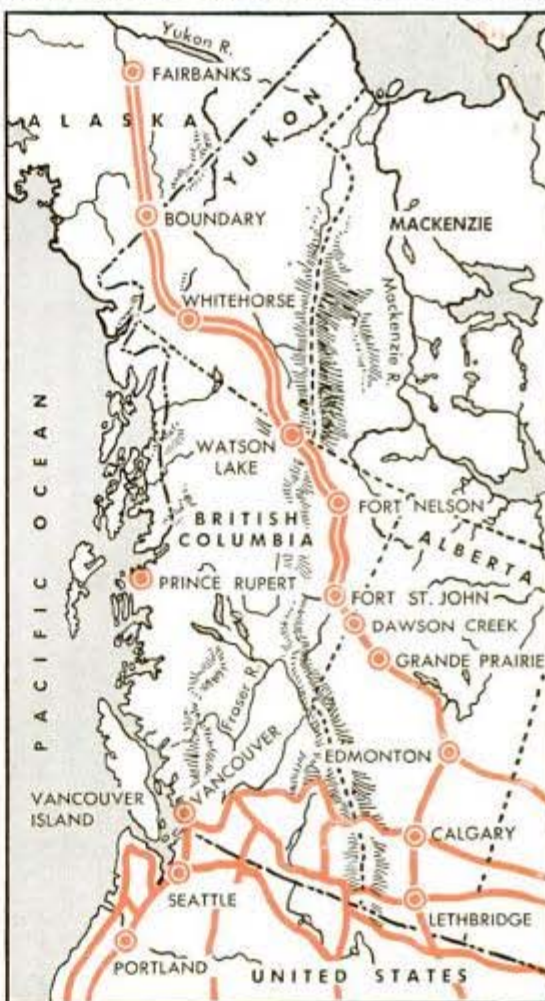
Exactly 75 years ago the United States bought Alaska from Russia for \$7,200,000. Critics called it "Seward's Folly," but it was a bargain at any price. Alaska is the base for any thrust across the north Pacific; it flanks any attack striking at the North American coast; enemy bases in Alaska could pour streams of bombers into our cities. Take a piece of string and stretch it across your globe from the Panama Canal to Tokyo. It shows that the shortest route from the canal to Japan and Vladivostok touches the Aleutian Islands.

In the last few years we have spent ten times its original cost to begin fortifying Alaska. Now we're spending 30 or 40 million dollars to build a road to the back door.

It will be a road like no other. Here, for the first time, highway follows airway.

It was only yesterday that caribou trails alone crossed this British Columbia wilderness. The Indians followed the caribou, fur traders and trappers followed the Indians. Only last year Canada completed a chain of air bases from Edmonton, Alta.—jumping-off place for the radium and gold

Double lines on map mark the new highway, which follows the chain of airports Canada built last year





The ubiquitous peep pauses at "Broadway and 42nd street" in a winter camp of the Army Engineers on the short cut to Tokyo

Somewhere in the winterbound wilderness a big shovel gets a lift from a tractor. The pioneer road is to be finished in a year



mines, the oil fields and trap lines of the north country—to Fairbanks, Alaska. Those air fields are the anchors of the new highway.

A full week before Canada and the United States actually agreed formally to the terms of the project, a 26-car trainload of troops from the states with jeeps and trucks, road machinery released from CCC camps, field kitchens and tents reached rail end at Dawson Creek, B. C., and overnight the hamlet of

one hotel, two stores and a cluster of houses, became the booming base of the road to Fairbanks.

Thirty miles north of Dawson Creek is Fort St. John, starting point of a winter road to Fort Nelson. Once the spring thaw set in it would be a quagmire, and the hundreds of American soldiers began the struggle in early March to push a fleet of ten-wheel trucks and gasoline trailers and road machinery up to Fort Nelson while ice still paved the trail. From Fort Nelson, bush country guides with dog teams led army reconnaissance units on to survey the route to Watson Lake, site of another air field, and westward across the Continental Divide—north end of the Rockies—into Whitehorse in the Yukon. From there the road strikes northwestward to the Boundary airport and thence to its terminal at Fairbanks, Alaska. Along those bleak miles the engineers step now and again upon the trail of the prospectors who fought their way here in the Klondike Gold Rush. At Watson Lake a band of 50 luckless gold hunters reached the end of their trail in 1898 and died of starvation and disease.

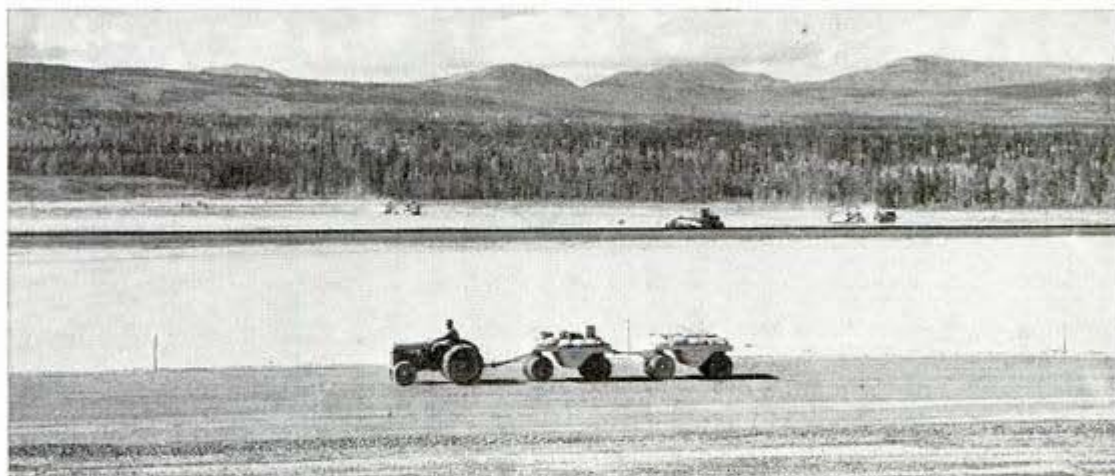
It's 1,200 miles from Edmonton to Fairbanks, and there's a problem for every mile. After the political problem, settled by the agreement that the United States



would build and maintain the road during the war and turn it over to Canada when peace returns, there came the topographical problem. The surveyors are settling that. Next, the job of getting men and supplies in. A pioneer road had to be surveyed and built to keep the truckloads of material flowing north. Over the Peace River and other water barriers a "bridge" of planks was laid to help support the heavy loads of equipment crossing on the ice before the spring break-up. Sawdust spread on the ice under the planks helped delay the thaw. When the ice did break, there would be a pause of



Crawling Diesels haul the "snow trains" laden with supplies. Usually there is a "caboose" serving as cookshed and dormitory



several weeks before the river cleared enough to reestablish the flow of transportation by ferries and ponton bridges. Until a surface is laid over the bottomless muskeg, the engineers at Fort Nelson will be isolated from the outside world for 150 days of the year, with airplanes the only means of bringing in food and equipment. At some work stations along the road cableways have been slung from lakes to hilltops to carry pipes for the camp water supply.

Even in the well-paved United States there are places where sinkholes continually undermine the highways. Bridging those hundreds of miles of quicksand and granite and muskeg in the

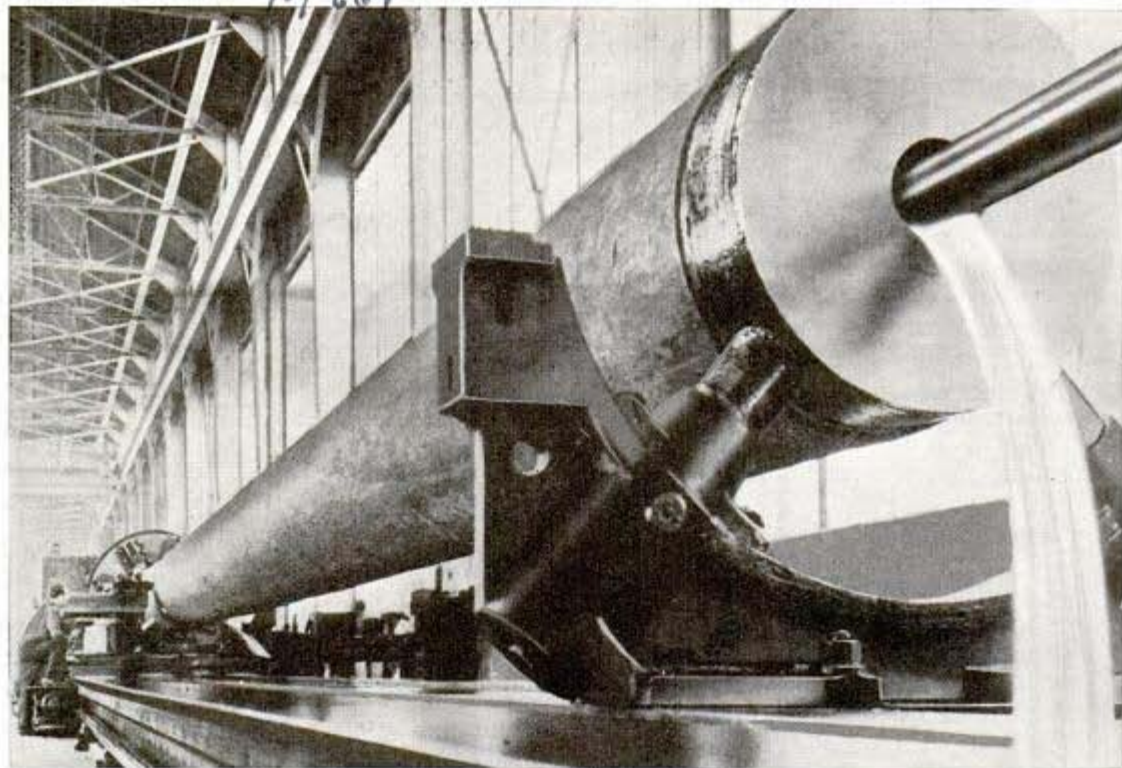
(Continued to page 170)

Not much more than a year ago this broad expanse of smooth air field was carved out of a wilderness of evergreen forest

Dog sleds, tractors, jeeps and airplanes all do their part in hauling men and supplies. Here a dog team skirts an airport



# Mesta Machine Co., Pittsburgh, Pa Giant Boring Lathe Hollows Out Huge Rifle



Workmen using an 84-inch boring lathe to hollow bore a forging for gun barrel nearly 70 feet long

Industry's largest tools have their part in creating gigantic engines of destruction needed to win the war. In one example of this, workmen may be seen hollow boring

a huge gun forging, nearly 70 feet long, in an 84-inch boring lathe, at a Mesta Machine company plant where big-scale production is in progress.

## Machine Gun With "False Nose" Screens Flash of Fire



Tubular extension at nose of machine gun hides the flashes that might otherwise aid hostile gunners in spotting the airplane's exact position

Flashes of fire emitted from a plane-mounted machine gun, as it spits death into enemy craft, can be hidden by a tubular piece fitted to the nose of the gun barrel. This .30-caliber Browning machine gun, a compact instrument of destruction, is fed cartridges by means of a belt, empty shells falling in a can under the barrel and used links flying into another container.

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

# Pigeons Carry Cameras to Spy for Nazi Army

Small cameras attached to the breasts of pigeons are being used by the Germans to get pictures behind the Russian lines. The cameras are equipped with automatic time releases that take photographs at intervals of about five minutes. Discovery of the use of birds as aerial spies was made by the Russians when the Germans abandoned six trucks equipped with pigeon coops. The booty included trained dogs that carry the birds in baskets to starting points.



Trained dogs carry birds in baskets tied to their sides to starting points where the roads are impassable

## Electric Dial on Riveting Gun Keeps Operation Uniform

War production may be speeded up with an electric control for rivet guns which permits only the number of taps required, makes the work uniform and reduces waste. The flow of compressed air to the gun is electrically controlled by a dial which may be regulated for any particular job. Hitherto, the riveter had to possess skill sufficient to apply just the right amount of pressure. If the invention proves successful in current tests it will reduce sharply the 200 hours of instruction required to prepare riveters for jobs.

## War Plants Hide Underground in Ancient Stone Quarries

British war factories and hundreds of skilled workmen are finding sanctuary from air raids in underground stone quarries begun in Roman times 2,000 years ago. Guided by quarrymen who alone knew their way about the dark caverns, surveyors mapped the quarries for the engineers who then laid plans for two factory sites. In the first site, a million cubic yards of space were added for the plant, but it was not necessary to widen or straighten the streets and avenues. Walls and roofs were painted yellow to bind the fine dust so it could not damage machinery. The second

underground factory is entirely air conditioned, the temperature being kept between 60 and 65 degrees. Elevators and moving stairways carry men and materials, and fluorescent lighting is used. The main restaurant is above ground, but a small room for making tea is underground, from which tea is delivered to the men and women at work. This factory is featured by a control room linked to all parts of the factory by telephone, loud speaker and microphone. A glance at the hourly production records tells the managing director how work is progressing at any section.

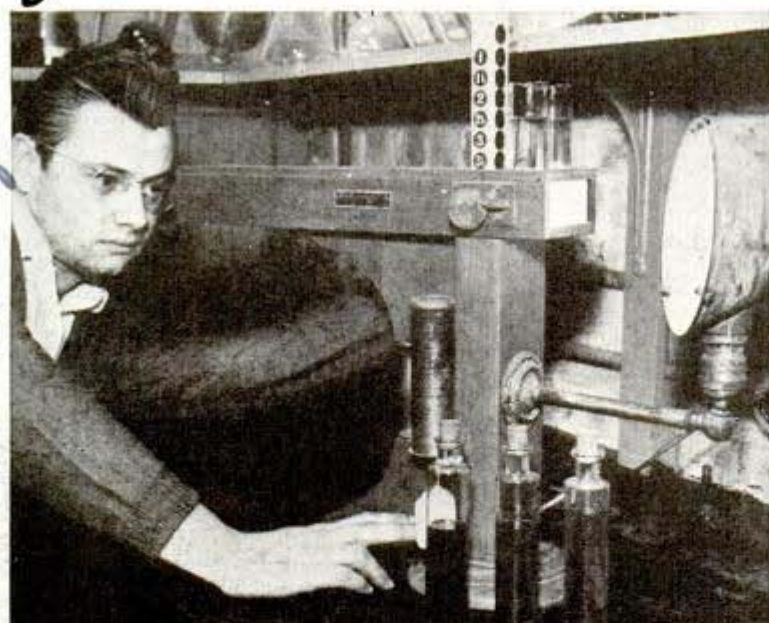
W 400 Cont. Thomas E. Stinson, Jr.  
3872 Franklin Av., S. A. Calif.

# NEW WEALTH from BLACK GOLD

the asphalt runways of air fields. Its white oils and petrolatums are necessities for the medical corps and its aromatic solvents are a basis of the lacquers used in camouflage. Submarines could be traced by oil spots on the surface if it were not for an unusual petroleum grease used to lubricate the fins of the underwater craft. Glycerin for nitroglycerin and 70 percent of the toluene used in TNT explosives are contributed by petroleum to munitions manufacture.

In fact, modern warfare is fought with petroleum. If it were not for the gasolines, fuel oils, and lubricating oils used by land, water, and air vehicles, the current war would be conducted at the tempo of the Civil

War. Our advantage here is that we possess more petroleum than our enemies and have super gasolines that give our airplanes more speed and punch. More than 60 percent of the world's output of crude oil is produced on this continent. This, ultimately, is going to give us superiority in the creation of synthetic rubber, another of the substances that is made from crude oil. One authority estimates that the Unit-



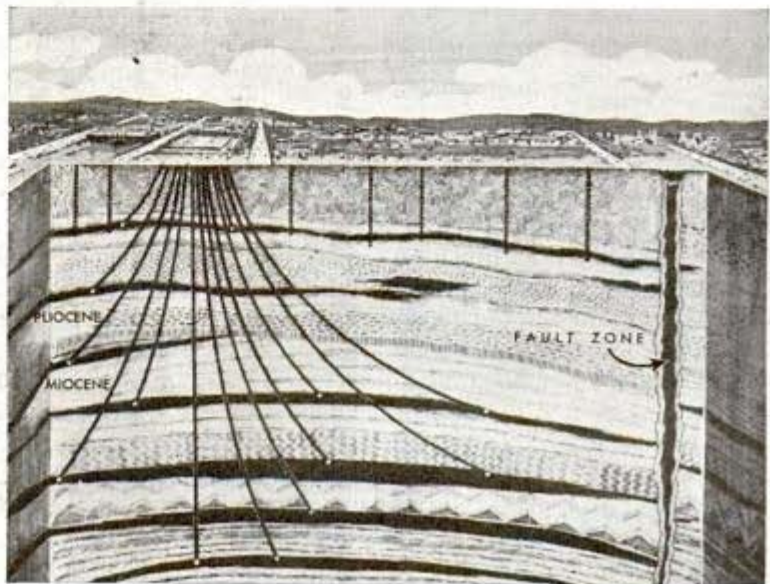
A petroleum engineer measures the opacity of samples of lubricating oils

**A** LADDIN'S wonderful lamp must have had a hydrocarbon flame, for no other substance has the magical qualities possessed by petroleum. Like the lamp in the story, this versatile oil can provide almost anything we wish.

Crude petroleum is a mixture of paraffinic, olefinic, naphthenic, and aromatic hydrocarbons. It ranges in quality from solid asphalt to almost pure gasoline. Its color may be cherry, green, yellow, brown, or dense black. Some crude oil is fluorescent and the oil from some fields is radio-active. Traces of platinum, gold, silver, and other metals are found in samples.

Today petroleum has joined the fighting forces and in a thousand and one ways is helping to win the war. It supplies wool oil for uniforms, furnishes the hard waxes that coat ammunition, and creates

Diagram shows how directional drilling from under one roof can tap oil sands over 1,000 acres



Ref. Lynn Talch, Public Relations Dept. Standard Oil Co. of Calif.  
Standard Oil Bldg., San Francisco, Calif.



Part of a big oil field is seen above through the spokes of drilling apparatus

ed States can more than make itself self-sustaining in rubber from its own vast hydrocarbon resources, some of this rubber being of a type that has 30 percent greater wear and strength as tire material than has natural rubber.

The contributions of petroleum to everyday life, even aside from transportation, are hard to total. It is the basis of a gas odor that makes gas leakages apparent, coal is treated with petroleum to make it dustless, an oil of petroleum keeps the leather plungers in bottling machines and other equipment soft and pliant, and an odorless and tasteless petroleum wax coats our paper milk cartons.

We use petroleum products in salad dressing, as movie fog, for airplane sky writing, for waterproofing vases, and for candling eggs. Fruit wrappers are insulated with a product of petroleum to avoid mildew, and petroleum paints keep the knots from drying out of knotty pine woods.

One of its oils is used as a float to prevent hot splashes from preserving kettles. A hydrocarbon chemical is used to roughen some of the surfaces in Diesel engines so that lubricating oils will cling to them, reducing scuffing and breaking-in wear by 90 percent.



Photo from Lane-Wells Co.

Lowering an electric gun into well to tap oil-producing zone. Each dimple on the barrel is a slug that will be fired into sands to drain off oil. Below is a night scene at the Richfield refinery





Expansion loops in hot oil lines at a big refinery

An asphaltic mastic painted on pipes prevents rust and corrosion underground. One sort of petroleum wax preserves our floors and another greases the ways for launching ships. An emulsified oil is used to waterproof adobe earth, which then becomes a satisfactory building material. Some of us heat our homes with fuel oil and keep them sanitary with germicides



Lane-Wells test apparatus being lowered into a well

and sprays compounded from petroleum.

At least one new plastic material has been created from crude oil, cosmetics and pharmaceuticals have been made from it for years, ethyl alcohol is another derivative, and an acid that attacks iron oxide is used for pickling steel plates.

All of these products are possible because chemists have found that they can take the hydrocarbons of petroleum apart and re-arrange them in different forms. Catalytic cracking, hydrogenation, polymerization, alkylation, and other processes developed in the last decade have been put to work on a giant scale. In the United States alone petroleum operations amount to a 14 billion dollars a year industry.

The refineries are busy increasing production, particularly of aviation gasoline, rubber, and raw materials for munitions. Emphasis is on production, but research has also been speeded up. Petroleum chemists are certain that there are many other raw materials in crude oil, not yet isolated, that can be put to use.

Now that we have become so dependent on petroleum it is important to know what our resources amount to. One pessimistic estimate is that the present known domestic reserves contain enough oil for no more than 15 years production, while a more optimistic point of view suggests that even without the discovery of new oil pools, the known oil shale and coal deposits will yield



Union Oil Co. photo

A research man tests the action of a new petroleum window-cleaning liquid under various conditions

enough oil for 20 centuries. Coal is petroleum's first cousin, and by hydrogenation can produce large quantities of gasoline and other oil products. Our known coal reserves amount to some three trillion tons. Converting coal into gasoline is expensive, but this might be offset by greater refining efficiency and more efficient engine carburetion, keeping miles per gallon cost low.

Oil drilling methods are being improved. The most interesting feature of this is the accuracy with which directional drilling can be controlled. Oil well holes can now be drilled in curves toward any desired direction and to within an accuracy, say, of 15 feet of a point 6,000 feet down and 4,000 feet to one side. This is done in part by placing steel wedges in the holes so that the drilling bits are forced to one side. The technique permits reaching far out under the ocean from beach locations and is also the basis of a proposal for "indoor" drilling to recover oil under residential areas.

In Los Angeles, for instance, a vast pool containing an estimated half billion barrels of crude exists under a fashionable residential district. No drilling is allowed. J. E. Elliott, petroleum engineer, proposes to recover the oil from inside a drill building that would avoid the ordinary noise, odor, and unsightliness of outdoor drilling. The plan calls for the construction of a building 75 feet tall covering up to 12 acres. Sixty-foot stands of drill pipe would be handled inside the building by roof hoists, eliminating the usual derrick structures. It is estimated that by directional drilling, some 1,000 acres of underground deposits could be tapped from the central building. The building would be soundproofed, include air conditioning equipment to wash objectionable odors from the air, and electric power instead of steam power would be used for drilling. There are several other potential fields in Los Angeles from which ordinary drilling is now barred and it is thought that oil deposits underlie residential portions of Oklahoma and Texas.

Some experts are coming to the conclusion that petroleum is being formed under the seas faster than we are consuming it. Attempts are being made to convert vegetable matter into alcohols which may then be changed into hydrocarbons, and chemists are also dreaming of the day when they will be able to combine simple hydrogen and carbon into the compounds upon which much of our civilization depends.

SEPTEMBER, 1942

*B. F. Goodrich Co.  
Akron, Ohio*  
"Guillotine" Tester for Tire  
Drops Plunger 92 Feet



Testing a truck tire for resistance to sharp blow

Truck tires are tested by the B. F. Goodrich company for their resistance to terrific blows with a special "guillotine" that drops a 37-pound plunger from a tower 92 feet high. The plunger travels downward at a speed of 52.4 miles per hour to strike a blow of 5,250 pounds on the tire. After this test the tire is examined for injury which would reveal flaws in construction.

Folding Pipe Locks Ashes In  
When Stored in Pocket

Tobacco ashes will not spill into your pocket when the swivel stem of a vest-pocket pipe is turned around to serve as a cover for the bowl. The folding pipe is useful for workmen who can take only a few puffs at one time, yet dislike to throw away the unsmoked tobacco.

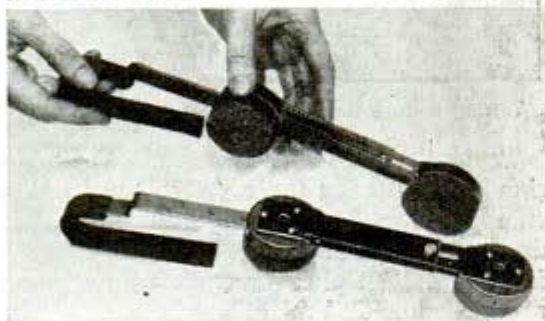


The swivel stem turns around to cover the pipe bowl

*The National Briar*  
*Pipe Co.*  
*45 Morris, Jersey City, N.J.*

## Cushions Quiet Typewriter As Bars Hold It to Table

M452



Legs of the machine are screwed to the pad holders

To reduce the pounding noise made by your typewriter, woolen cushions may be obtained for its legs. The pads are fastened to metal holders attached to brackets—one for each side of the typewriter. The legs of the machine are screwed to the pad holders and hooked bars covered with black felt hold the typewriter to the desk.

## Plastic Tips for Open-Toe Shoes Guard Hose From Soiling

M406



Plastic toe-tip inserts, available in various colors to match all hosiery shades as well as shoe colors, protect hose from rain, dirt and gravel without detracting from the smart appearance of the shoes. To produce spe-

*Dr. E. H. Evans, Jr.*  
*Univ. of Chi, Chicago, Ill.*  
cial style effects, contrasting colors may be worn. It is only necessary to push the toe tip into the toe of the shoe, to convert an open-toe shoe into a closed-toe shoe.

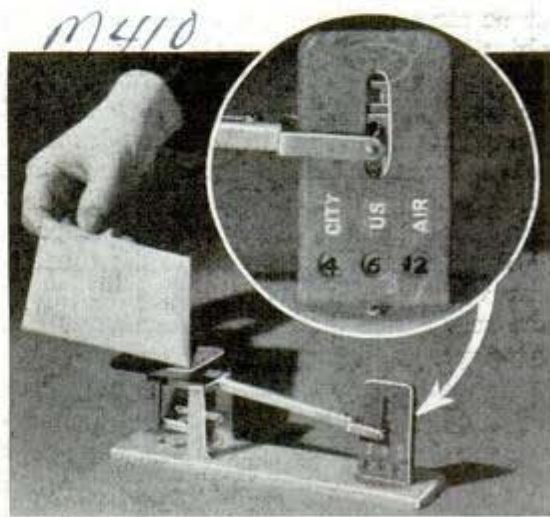
## Animals Use Carbon Dioxide For Growth Like Plants

M430

Animals as well as plants use carbon dioxide to build up cells and tissues, according to a discovery announced by Dr. E. A. Evans, Jr., of the University of Chicago. This finding was based on the tracing of radioactive carbon atoms in food fed to the animals studied. The "tagged" atoms were found later in muscle and liver tissues. Water solutions from dried liver were found to contain enzymes able to convert carbon dioxide into organic molecules. Hitherto it was thought that animals expelled all carbon dioxide as waste.

## Postal Scale Shows Mailing Cost Instead of the Weight

Weighing letters up to and including the three-ounce rate, a balance scale made of plastic shows the cost of mailing the letter instead of indicating its weight in ounces. In three small windows the figures two, three and six appear until a letter weighing more than one ounce is placed upon the platform. These figures represent the one-ounce rate for letters directed, respectively, within the local post office area, outside the area but within the United States, and for domestic air mail service. For heavier letters the figures tell two and three-ounce rates for each type of service.



Scale indicates city, domestic and airmail postage

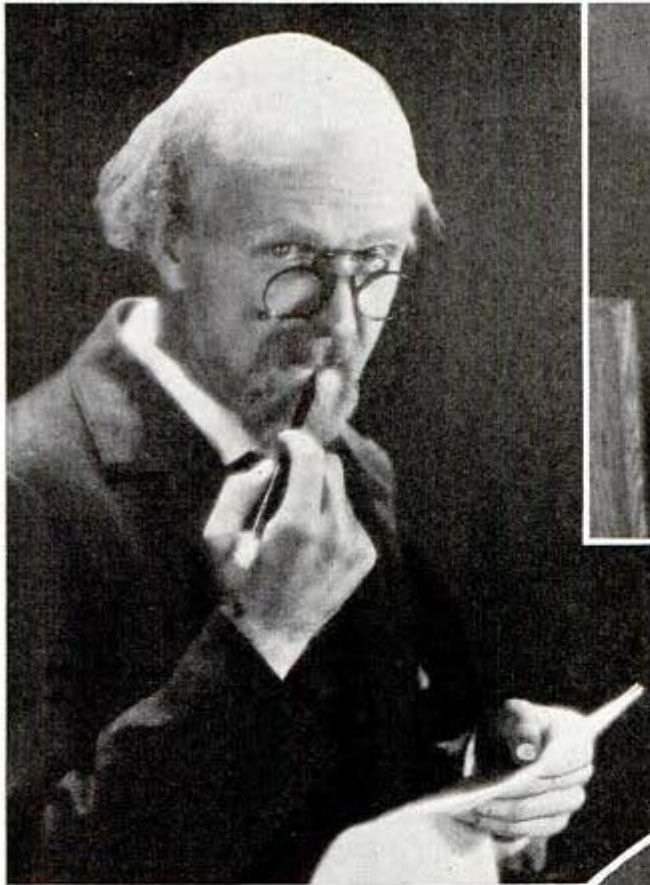
POPULAR MECHANICS

*Beverlycraft*  
*Beverly Hills, Calif.*

*Dist. Gardner's Inc., Indae Mart, Chicago, Ill.*  
*Dist. Sears Roebuck & Co State & Gen. Bureau, Ill.*



# Actor "Tailors" Features With Plastic Makeup



Plastic nose and brows fit perfectly, for they were made from a plaster model of the actor's head. The "rubber" features are smoothed out so no dividing lines show and they are tinted a flesh color. The plastic, flexible enough to permit a normal show of emotion, will not crack or lose shape under the hot studio lights

Handed a script for a new movie role, Lucien Littlefield, the character actor, studies it and decides he should have a new nose, a slight sag to his jowls and changed contour of his cheekbones. This is a simple matter for Mr. Littlefield, a student of makeup since the age of 10, who has developed a process for making artificial features with plastics to eliminate painful skin-stretching or padding



Molding clay is applied to the plaster model, changing the features. Above, the actor is enlarging the eyebrows for a sinister appearance. After the clay is molded he makes a plaster-of-Paris cast, lines it with a thin layer of absorbent cotton and pours the liquid plastic into the parts where the features have been altered. When set, the plastic nose, brows, cheeks or other features are carefully removed. At left, Mr. Littlefield is lifting the cast from the full-sized model. Clay is scraped off and the model is put away till a new script appears

Mr. Grant M 369

# GIRLS *in* OVERALLS



Two former drug-store cashiers torch-welding stainless steel at North American Aviation factory

for women's war work by sewing a flag. Women are still more skillful than men at that sort of work; modern Betsy Rosses are sewing barrage balloons and patrol blimps, rubber life rafts and silk parachutes and airplane wings, not to mention a few million uniforms.

But industry has so mechanized itself that there is scarcely a job too heavy for the ladies. Their dexterity, accuracy, and aptitude for repetitive tasks make them adept at handling assembly of small parts, using hand tools, and such erstwhile

**WANTED:** 6,000,000 women.

It's a sign of the times. If there was a faint echo left of that old refrain—"it's a man's world, and woman's place is in the home"—it has faded completely now. Manpower is not enough to win a war today.

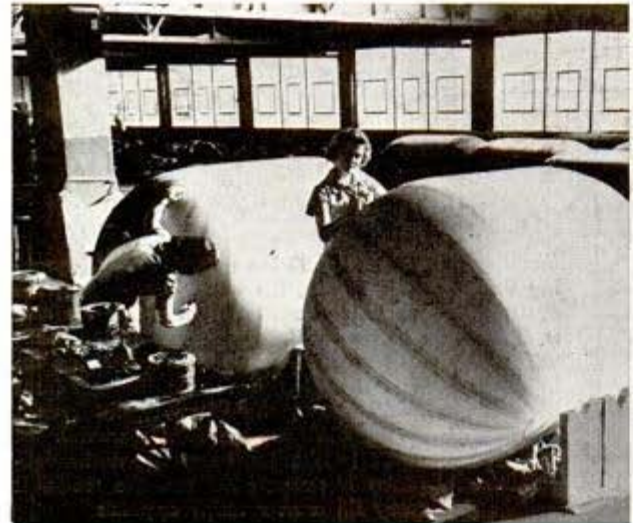
At the start of 1942 a half million girls and women were in overalls, and by the year's end 6,000,000 may be at work in war industries and essential services. That would be 40 percent of the war labor army of 15,000,000 Uncle Sam wants on the job by December 31.

Several wars ago Betsy Ross set the style

masculine machines as drill presses, punch presses, lathes, and welders. And lately the introduction of automatic machinery and lifting and positioning devices has made it possible for women to handle really big stuff we used to think was "For Men Only." At the Glenn L. Martin aircraft plant, for example, the engineers have worked out new manufacturing methods and installed new devices so that women employees could operate unusually heavy machinery.

The girls seem to like building bombers and fighters, for there are more than 15,000

A small army of women at the Goodyear plant fabricate flotation bags for airplanes, life rafts, balloons, etc. (left). Right, a girl in overalls operates automatic riveter in the Glenn L. Martin bomber factory





Douglas Aircraft Co. photo  
Thousands of girls work in the Douglas plant. They wear slacks-style uniforms for comfort and efficiency

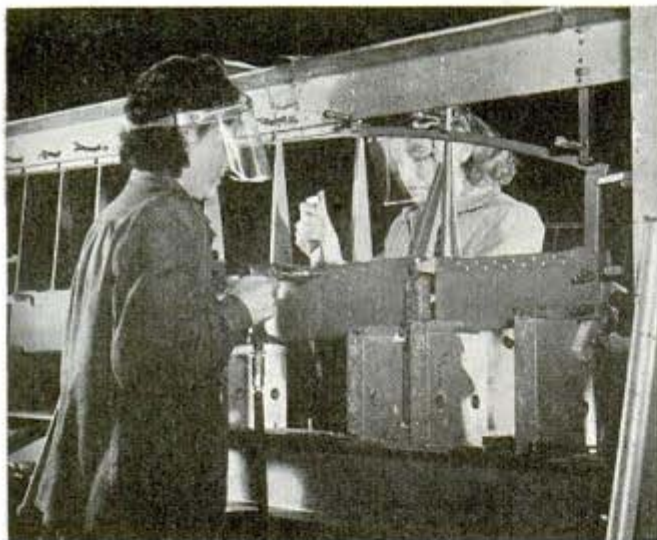
of them in the airplane factories and they're doing every job imaginable. One girl applied for a place as stenographer in the Ryan Aeronautical works but they found out she'd studied drawing at the Kansas City Art Institute and now she's doing perspective drawings for the engineers. Another, a crack shot with a pistol, became the first of her sex on Ryan's plant protection force. Douglas Aircraft discovered that women have "what it takes to buck rivets—or any other wartime chore," and the delusion of feminine frailty went out the window. Girls who had built their own radio stations, raced and repaired automobiles, and one who welded fuel tanks in the first world war are doing anything from aluminum welding, turret lathe operations, handling rivet guns and assembly-line installations on Vultee planes down to electric wiring and radio assembly and sewing fabric on ailerons, rudders and elevators. A Kentucky school teacher supervises 50 girls using precision gauges and test apparatus at the N. A. Woodworth factory, producing a hundred different airplane engine parts. In the Texas plant of North American Aviation they call them "planes-women"; a one-time interior dec-



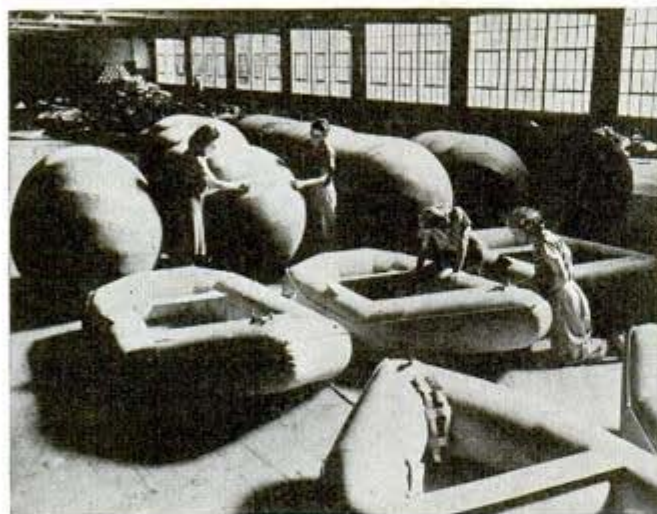
Girl at left bucks rivets driven by gun at right in assembling fuselage bulkhead for a Vultee plane



Masks protect girls from fumes in paint shop at Vultee Field



† Douglas girls team up at the rivet gun and bucking bar in a scene symbolic of an age of aluminum planes and girl mechanics



Thousands of pneumatic boats flow from Goodyear workrooms to the armed forces. Here modern Betsy Rosses are building them

This may resemble a permanent wave machine, but it's not even a distant relative. The woman is welding an aluminum fuel tank



Canadian Information Bureau

orator is an inspector on the final assembly line, a girl studying for grand opera by night helps on sub-assemblies of plane parts by day.

Once upon a time a girl in an engineering school was a rarity. She might even have been considered a little queer. But the girls are making up for lost training today. The University of California organized a three-months engineering training course for aircraft draftswomen. Goodyear Tire & Rubber company is training junior draftswomen and sheet metal workers in two special classes. Ford, breaking a 40-year rule against women in factory work, started 28 women in the enormous Willow Run bomber plant and is training hundreds; eventually 12,000 to 15,000 women may be put to work there. The Navy Yard is looking for women who hold degrees in mathematics and physics, and mechanical, electrical, metallurgical and chemical engineering. Women engineers, industrial chemists, smart mathematicians and photomicrographers are sought by Westinghouse and General Electric.

At first some of the factory managements were a little worried about bringing girls into the plants. They were afraid the men would pay more attention to the girls than to the machines. But that wore off. Men and women work side by side today; in most cases efficiency has stepped up rather than down; women employees are treated like the men, paid the same for equal work; but there is one thing they must give up. No more feminine frills and high heels, fluffy hairdos and jewelry. There are exceptions according to the job, of course, but generally slacks are essential and skirts are out, low heels and closed toes are required for comfort and safety, hair must be tight against the head or protected by net, snood or scarf lest it be caught in whirling machinery. Bracelets, rings, dangling necklaces and frilly garments are banned for the

same reason. There must be nothing to snag on a spinning drill or cog or rolling conveyor belt.

These girls in overalls are not crowding men out of jobs. There just aren't enough men to go around. At Douglas Aircraft the management gave assurance that no experienced man, young or old, would lose his job to a woman; instead, men who had gained experience are being promoted to key positions and women are helping fill the vacancies in the ranks.

Over in England, women 80 years old make airplane parts; women in a Midlands factory repair crashed planes; others are running transmitting stations of the British Broadcasting company, making money at the Mint, servicing locomotives, building ships and working in steel foundries. There are plenty of men in America who'd



↑  
**Women's dexterous fingers excel at a job like this, winding insulating tape on a huge Westinghouse turbine generator that develops 65 million watts**



←  
**In the Briggs factory many women are employed in sewing fabric on wing sections, working on final wing assemblies and various other tasks**

↓  
**Rows of delicate instruments which serve as eyes of our warplanes parade across the desk of a Westinghouse girl in final assembly operation**

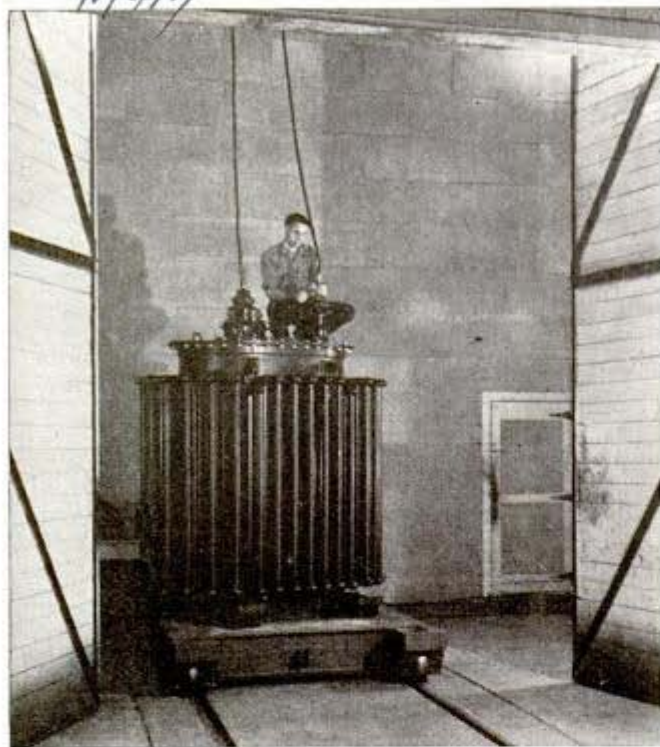


envy the English girls who are operating steam shovels.

A survey by the U. S. Census Bureau showed there are 15,600,000 housewives between the ages of 18 and 44 who constitute the principal reserve from which war labor may be drawn. It indicated that the bulk of the women war workers must come from urban and rural, non-farm areas.

There may not be much glamor about cleaning spark plugs for the Pan-American Clipper, riveting a cockpit cabin on a fighter plane, shearing metal at a shipyard or running a tool shop. But women are finding opportunities never open to them before; they're discovering skills they never realized were theirs, and they're doing a job that's needed.

*Westinghouse Elec + Mfg. Co.*  
*East Pittsburgh, Pa.*  
**Transformers Given 'Voice Test'**  
**Before They Are Installed**



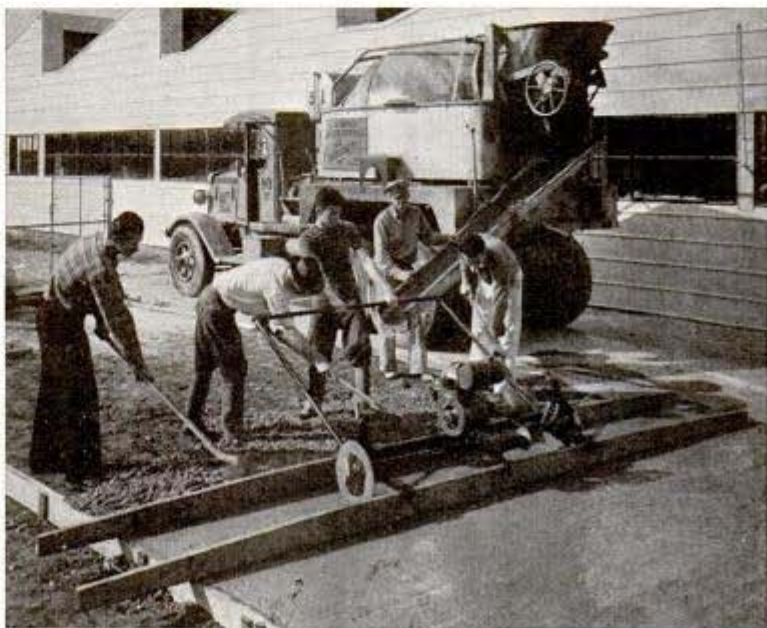
Large transformer carried into soundproof laboratory on rails receives a "voice test" before being assigned for installation

Electric transformers intended for outdoor use on power lines are wheeled into a soundproof laboratory for a "radio voice test" before being assigned to their post. The object is to make sure that a transformer will not produce louder sounds than the normal noises of the location in which it is to be installed. For instance, the noise level of a residential district at night is from 25 decibels, about equal to the purring of a cat, to 30 decibels, which is nearly twice as loud. In a business district a transformer may be louder, since the noise of a busy city street is about 90 decibels. An increase of six decibels represents approximately doubled noise level, so 90 decibels would be nearly 2,000 times as loud as 25 decibels. Regardless of their degree of loudness, transformers

always hum at a monotone of 120 cycles a second, which corresponds with the second B below middle C on a piano. The laboratory, located at the Westinghouse Transformer Division in Sharon, Pa., is a building within a building, the inner one enclosed in walls composed of sound-absorbing materials, and the outer building having eight-inch brick walls. Three soundproof doors help shut out noises from a nearby factory. Noise within the soundproof laboratory has been reduced to only 20 decibels. A microphone, held a foot from the humming transformer, is connected to a sensitive electric sound meter to record the intensity of the hum.

**Vibrator for Concrete**  
**Speeds Drying Floors**

M 455  
Concrete for floors or pavements may be smoothed speedily and the moisture brought to the top for quick drying with a motorized unit attached to the conventional screed used in tamping and smoothing. The unit reduces the concrete to a solid mass by vibration and may be operated on a pour of only one inch instead of the usual four to six inches.



Motorized unit shakes concrete, bringing water to the top for drying

# Highway "Mounties" Train to Hunt Parachutists

M 478



California's highway patrolmen gird for defense duties that may include running down saboteurs and parachutists or keeping the roads clear for troops during maneuvers. Rookie patrolman (above) learns the hazardous trick of leaping from one moving automobile to another.



Firing machine gun while speeding along on motorcycle (above) requires great skill, for both hands are used in shooting gun. Below, one of 300 rookies recently added to regular force of 850, tries his hand—and feet—at scaling barrier left by "foe"



Left, patrolmen are instructed in use of balloon to raise an aerial for attachment to emergency radio which members of force must know how to set up and operate. The vast new training program also includes use of tear-gas grenades, gas masks, how to fight incendiary bombs, and the usual instruction pertaining to small arms and self-defense. Patrolmen, more familiar with California's highways than any other group, might be first to arrive at the scene of an enemy parachute landing along desolate areas of the west coast.

Cost: Mr. Leggett - U. S. Army Air Corps, Wright  
Field, Dayton, Ohio.

# SKY HIGH and a STATE WIDE

M394



In this official photographic plane of the Army Air Forces, new techniques in aerial mapping are tried out

**T**WENTY thousand feet above the green and yellow checkerboard of Ohio a Wright Field cameraman caught with his wide-angle lens the remarkable photograph on the opposite page. It embraces hundreds of square miles, spans a state. The army man pointed his camera toward Fort Wayne and South Bend, Ind. Nearly four miles beneath him the main highways and section lines ruled off Ohio like a printed map. In the middle distance a black

blot marked Lake St. Marys, with Celina, O., at its upper corner. Beyond was Indiana, and just over the horizon, about 250 miles away, was Chicago.

Infrared film and the new camera made possible this picture, with its amazing clarity of detail which the human eye itself could not discern through the haze. The Air Force cameramen have recently completed a series of tests with this metrogon wide-angle lens, which has a six-inch focal length and takes in everything within a 74-degree angle in one shot; and it is probable that it will soon supplant the five and nine-lens mapping camera.

Wright Field men map-photographed an area of 1,600 square miles from an altitude of 25,000 feet and were back on the ground in three hours and 35 minutes. They shot "strip" photographs each 50 miles long, overlapping each strip. With the technique and equipment in army use ten years ago this 1,600-mile mapping project would have required days of flying at 100 miles an hour and at 15,000 feet. The new camera is already in mass production.



Here one of the army's multi-lens cameras is installed in a plane to shoot through the floor, mapping the country by strips





You are 20,000 feet high over western Ohio, looking toward Ft. Wayne and South Bend, Ind. The ink blot is Lake St. Marys, Chicago is just over the horizon. This remarkable photograph was made on infra-red film with a new army wide-angle lens

*Spinks Scale Co.*  
*422 Hillside Dr., S.W.*  
**Filling Bag Is One-Man Job**  
**With U-Shaped Holder**  
*M 466*

*Atlanta, Ga.*

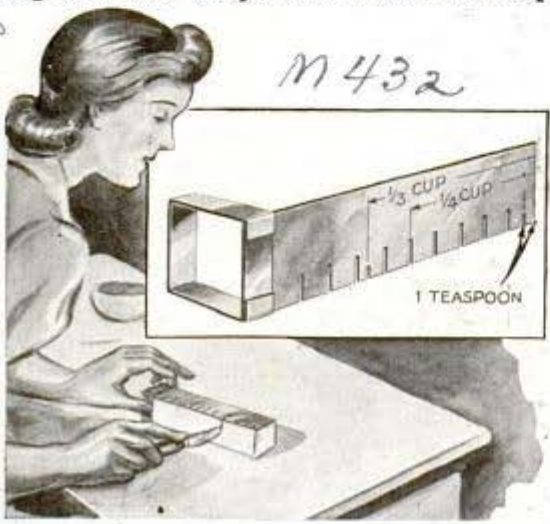


Adjustable holder has trough to guide sand into bag

One man can fill a sand bag with a U-shaped metal rack which holds the sack and also provides a trough into which the sand may be shoveled. Adjustable to all sizes of bags, the holder allows the bag to rest on the ground and saves unnecessary handling and lifting.

**Gauge Measures Butter Stick In Fractions of Cupfuls**

Swift and easy measuring of quarter-pound pieces of butter into portions varying from one teaspoonful to one-half cup

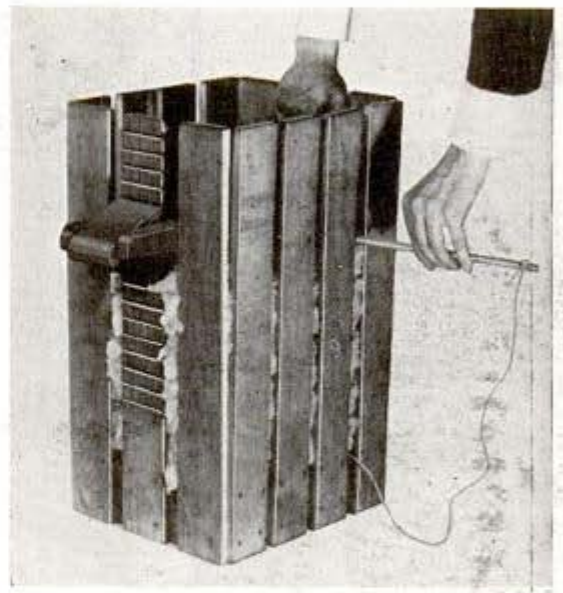


Slots on the back of gauge aid cook to follow recipe

*Distr: E.H. Vandy*  
*Midw. Mart. Chicago.*  
 is permitted by a gauge now on the market. The gauge consists of a flat metal scale with a square frame on one end. Slots on the back of the gauge bear notations telling where to cut for the desired portions. Using the scale as a handle, the square frame may be pressed into bulk butter to form quarter-pound sections.

**Waste-Paper Press for Home Use Binds Bundle With Cord**

Waste paper can be pressed and tied into neat bundles with a handy home press. Cord on a wooden needle is passed through grooves under the lid and on the bottom and between thick slats that form the sides.



Wooden needle passes through grooves under the lid

After each dumping the lid is pressed down and held in place by handle blocks that engage slots on each side. The bundles can be stacked to await the collector.

**"Kick" Removed From Explosive Until Ready for Use**

Observing that sticks of dynamite hardened with age often fail to explode, Jacob Barab of Wilmington, Del., has developed a reversible explosive which is made harmless for shipping and then activated for use. The explosive, intended for blasting, is made by mixing ammonium nitrate with combustible particles of exceedingly small size and compressing the mixture into hard sticks. The explosive is made active again by grinding it into grains.

POPULAR MECHANICS  
*Mr. Jacob Barab*  
 Pat # 2,280,366

*Distr: Carson Lue Scott & Co.*  
*State & Monroe St., Chicago, Ill.*

# Chinese Divert Rivers to Hasten Rail Building

Railroad engineers in China are diverting rivers from their natural courses into tunnels to save building bridges. This method is speeding the construction of the Lunghai railroad through the mountains of Shensi province in northwest China. In some of the especially rocky sections of the area, the track is being laid in open tunnels which must be cut laboriously through solid rock.



Track is laid in open tunnel cut through rock. Upper right, changing river's course to save building bridge

## Metal "Ice Grips" in Tire Tread Keep Plane From Skidding

Skidding of an airplane on glare ice can be prevented by using a new "ice-grip" tire having sharp, cylindrical, crimped steel inserts in its tread. These inserts, distributed profusely over the surface of the tread, wear down with the tire so their exposed portion remains below the outer surface of the tread, and do not contact the road until after the initial engagement of the tread; hence they cause no sudden impact or objectionable noise. The metal inserts provide traction to insure good braking power on snow and ice.

M.S. Rubber Co., Rochester, N.Y.  
 M. 649

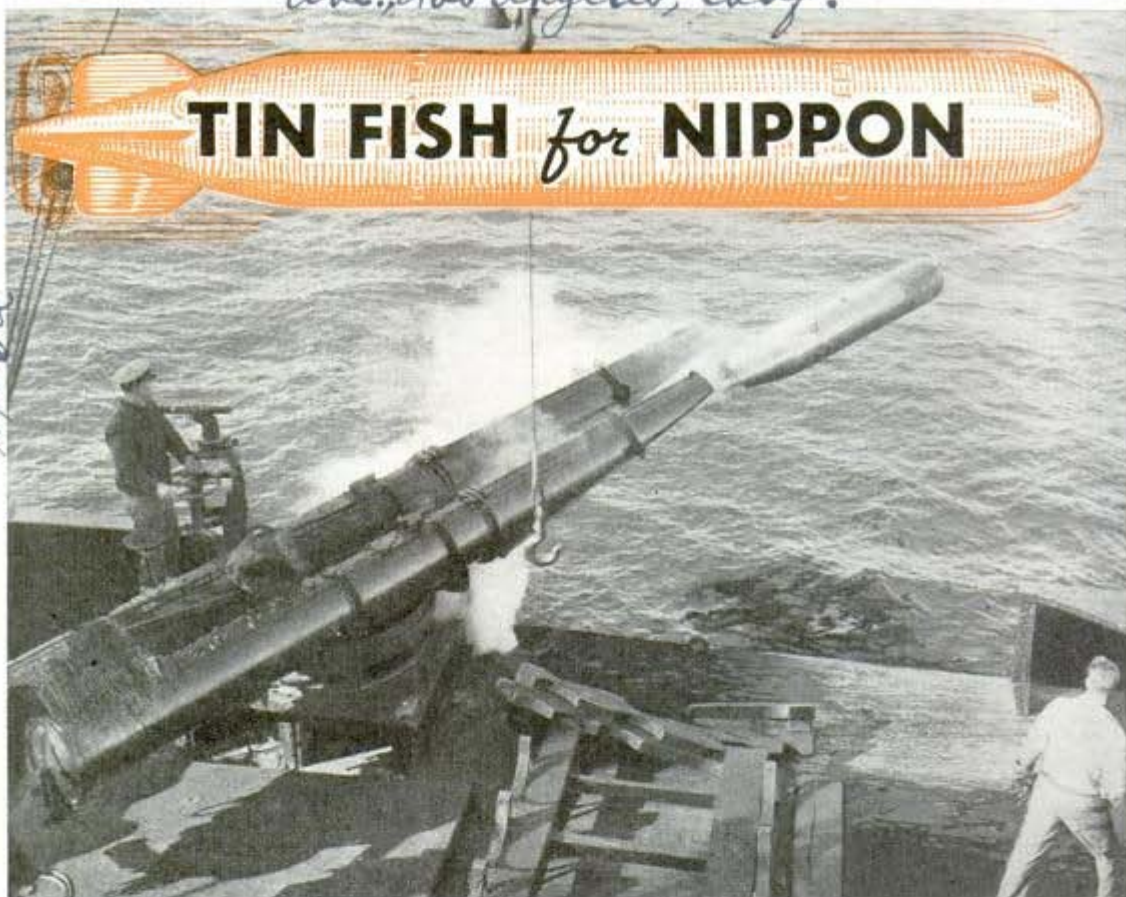
## Life Span in the United States Almost Doubled Over Sixty Years Ago

During the past 60 years the average length of life for a wage-earner's children in America has almost doubled, according to mortality figures computed by Metro-politan Life Insurance company. In 1941 the average life span for industrial policy holders was 63.42 years, while records for the 10-year period 1879 to 1889 show it was then 40 years. Other records of that day indicate that expectation of life at birth was

about 34 years, a little more than half of what it is now. The average policy holder 35 years old today still has as many years before him as was held out for a child in the wage-earning family sixty years ago at its birth.

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

Cont: H. J. Hamilton, 1177 1/2 S. Westmoreland Ave., Los Angeles, Calif.



M362

"Fire one!" is the order and a deadly torpedo takes to the water where it will guide itself to the target

Checking the "test run" of a torpedo from the tower of a U. S. Navy torpedo station before it is approved for a load of TNT



THE American submarine skipper's face was grim as he sighted through the periscope. Within the circle of vision lay a Japanese cruiser, the flag of the Rising Sun fluttering from her stern. He moved the greasy crossbars of the periscope a fraction of an inch to center his target.

"Range, 1,200 yards," he said, "bearing one four seven."

The men within the steamy hull were tense. They knew they were moving in for the kill.

"Stand by all tubes!" came the order.

Another moment of silence and then . . .

"Fire one!"

The bow of the American sub lurched as deadly steel and TNT left the tube.

"Fire two!"

A second "tin fish" plowed from her oily bed.

"Fire three!"

Another tremendous roar . . .

"Fire four!"

And another . . .

The average newspaper reader, conditioned by headlines, often thinks that the torpedo is exclusively an Axis weapon. But the U. S. Navy is also using the torpedo—and getting results.

The torpedo, like the mine, is sometimes said to be the weapon of the inferior naval power. Properly used, it can be extremely effective no matter who uses it. Torpedoes are coming into their own in World War II as a powerful offensive weapon.

They can be shot out of the belly of a submarine, launched from the deck of a surface ship and dropped from planes.

Yankee ingenuity and scientific perfection have made American built torpedoes the finest in the world. And years of practice in peacetime have made the crews of our warships first-rate marksmen with the deadly "tin fish."

The Civil War saw the forerunner of the torpedo. A charge of powder was fastened to a long pole on the bow of a small patrol



Fish out of water—two early models of American torpedoes. At right is a depth charge

boat. In the blackness of the night daring Union naval officers piloted their suicide craft alongside Confederate ships and detonated the powder by an electric wire. The attacker had a chance to escape—if he could swim. His own boat was usually blown up as well as that of the enemy.

Credit for the modern, self-propelling torpedo which moves under its own power is given to Robert Whitehead, a Scotch engineer. The idea was suggested by a Capt. Luppis of the Austrian Navy while White-

At 60 miles an hour a squadron of "mosquito boats" closes in for the "kill." Each carries four torpedoes



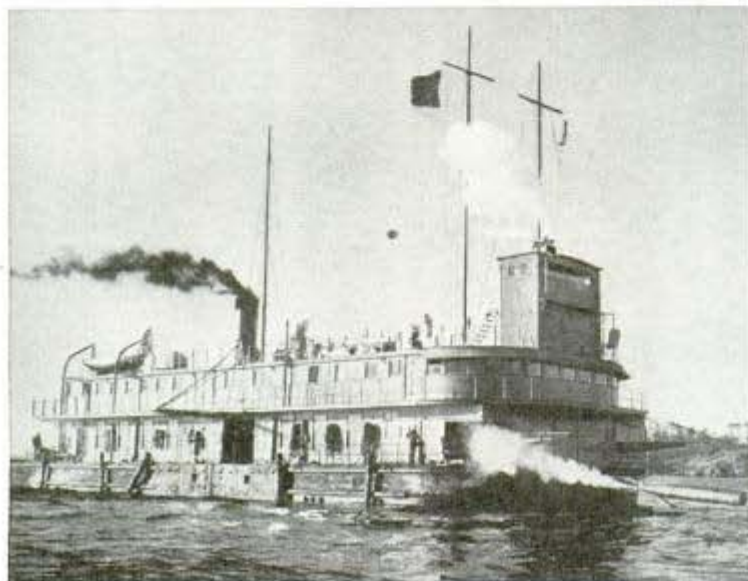


Loading torpedoes with "dummy" heads filled with water on a testing barge where they will be fired to check propellers, rudders and gyroscopes

head was working at the naval base at Fiume.

Whitehead experimented for two years and in 1866 produced a cigar-shaped steel cylinder, 14 inches in diameter, 10 feet long and weighing 300 pounds. In its nose it carried a 14-pound charge of powder. It was propelled by a compressed-air rotary motor and could do about 6 knots for a short distance.

Torpedoes have been much improved since Whitehead's first crude model, but in spite of many changes his basic principles still remain.



Before World War I most torpedoes averaged 14 inches in diameter. But during the years 1914-18, they went up to 18 inches and then 21 inches. The latter size is most widely used today.

Except in some of its early "mosquito boats," the U. S. Navy uses the standard 21-inch torpedo in submarines, destroyers, motor torpedo boats and planes. The British Navy also uses the 21-inch size, but it is said that the battleships Rodney and Nelson are equipped with 24-inch giants. Until recently Germany was content to use 19.7-inch torpedoes but its newest vessels are

using the 21-inch model. The French navy has five sizes—15.7, 18, 19.7, 21 and 21.7 inches, which makes mass production difficult. The Japanese navy, modeled on the British pattern, is believed to use 21-inch torpedoes.

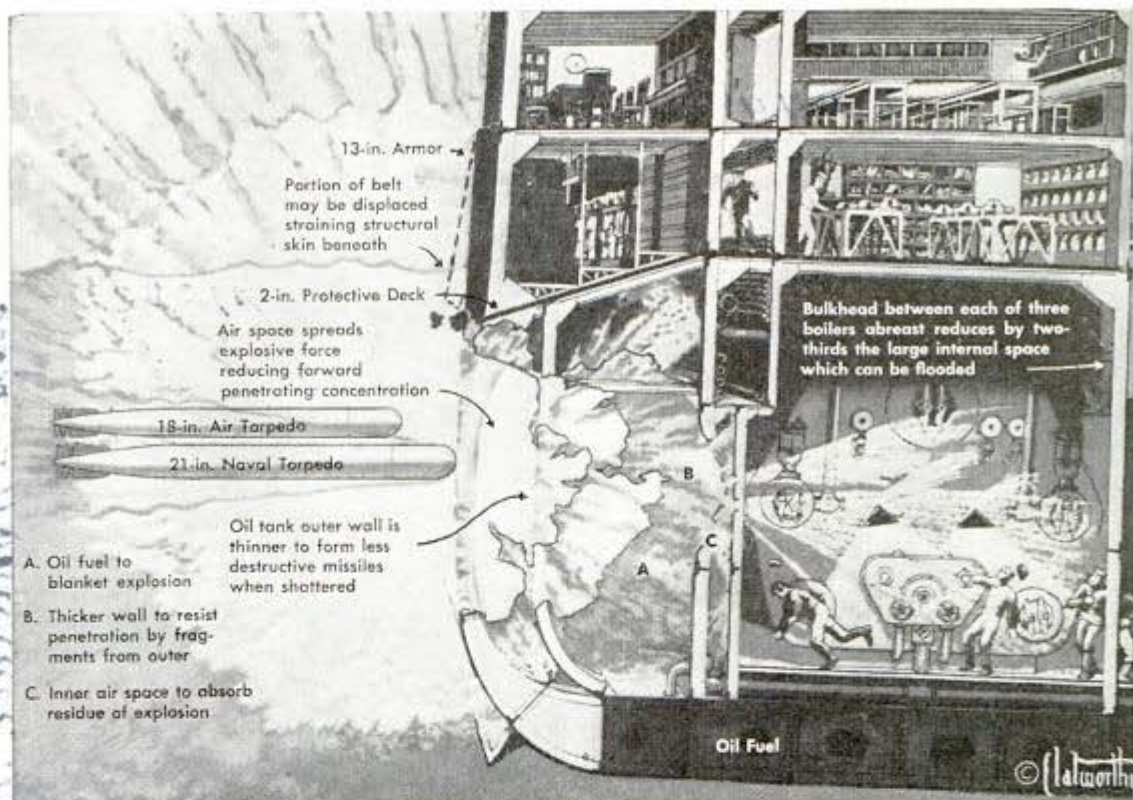
The standard 21-inch torpedo used by the U. S. Navy is 24 feet long. In its head it carries a powerful charge of TNT. The cost of these instruments of death and destruction runs around \$12,000 apiece.

Internally, the torpedo is divided into six compartments and is so balanced that it will just float when placed gently in the water. The foremost section contains the TNT charge, followed by a thinly walled flask containing compressed air under pressure of 3,000 pounds per square inch, the rudder mechanism, the propelling mechanism, the buoyancy chamber, the gyroscope and propellers.

The modern, American-built torpedo contains a highly complicated set of mechanisms and its manufacture calls for accurate

Away for its final test run—a "tin fish" leaves the testing barge under the eyes of experts

Крестовый разрез торпеды



and precise machine tools. There are more than 1,325 parts, many of which work with watchlike precision. That's why the U.S. Navy's torpedo-manufacturing plants look strangely like modern machine shops.

At the U. S. Navy Gun Shop and the Torpedo Station, principal centers for making Uncle Sam's torpedoes, men are working night and day, seven days a week, to provide ammunition for the hundreds of torpedo tubes of the growing fleet.

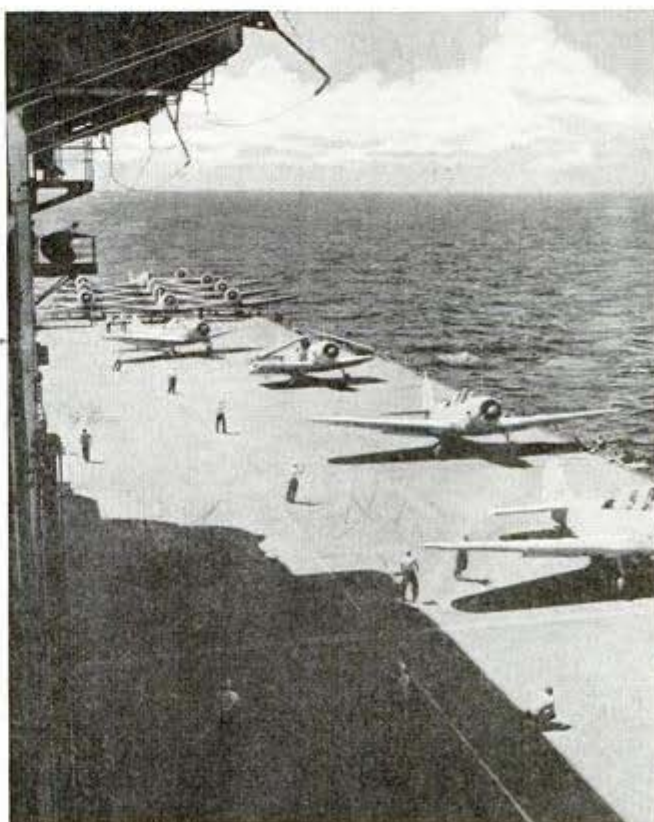
After the gleaming steel cylinders are finished and their clock-like works installed, they are taken to a proving range for checking. One of these is located on the Potomac. An old barge, fitted with torpedo tubes, is anchored in the river. Torpedoes are shot from its tubes to make test runs down the river under the keen eyes of naval torpedo experts.

During these trial runs, the torpedoes are fitted with dummy heads—filled with water. At the end of the run the water is ejected

(Continued to page 176)

**Cross-section of a heavily armored capital ship showing how the hull construction partially checks the torpedo explosion**

**Taxiing across the deck of a carrier far at sea, this squadron of torpedo bombers carries a load of big 21-inch torpedoes**



## Mower Motor on a Bicycle Gets Big Gas Mileage

M 449



Motorbike has top speed of about 18 miles per hour

Gas and automobile rationing hold no terrors for M. E. Morris of Richmond, Va., who has rigged up a bicycle with a lawnmower motor and can travel 140 miles on a gallon of gasoline. The one-cylinder motor transmits power to the rear wheel through a friction pulley driven by a V-belt. It is controlled by a hand lever.

## Holder Helps Assemble Papers In Proper Sequence

Papers may be assembled speedily in proper sequence by using a device which

M 1446



Twelve-section unit has a capacity of 6,000 sheets

fits the average-sized desk and holds the papers at a 45-degree angle. The standard unit of 12 sections, each with a capacity of 500 sheets of paper, permits operators to work from either side.

## Pencil Chained to Vacuum Cup Is Always Handy for Use

M 282

Handy for use in the automobile, home or office, a pencil that will stay put is chained to a reel fitted with a vacuum cup. It may be secured to any flat, smooth surface such as a windshield, kitchen cabinet, typewriter or drawer of a filing cabinet, and the fine chain holding the pencil may be unreeled for 14 inches.



## Fast Driver Could Save Money By Cutting His Speed

M 357

Observance of a 40-mile-an-hour speed limit would result in a financial saving for drivers who have made a practice of "burning up the road" on long trips. At 25 miles an hour on a 1,000-mile trip, for instance, the average auto expense would be \$14.38, including fuel and oil consumption, tire wear and maintenance costs, based on studies reported by the Illinois Automobile Club. Increase the speed to 35 miles an hour and the cost becomes \$17.88; at 45 miles it increases to \$22.03; rises to \$30.33 at 55 miles, and jumps to \$38.63 at 65 miles an hour. Fuel consumption for 1,000 miles at 25 miles an hour averages 50 gallons, 55 gallons at 35 miles, 60 gallons at 45 miles, 69 gallons at 55 miles, and about 80 gallons at 65 miles an hour. Tires deteriorate twice as fast when going at 60 as they do at 40 miles per hour, it is estimated, while maintenance costs are about double for a car habitually driven at 65, as compared with one driven at 45 miles an hour.

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

2115 Halifax

The Co-Collector Co.  
16 1/2 No. 9th St. Richmond Va.

Retelham + Mc Orungal, Inc.  
Water-Mountain, N.Y.



# Bunk Is Not Far From Battle Station on a Sub

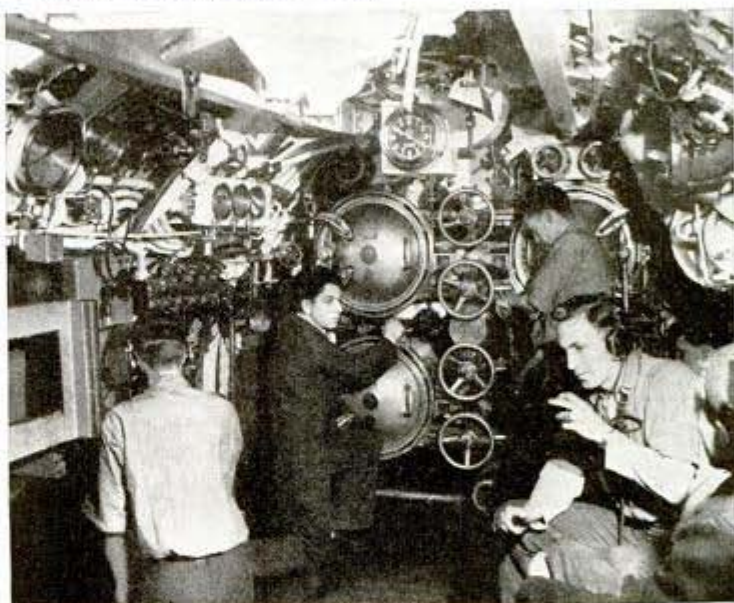
M 441



You really get to know your neighbor on a sub. The four-deck bunks might seem a bit tight-fitting to land-lubbers, but to sub men they're snug; and it's not a long walk to "battle stations" when a Jap ship looms up in the periscope



Surfacing to run on her Diesel engines during a long patrol, an American submarine plows along at top speed with her crew ready at the deck gun. More often than not the deck is under water in choppy seas, but submarines like it rough, for it's easier to escape detection



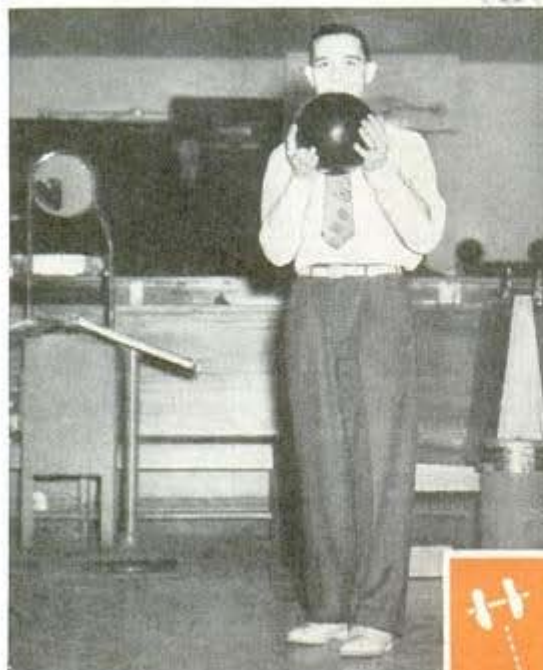
The "tin fish" get their kickoff in the tight little room above, its walls studded with vital gauges and valves. Two of the torpedo tubes are visible at the center, behind the kneeling man. At right, the man with earphones is receiving orders from the control room, and at the second the enemy ship appears in the periscope sight at proper range, the torpedo is away. Even the skipper sleeps close to his work. At left is the lieutenant who commands the undersea ship, examining the navigation chart brought in by his junior officer. As he awakens he glances above his bunk at three gauges which tell him the heading of the ship, its depth and the time. From left to right they are compass, depth gauge and chronometer

M395

# IT'S *the* SPARES *that* COUNT

By **Tony Monteverde**

Famous Bowling Star and Hollywood Coach



Preparing to throw cross alley at the 10 pin in the far right corner, Tony Monteverde faces directly at the pin. Diagram shows stance for spare leaves



Throwing for the 10 pin, Tony lays the ball down about 9 or 10 inches from left hand side of the alley—a hard shot

THE other day I saw a bowler lay down five consecutive strikes. After the last one, he beamed, snapped his suspenders, and sat down, certain that he had won the game. His opponent had been struggling along without doing anything spectacular, just picking up his spares. After the fifth frame, the mighty strike bowler got a little out of the groove, which wouldn't have done him any great harm—if he hadn't missed his spares.

The accurate spare bowler kept plugging along. In the end, he won the match by eight pins. The fellow who laid down the five strikes at the start of the game was so mad he threatened to shoot the pin boy.

That sort of thing happens daily in every bowling alley. Hundreds of bowlers have low averages—and short tempers—simply because they haven't learned to pick up spares. Just to show how important it is to pick up spares, take a look at the following statistics:

A man who makes five strikes in a game—and is lucky enough to bowl them in succession—but doesn't spare, would have a maximum possible score of 183. On the other hand, if a bowler spared every frame, and got nine pins on the first throw after each spare, his score would be 190. Therefore, he would easily beat the man who rolled five strikes in a row.

Even if a bowler rolled seven strikes in a game, including two doubles (a double is two strikes in succession), he would

Ready to be thrown, the ball is supported by the → left hand with elbow on hip bone to give balance

still have a maximum possible score of only 170—or 20 pins less than the man who simply picked up his spares. Picking up spares helped me maintain an average of 212 for 60 games in a match against Gene Gagliardi.

I don't think I have to give any more proof of the importance of sparing. Just try to beat a consistent spare bowler, and you'll see that figures don't lie.

In teaching bowlers how to become accurate in picking up spares, I always begin by saying a few things about "spare psychology."

There are two mental attitudes which cause bowlers to miss spares. The first attitude is: "This is just a simple little spare, and I don't need to pay much attention to it." Making a spare is just as hard, often harder, than making a strike. So, never think that any spare is simple. Concentrate on a spare even more than on a strike, concentrate so completely that you don't realize what's happening in the alleys beside you, or what other players are saying.

The second mental attitude that results in poor spare bowling is "spare jitters." This is usually caused by the bowler thinking how much space there is on each side of the pin he's trying to hit. The simple



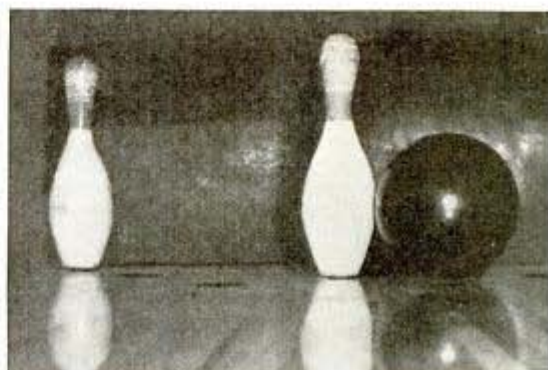
Don't let a one-pin spare give you the jitters— → you have two feet of leeway to pick up the pin

A	X		X		X	X	X	X		XX	
	19	28	47	56	85	104	113	132	141	170	170
B	X	X	X	X	X						
	30	60	90	119	138	147	156	165	174	183	183
C	/	/	/	/	/	/	/	/	/	/	/
	19	38	57	76	95	114	133	152	171	190	190

These bowling scores show how the player who made a spare in each frame defeated opponents with strikes

antidote for this type of psychology is to remember the following facts:

A bowling pin is approximately 4.7 inches across at its widest point. The diameter of a standard bowling ball is a little over 8.6 inches. Pins are set so that their centers are 12 inches apart. Therefore, in throwing at a single pin, you actually have a mark 23 inches across to shoot at. In other words, you can be nearly two feet wide of



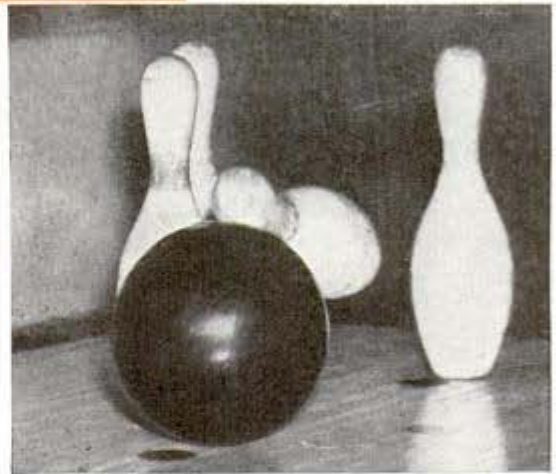
The average bowler has little chance of clipping a → pin thin enough to pick up a 5-7 split like this



study the actual mechanics of spare bowling.

First, let's take up the matter of how to hold the ball when you are standing perfectly still, ready to begin your run and throw. Many people think this is unimportant. Nothing can be farther from the truth. Bowling is a game of balance, and spare bowling takes even

Tony lets a ball fly toward a "sleeper" (a pin directly behind another in a spare leave). Diagram shows the path of the ball aimed at the 8 pin sleeper. Below, front pins will fall



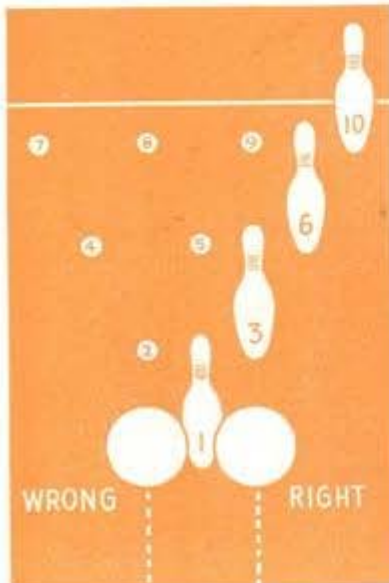
the spot where you intended to throw the ball, and still get the pin.

Of course, you don't have quite as much leeway when throwing for the 7 and 10 pins (the two pins at the extreme corners of the alley). However, you still have a 13½-inch target—which is pretty big.

Once you've mastered the psychology, so that you can concentrate on the throw without getting the jitters, you're ready to

more balance than strike bowling. Throughout your entire run and throw, you have to swing the weight of a 16-pound bowling ball. If that weight isn't placed in the proper position to begin with, you'll never get it in balance.

When you take your stance ready to begin your throw, hold the ball about shoulder high, support it with your left hand and brace the left elbow on the point of the hip bone. In



To take out a 1-3-6-10 spare leave, the ball should strike between the front pin and the next one to it as shown in diagram—not on the outside of the front pin



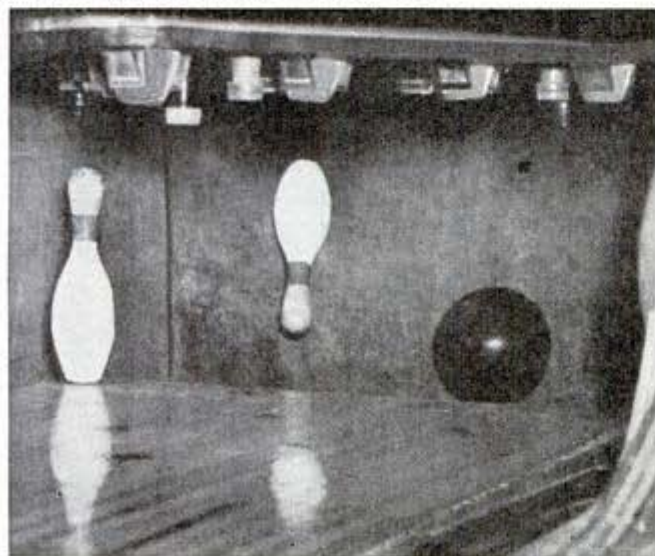
this position, the weight of the ball is properly placed, and at the same time supported by the left hip bone. This is a great help in easing the tiring effect on the arms and fingers of a long stretch of bowling.

When you have set yourself for your throw, make sure that you are facing your spare. In other words, stand so that your shoulders are at right angles to an imaginary line drawn from your feet to the point where you want to hit the pins. This system works as follows: If you are throwing at a pin in the center of the alley, say the 5 pin, stand with your shoulders at right angles to the alley. If you are throwing at a pin on either edge of the alley, say the 7 or 10, turn your body at enough of an angle so that you face the pin. Incidentally, always throw cross-alley at the 7 or 10 pin.

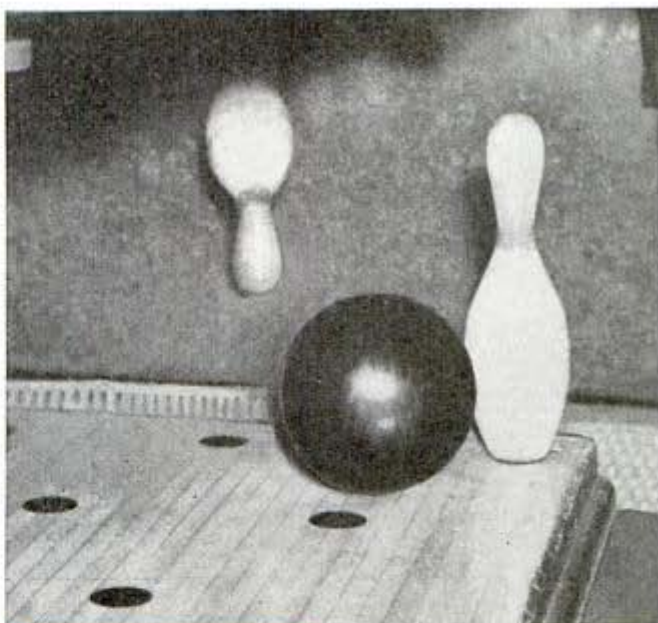
By facing directly at your spare, you are in a position to walk along the line you want to roll your ball, whereas if you always face straight at the center of the alley, you are forced to jerk your ball at an angle when throwing at such spares as the 7 or 10 pin.

Many bowlers, particularly those who use a hook ball, feel that they must throw exactly the

**This is what happens if you try to make a 2-7 "baby split" the wrong way—hitting the 2 pin on the far side from the 7**



SEPTEMBER, 1942



**How to make a 3-10 or 2-7 "baby split"—the ball is thrown to hit the front pin and is deflected to strike rear pin**

same type of ball at all spares. I don't agree with this. For instance, the 10 pin (which is at the extreme right hand corner of the alley), is very difficult for most right-hand bowlers. It is harder still for a right-hand bowler who throws a hook. Therefore, such a bowler often finds it is far easier to pick up a 10 pin by using a straight ball. I al-

ways tell him to go ahead and use a straight ball for all spares at the right of the alley.

So, if there is any one spare which you find it difficult to get with the ball you normally throw, use a different type of delivery for that particular spare. Under such circumstances throwing two types of balls doesn't hurt your game.

I consider it best for the average bowler to look at the pins when throwing for spares. In throwing for strikes, you can pick out a spot on the boards and attempt to roll your ball over it; but with spares it is generally better to keep your eyes focused directly on the pins.

59



The wrong way to throw for a spare—the bowler is tense and trying to control ball with his fingers

Most bowlers feel they gain accuracy on spares by throwing a slower ball. My own experience, and the experience of persons whom I have taught, has been just the opposite. I throw a slightly faster ball for a spare than for a strike. I have found that the additional speed tends to keep the ball more surely on its course and prevents it from drifting or wavering.

There are three types of spares which require special treatment:

1. When throwing at a spare containing a "sleeper" (a sleeper is a pin directly behind another pin), aim for the sleeper rather than for the front pins. Almost always if the ball hits the sleeper, it also hits the pin in front of it. Therefore, concentrate on getting the sleeper.

2. When throwing at the 1-2-4 or 1-3-6 pins, roll your ball at a spot between the front pin and the pin next to it. Not only is this the best method of making the spare,

Picking up a 6-9-10 spare, as pin boy sees it. Hit forward pin of triangle from an angle, never head-on



The right way to throw—the bowler is relaxed and controls the ball with a rhythmic swing of his arm

but if you do miss it, you will probably get at least two pins.

3. When you are throwing at any pin or combination of pins in the back line, that is, the 7, 8, 9, and 10 pins, remember that these pins are almost three feet farther away than the head pin. A failure to compensate for this fact is particularly noticeable with a hook ball, as the extra distance



permits the hook to pull the ball past the pins.

Now a word about splits. It is my firm opinion that the average bowler would do much better if he didn't try to be too accurate when throwing at a split. He should simply concentrate on hitting the front pin on the proper side to drive it toward the remaining pin or pins. If you try to clip the pin just thick enough, you'll probably tighten up and miss the spare entirely. Whereas, if you simply try to hit the pin on the right side, you always have a good chance that you'll pick up the split.

There are four types of splits that you should never attempt to make. They are the 4-6, the 7-9, 8-10, and the 7-10. These splits are virtually never picked up, and when they are made it is only by some freak of luck. Therefore, just throw to make one pin. This has two advantages: first, you get that much more practice in throwing at single pins; second, one pin, particularly if you are on a strike, will make an appreciable difference in your score. Remember if you are on a strike, one pin makes a difference of two pins in your final score—and a lot of games are lost by two pins.

There is one type of split which the average bowler has a good chance of making. That is the so-called "baby" split. A baby is either the 2 and 7 or the 3 and 10 pins. In picking up this split, always throw to make it from the "inside." In other words, your ball should hit the front pin and be deflected so as to hit the back pin. This method is much surer than trying to drive the front pin over so it will take out the back pin.

Finally, let me say that anyone may become a good spare bowler. Spare bowling comes easier to some people than to others. If you are one of those persons who finds it hard to become consistent on spares, then spend a few sessions at the bowling alley throwing at nothing but spares. Have your pin boy set only those spares which are most difficult for you to make.

Whether you have your sights set on being an excellent bowler or merely a good average bowler, the first thing to do is to learn to pick up your spares.

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

## Homemade Motorized Bike Runs 78 Miles to Gallon

M 638

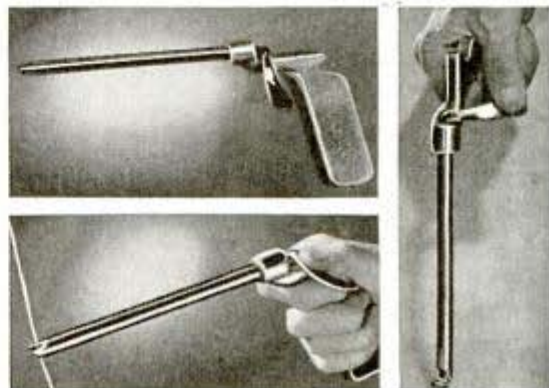


Gas-saving motorbike supplies cheap transportation

Seeking an answer to problems of gasoline rationing, Technical Sergeant A. Keuntz of Kelly Field, Tex., built a motor-cycle that will carry him far on meager rations. With an engine mounted over the rear wheel, the motorbike weighs only 90 pounds, developing one horsepower and giving 78 miles to the gallon of fuel.

## Long-Shank Cutter Used as Tong Retrieves Small Articles

Small objects can be lifted from inaccessible places with a cutter having a long, slender barrel. Pressure on the trigger actuates a rod within the barrel causing the cutter to close. The blades can snip off wires or act as a tong to pick up metal parts.



Cutter snips wires or grips articles hard to reach

Pack-Rite Machine Corp.  
828 No. Broadway, Milwaukee, Wis.

*Inv. Wm. J. Jones, Maintenance Foreman, Seattle  
Fire Dept., Seattle, Wash.*

## Family Car Is Fire Engine in Raid Emergency

*M 472*



Every family car in Seattle is a potential fire engine with the use of a pump invented by Fireman William J. Jones as his contribution to the city's air raid defense system. When the car is backed onto the mechanism the spinning rear wheels supply power to operate a pump that will project streams of water from small hose to considerable heights.

**Spinning rear wheels of car supply enough power to pump water through small hose to top of a three-story building**

## Portable Torch Speeds Rescue by Burning Away Girders

*M 393*

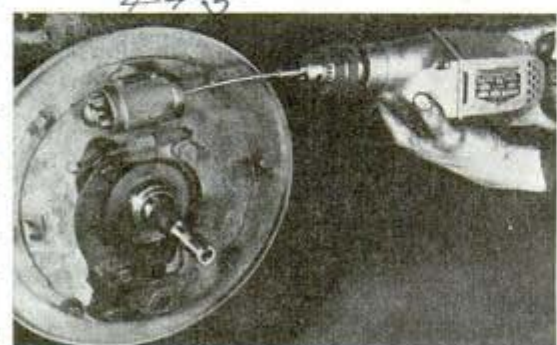
Rescue of victims that may be pinned under debris in the wake of falling bombs can be hastened with the aid of a portable acetylene-oxygen torch invented by J. C. Phillips of San Francisco. The 96-pound demolition torch, carried as a back-pack, can be used to cut away steel girders and heavy timbers in cleaning up the wreckage after air raids.



**Cutting away heavy steel girder to release victim pinned beneath wreckage. Rescuer, carrying tanks on back, can reach confined places**

## Flexible Hone for Brake Cylinder Saves Removing It From the Car

*445*



**Tool automatically adjusts itself to any cylinder size; flexible shaft is designed for work in cramped space**

Wheel cylinders may be honed to improve braking efficiency without removing them from a car with the aid of a tool on a flexible shaft, which attaches to an electric drill. The tool, equipped with three stones mounted to prevent out-of-round honing, automatically adjusts itself to any cylinder diameter and may be used in cramped space.

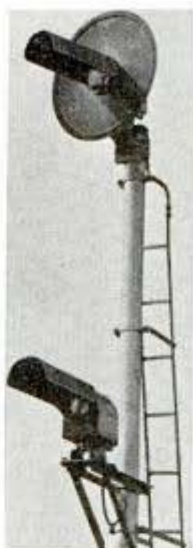
**Look in the index to find where to buy articles described in this magazine. Say You Saw It in Popular Mechanics.**

*62 Thermoid Co.,  
Whitehead Rd.,  
Trenton, N.J.*



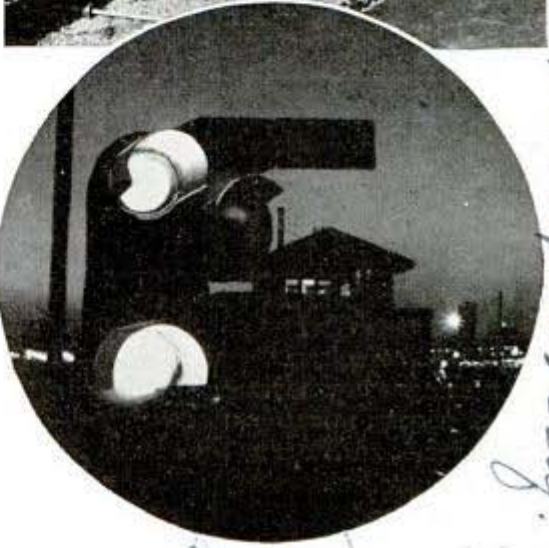
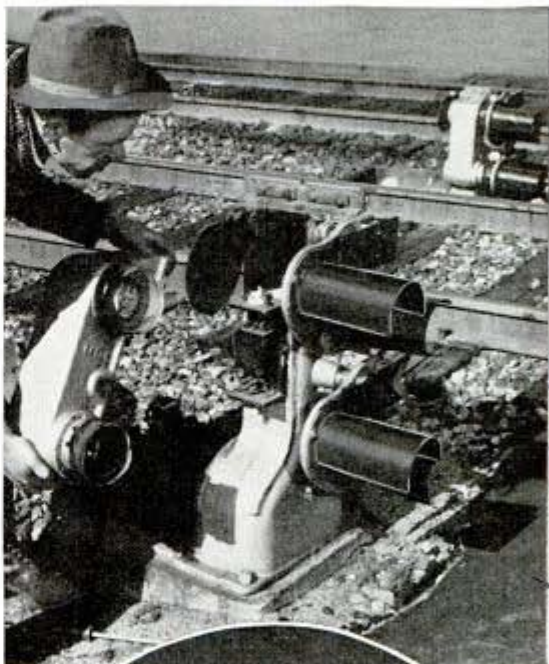
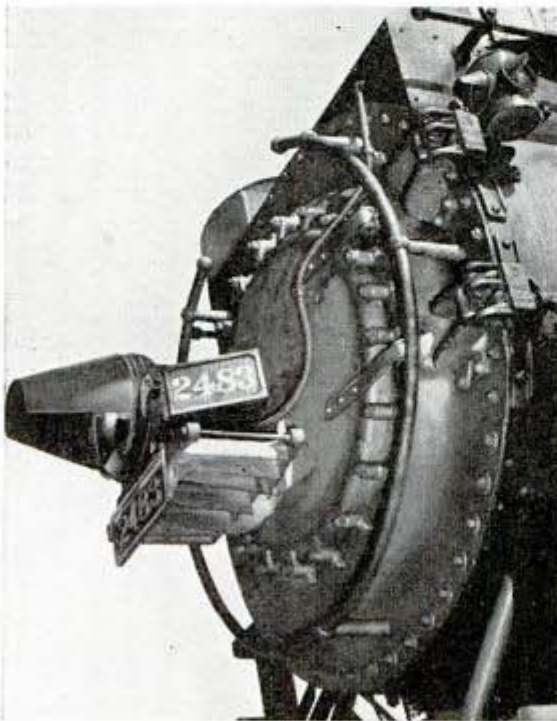
Cont. Thomas E. Steinson, Jr. 3872 Franklin Av.  
 Los Angeles, Calif.

# Railroads Keep 'Em Rolling During Blackout



Signal lights are fitted with metal hoods (left) making them visible only from the ground. All blackout equipment was carefully tested by army officers who made observations from the air over a blacked out section of the Southern Pacific and reported horizontal rays are invisible from above. Below, hooded trackside signals can be seen easily by the engineers

Railroads on the west coast operate through blackouts with hooded lights hiding vertical beams from enemy bombers; fire boxes are screened; windows are painted black. Above, a brakeman attaches a hooded marker light at rear of Southern Pacific train



Locomotive headlights that would serve as a beacon for a flier miles away wear blackout hoods (above) that throw the powerful ray downward. At right are "dwarf" signals subdued at night with long protective coverings that give plenty of light for safe travel and the transportation of vital war materials without violating blackout regulations. All station and switch lights are also equipped with circular covers and the powerful floodlights in the yards have been replaced by smaller lamps for the "duration"

SEPTEMBER, 1942

Rep: Fred Woodward, News Bureau, Southern Pacific Co. 406 Pacific  
 Los Angeles, Calif.

*[Faint, illegible handwritten notes at the bottom left of the page.]*

# Army Optical Shop on Wheels Serves Men on Battlefield

American Optical Co. Southbridge, Mass.

M-508



Truck is equipped with optical machinery to care for 300,000 soldiers

Mobile optical shops, first of their kind to be attached to field armies of the United States, will repair or replace spectacles broken or lost by overseas soldiers in camp or on the battlefield. One unit, housed in a big army truck, contains optical machinery, 36,000 lenses, 8,400 frames, 600 pairs of extra temple pieces and 1,200 spectacle cases. Sixty pairs of lenses can be edged and mounted daily. This is estimated to be sufficient to care for the needs of 300,000 men. Soldiers who wear glasses (about 15 percent of the men in service) will have prescriptions attached to their service records to facilitate the work in the field.

## Lacquer Made From Milk Replaces Tin in Cans

M-514

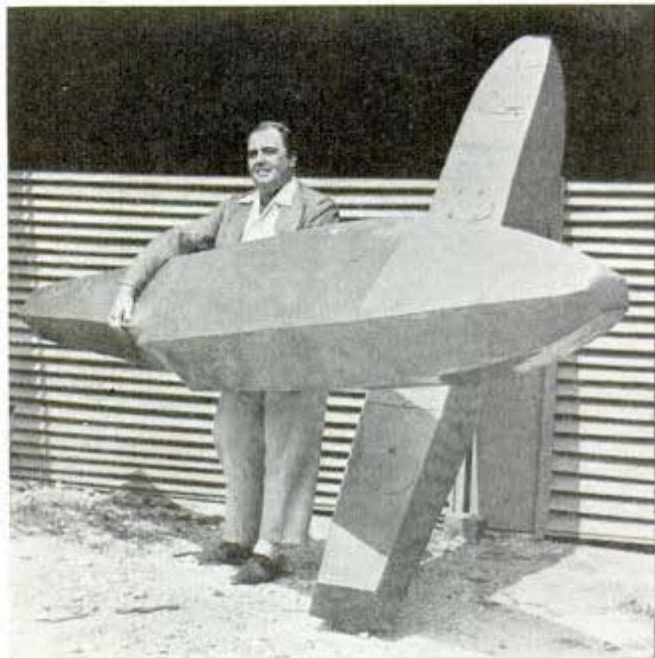
Lacquer made from cow's milk to serve as a substitute for the tin coating in cans used for evaporated milk has been developed by the Bureau of Dairy Industry of the U. S. Department of Agriculture. It is made from lactic acid and a small proportion of vegetable oil. The acid is obtained by fermenting the sugar in whey, a by-product of cheese manufacture for which the industry has long sought a profitable outlet. The bureau found that evaporated

milk sealed in cans coated with the lacquer retains its normal flavor after a month of storage. Tests are also being made with the large five and 10-gallon steel cans which are used for shipping milk and cream.

## Plastic Pontoons Speed Takeoff

M-509 of Plane

Airplane pontoons made of plastic conserve aluminum and at the same time function better than those made of metal, according to a Cincinnati inventor who has developed a method of molding plastic without heat or pressure. Plastic pontoons are as light in weight as those made of aluminum, cost only half as much and permit faster takeoffs by eliminating the drag caused by rivets and seams on metal pontoons. They are also said to be as strong as those made of aluminum.



Light and strong as aluminum, pontoons of plastic save metal

64 Wash. D.C.

POPULAR MECHANICS  
Powell Crosby III, Crosby Corp.  
1329 Arlington, Cincinnati, O.

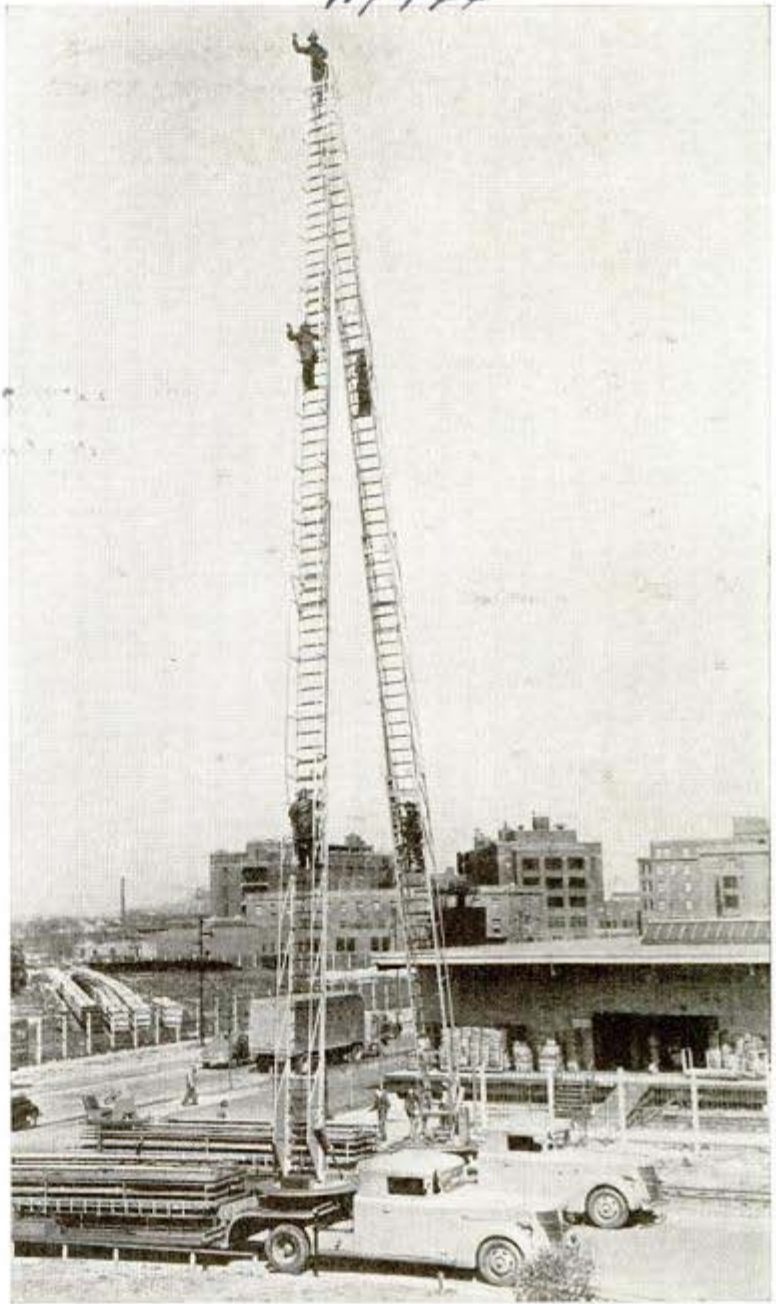
# Handrails on 100-Foot Ladders Help Firemen

Handrails on the sides of two 100-foot extension ladders recently acquired by the Chicago Fire Department provide portable fire escapes for persons trapped in a burning building. The ladders, mounted on trucks, are made of steel and hydraulically operated. Each unit costs \$20,000.

## Tiny Radio 'Bomb' Tossed by Pilot Tells Altitude

If a pilot is flying through clouds or darkness and his instruments fail, he won't have to wait until he hits a chimney or high wire to find out how far he is from the ground—thanks to a Chicago inventor. The altitude may be figured with a small automatic radio set in a bomb-shaped casing. As soon as the radio "bomb" is tossed overboard it starts to send a signal which ceases when it strikes the ground. The pilot measures the time of the fall and translates it into terms of height. This system of waiting for the falling body to become silent is like the old practice of measuring wells by dropping a stone and listening for the splash.

Mrs. Laurens Hammond  
 421 N. State, Chicago



Huge steel ladders, hydraulically operated, make portable fire escapes

## Sliding Band on Wrench Handle Automatically Adjusts Jaws to Nut



Strength of the grip is increased with size of nut

Sliding a band in the handle of a new wrench automatically adjusts the jaws on a nut, holding it in a firm grip. The action on the handle is accomplished by a spiral shaft that meshes with a worm gear inside the wrench head which operates the sliding jaws. The hold on a nut is loosened by merely zipping the handle band downward. The wrench is made in four sizes.

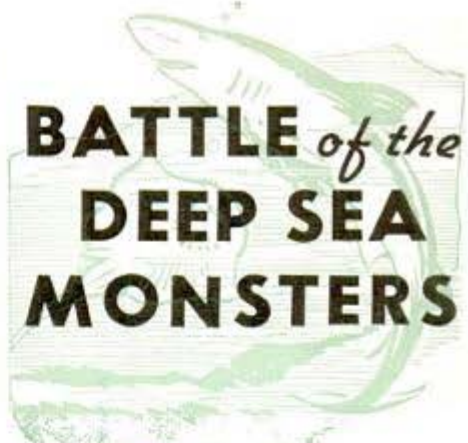
SEPTEMBER, 1942

Pack-Rite Machine Corp. 828 No. Broadway, Milwaukee, Wis.

M 68



A 24-foot octopus stares back at Lieutenant Rieseberg as he peers from the window of his deep-sea robot during a dive



# BATTLE of the DEEP SEA MONSTERS

5127 Jountain Av.  
Los Angeles By Calif

**Lieut. Harry E. Rieseberg**

Deep Sea Explorer and Salvage Expert



The savage battle between the octopus and the tiger shark begins with a sudden thrust of the tentacles at the shark's neck

The battle made a bull fight tame by contrast. At the end the shark lay on the ocean floor, strangled by those powerful arms



IT WAS while I was exploring the seaways and depths of the Caribbean, 100 miles north of Port au Prince, Haiti, that I witnessed the death duel between two huge monsters on the floor of the ocean—a scene of savagery that fascinated me with its horror as never before in my underwater experiences.

During my travels as a deep-sea salvor of sunken treasure I have seen plenty of action, yet none like that struggle on the sea bed thirty fathoms down in the Silver Shoals Passage.

Our expedition was equipped with the latest deep-sea diving gear and robot; the latter had powerful underwater lights which illumined the bottom for many yards about. An observation bell and other scientific equipment also were a part of our expedition, and we had a movie camera, specially devised for subsea operations.

The cumbersome 3,900-pound diving robot was constructed of iron and steel. It was equipped with barometer, thermometer-humidity recorder, telephone and battery box, blower, trays and pan of chemical apparatus for absorption of carbon dioxide, and oxygen tank. Its vision plates were of half-inch fused quartz, the strongest and most transparent substance in the world.

It was through these windows

*[Handwritten notes and signatures at the bottom of the page, including 'M. Rieseberg' and other illegible text.]*

that I peered out into the world on the bottom of the sea—and photographed the dramatic battle between an octopus and a shark.

I dropped over the schooner's rail, encased within the huge diving sphere, and was slowly lowered to the bottom. There, where a shoal stretches a mile or more between coral atolls an enormous and squirming creature made its appearance from the jagged rock caves. Through the murky water came a quivering mass with long arms, sinister eyes—the largest octopus I had ever gazed upon.

Suddenly, from above, a shadow came over the scene.

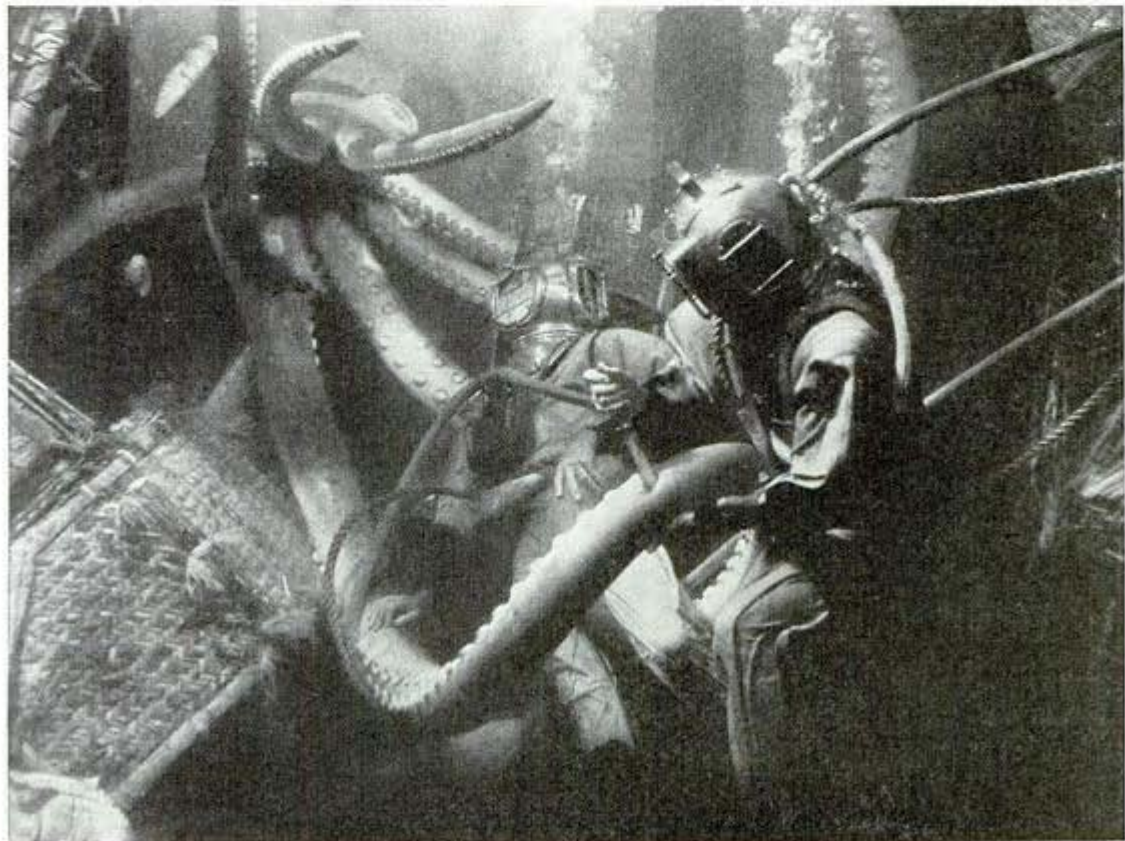
It was a shark! A huge tiger shark about 18 feet long, and a glance at this ferocious creature was enough to send a shiver down anyone's backbone. The natives along these shores of the Caribbean call it the tiger of the sea—"El tigre!" And it is a man-eater, the most savage and tricky of all sharks.

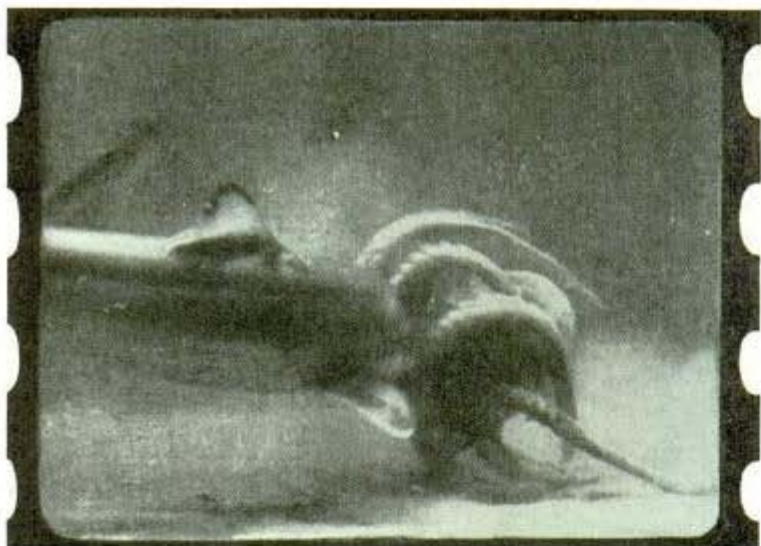
This "tiger" stirred enormous



Before venturing into the sea with his movie equipment, Riesenberg inspects the pump that supplies air to his diving suit

Divers stage an underwater fight with a mechanical rubber octopus for Paramount film, "Reap the Wild Wind"





The tiger shark charges into the octopus in another real-life movie scene

swirls and eddies with his massive tail as he cruised about. Suddenly the shark made a swift downward plunge. He sighted the octopus!

The effect of the octopus upon the charging shark was most extraordinary, for the shark seemed to be driven insane, dashing up and down, back and forth in a frenzy, darting to the surface, hurling spray high into the air, then down again.

But the wily octopus moved with deadly purpose. Rearing up on his eight slimy tentacles, his little slanting eyes steadily watching the mad gyrations of its enemy, the strangler took his own good time. As I watched through the vision plates of the robot, I thought that it was no wonder the shark found such terror in this nightmare of a creature! I had my own fears, too, yet it was an opportunity that comes to an underwater explorer but once in a lifetime—to witness and photograph such dramatic action as was taking place before my eyes.

So for the moment I laid aside these fears, and reached for the camera. I placed it in position against the vision plate, and the camera started whirring.

What followed made a bull fight seem dull, slow business. The shark had become wildly nervous, for all his huge bulk and power. The octopus was playing for position. Like a boxer sparring, the tentacled creature feinted this way and

Sighting an enemy, the octopus throws out its protective "smoke screen" of inky fluid

that, crawled slowly forward and then darted sideways, dodged a rush from the maddened shark and shot backward, ever working, it seemed, with some definite plan in mind. It made little difference to him how long these preliminary moves took, he was always waiting, watching, alert for the moment of attack.

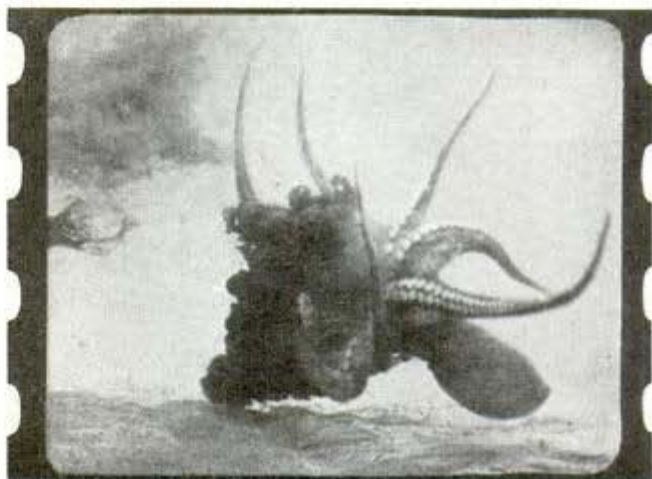
Thus, for some minutes, the two monster gladiators sparred in the arena of the underwater world. Then, suddenly and with supernatural speed it seemed, that hydraulic drive of the

octopus exploded with swift action as the creature shot himself at the shark so fast that my eyes could not follow his motions! He missed his aim, then tried again.

It was most thrilling to watch the address with which the octopus curved to one side, gathering himself together, then began all over again. Yet sooner or later one of these powerful catapultings must be too swift for the tiger.

There it was! A flash! A blur, and the slimy creature was locked fast to the shark's neck, its 12-foot tentacles wound about and clinging with their leech-like suckers to the shark's hide. Each sucker has a gripping capacity of approximately 19 pounds—and there are hundreds of them, it seems, lining the tentacles.

Now water began to fly! The great shark dashed madly about, endeavoring desperately to unseat its foe. The octopus merely took his ride, gripped like a vise



to the shark's neck. The powerful fish could not rub him off against the jagged coral without injuring himself. The shark tried to rid himself of his rider with the leaps and bounds, plunges and turns and speed of a bucking bronco. But it was in vain, for the octopus still clung to that huge neck.

Presently the shark began to speed back and forth with renewed energy. From behind the clear quartz plates of my robot I could see all his swift movements vividly while I kept the camera whirring, focused on the action. However, the beast soon slackened in his pace, then thrashed wildly again. This lasted but a few short minutes, when finally the shark slowed almost to a dead stop with the fleshy ball of octopus still clinging to his neck. Down to the sandy sea-bed they sank together at last.

That was the shark's finish! There were a few kicks, some feeble convulsions, but it was all over.

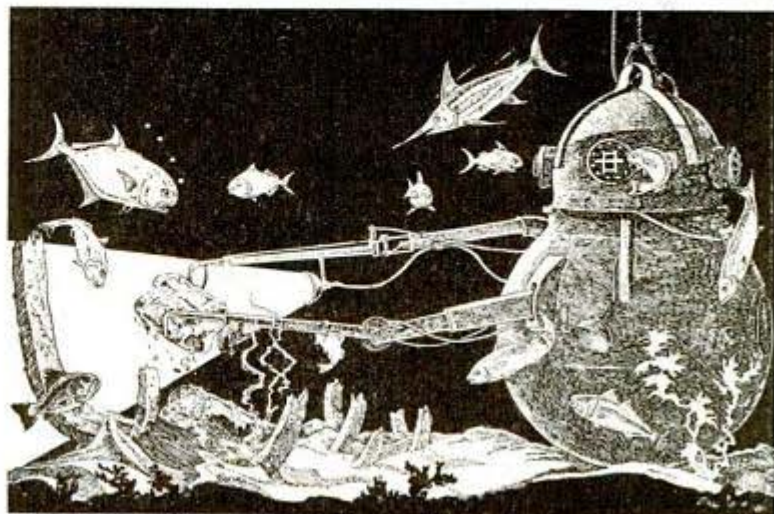
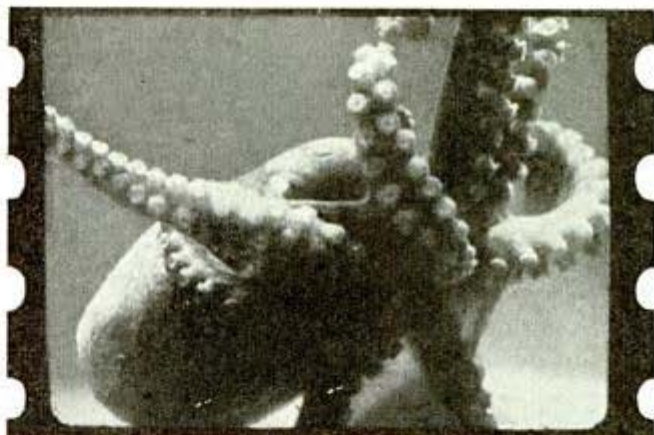
The octopus slowly secured its tentacles about the shark's gill-flaps and strangled him, the sucker-like arms shutting off the creature's wind and thus actually drowning the shark. Then the winner slid his tentacles fan-wise, like anchors, ready to haul the carcass away into some rocky crevice for a leisurely dinner.

All this time—possibly no more than 25 minutes—I was grinding away, one magazine load after another, each 100 feet in length, yet it seemed like hours down there on the bottom of the sea watching the greatest underwater adventure I had ever witnessed. I had seen it from a ringside seat, my nerves all on edge. Better still, I found later I had caught on film nearly every action of the fight!

Drawing shows how the deep-sea observation bell is operated with its long grappling arms



Rieseberg examines plaster cast of angel shark from Caribbean  
The big octopus that fought the shark comes in for a closeup



# Workman Dangles From a Rope To Beautify Face of Dam

M424



This beauty operator removes blemishes with hammer and chisel

Finishing touches to massive Friant Dam, near Sacramento, Calif., include a beauty treatment administered with hammer and chisel. Blobs of spilled concrete, water streaks and other blemishes that mar the downstream face of the structure are removed by workmen dangling from ropes suspended from the top. Although this stone "facial" does not add to the dam's utility, it leaves a smooth surface—at least from a distance—to be admired by the thousands who will visit this project.

## Diesel Locomotives Eclipse Steam By 3 1/2 to One in Building Rate

M1571

Seven years after the first Diesel entered railroad passenger service at the head of a Burlington "Zephyr," the Diesel locomotive has stepped far ahead of steam in units built during the year 1941. Out of a total of 1,436 locomotives of all kinds ordered last year, 1,096, or 76 percent, were Diesels;

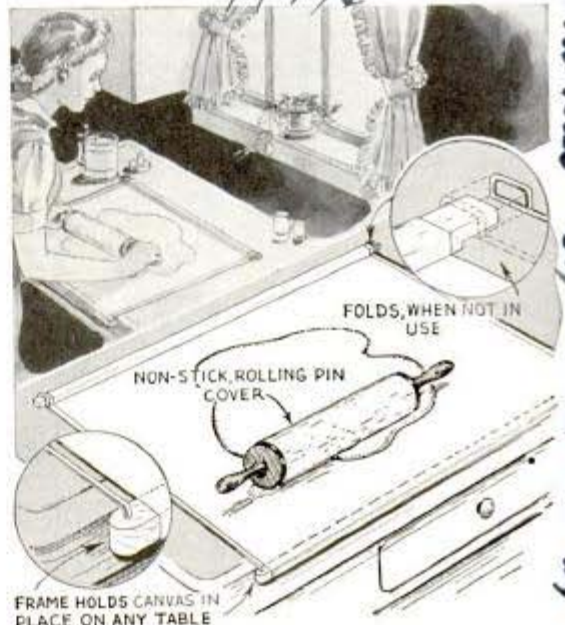
70 Taken from  
"Diesel Power and  
Transportation" - May 1942

302, or 21 percent, were steam-powered, and 38 were electric. In 1934, out of a total of 185 locomotives purchased, 37, or only 20 percent, were Diesel-powered. In locomotives actually in service, however, the steam-powered variety still outnumbers the Diesels by many thousands. At the close of 1941, American railroads owned about 40,000 locomotives of all kinds, while there were only 2,600 Diesel-powered locomotives owned and operated by railroads and industrial companies. The Diesel started as a switching engine, then in 1934 entering the passenger field in a streamline dress, and recently emerged as a long-haul freight locomotive.

## Canvas for Rolling Dough Folds to Save Space

Designed to save space, a folding device on which dough may be rolled is made of cloth resembling canvas and held taut by a frame of two wooden pieces and metal bars that loop over the ends of the smaller stick. The larger wooden piece helps hold it in place by hanging over the table edge. It rolls up like a curtain for storage.

M476



Cloth is dusted with flour to prevent dough from sticking; if soiled, it can be taken off frame and washed

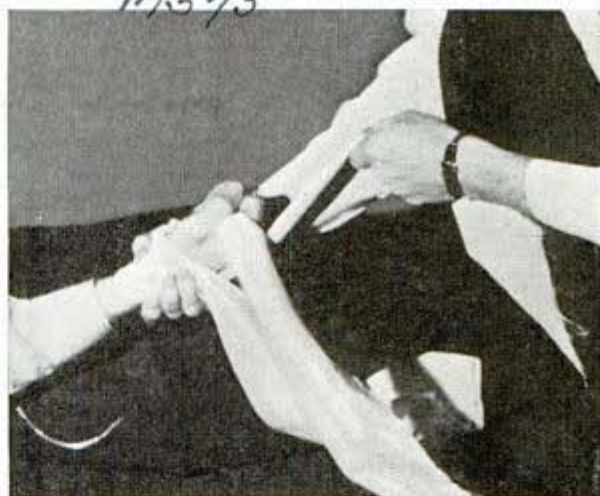
POPULAR MECHANICS  
Distr. Sears Roebuck & Co.  
State & Van Buren, Chicago.

ref. E. S. Cardwell Co., Duotoma, Minn

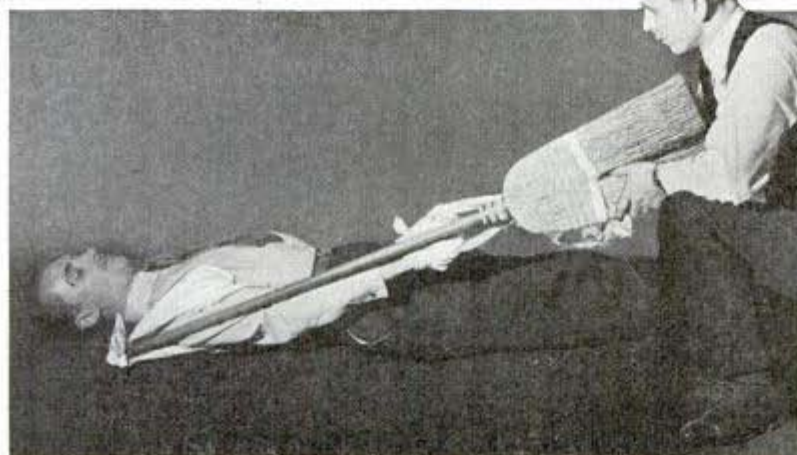


John R. ... (1942) ...  
Kitchen Broom "Drafted" as Splint for First-Aid

M.573



If you know how to use them, many ordinary household tools are helpful in administering first-aid. One example is the broom which may be used as a temporary splint for a broken arm. A few pieces of bandage and a cylindrical object about the size of a clothespin are required to apply the splint. The first step, shown above, is to wrap the cylinder in a triangular piece of cloth. The wrapped cylinder is placed in the victim's hand. Another triangular bandage is turned around the wrist (upper right) and then tied around the knuckles to hold the cylinder firmly in position



Ends of the bandage, which is fixed tightly in the victim's hand, are pulled (above) to apply traction preventing the broken bones from rubbing together. The end of the broom handle is thrust into a loop tied around the shoulder, as shown at left, and the bandage is drawn through the straw and tied securely. The straw provides a spring. After the splint is adjusted, as demonstrated at the new safety school of the New York Telephone Company, the victim may be moved to a hospital without agitating the injury

Cont: Mrs. Mary Elliott, 34 3 E. 33rd St  
N.Y., N.Y.

M361

## The LAST ROUND-UP

ONE of the most surprising possibilities in this changing world is that your children's children may never see a live bison, grizzly bear, mountain lion or scores of other varieties of American mammals that held the land before the predatory white man came.

Authentic background for this belief has just been provided in New York City where the American Museum of Natural History, the largest of its kind in the world, recently opened—even before it was half finished—the most modern exhibit of animals ever put together by artistic skill.

The fact that it is entirely devoted to North American mammals is proof that they are becoming so rare even in our day that they have a new curiosity value to the American public.

Up to now, Africa and Asia and faraway lands with strange-looking beasts in romantic settings have held the attention of natural history museums and the public. Elephants, wildebeests, pandas, zebras and others have been fashionable. All of a sudden elk, deer, moose—as American as the Indian or cowboy—are coming in for their share of attention because museum experts realize our own animals are vanishing at an alarming rate.

The fact that the new exhibition was

This bison calf wears a Cellophane overcoat to protect his fur during the preparation of an exhibit

A Hollywood touch is supplied by making a "studio" tree from real branches stuck on an artificial trunk



thrown open in an incomplete state in the hope that American interest in American animals might help push the \$250,000 project to an early completion has a sinister aspect, the learned museum experts admit.

While one group of scientists, employed by the government, is trying to keep the ever-disappearing animals alive, this group of experts is working with unusual haste for them, saving the vanishing species in museum settings—just in case worst comes to worst.

Dr. Harold E. Anthony, curator of mammals in the famous museum, points out that the war has provided a new threat to American wildlife, a threat that cannot be lightly disregarded.

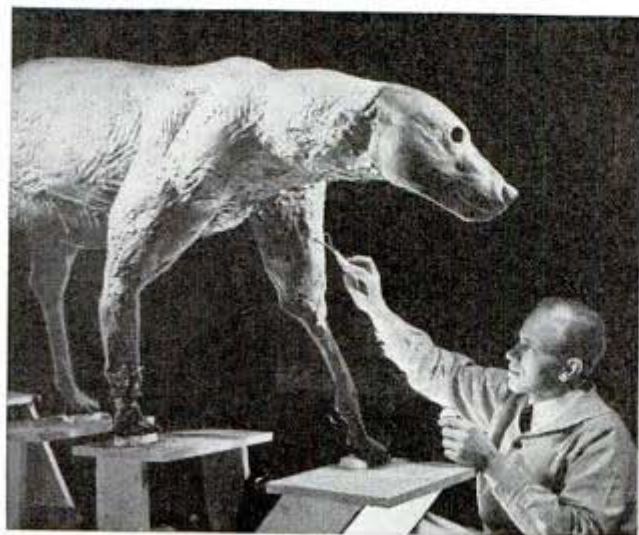
Since the impact of the war in America thus far has followed the European pattern, it is quite possible that before the conflict is ended we may be forced to shoot our animals in zoos, national parks and reservations as they have in other countries to save food for our



The white-tail deer look realistic enough to nibble the grass held out to them

"Just like his pictures and the model," say the experts of brown bear, right

Sculpturing the body of a grizzly in clay—stuffing of skins is now outdated





Painting the background for the Alaskan brown bear, the artist works from color photographs and sketches made at the scene by the museum's staff

soldiers, civilians and domestic animals.

It is also likely that the increased need for meat, hides and wool will greatly increase grazing throughout the West and more and more cattle and sheep will encroach on the already restricted areas in which the remaining wild American mammals roam. The danger here is not a lack of food for the undomesticated animals, but in the fact that sheep and cattle carry diseases into uncontaminated areas. Then, too, in the face of mounting demands for conservation of money spent on nonwar projects, it is quite likely that the government's expenditures for protection of wild animals will be cut or stopped entirely.

The final possibility is that if this nation becomes pinched for food, herds of protected buffalo, moose and deer will present themselves as a temptation for the hunter's gun.

Whatever the outcome may be, the museum is taking no chances.

Dozens of other museums have American mammals in cases, but because of the recent discoveries in plastics, adhesives, paints and other materials, some of these exhibits are outdated by the newly

**Miniature models serve as blueprints in making the life-size bison group exhibit**

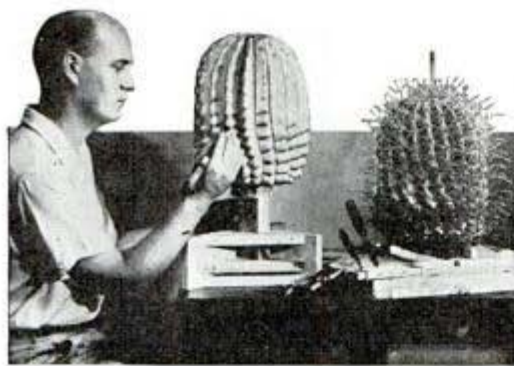
opened hall in the New York institution. Earlier exhibits represent American mammals about as well as Model T Fords would portray the American automobile if scientists decided that autos would become extinct in a generation or two and wanted to place representative cars behind glass for preservation.

People who think museum artists merely stuff something into a bear skin, no matter how artistically, and produce a natural-looking bear would be surprised to learn that it has taken 18 years of planning by Dr. Anthony and six years of actual work by him and Dr. James L. Clark, head

of the department of arts and preparation, assisted by about 35 men, to complete 10 habitat groups which are now being shown to the public.

The result, however, is that the new hall presents a panorama of wildlife throughout the continent, extending from Ellesmere Land, near the North Pole, to Mexico and from New York to the west coast of Alaska. The American animals are mounted in realistic life settings of their native plains, forests, swamps, mountains and deserts—a vista of North America's natural wonders and tremendous space. The hall has none of the "stuffed animal" appearance





**New lacquers and plastics will help fool the experts when this cactus is finished**

of the average museum exhibition.

Particularly striking is the Alaskan brown bear group. The scene is of the Aghileen Pinnacles at the tip of the Alaskan Peninsula in late spring. In the foreground, seeming to dwarf the snow-topped mountains, are two immense Alaska brown bears. This species is the largest carnivorous land mammal in existence, and the giant relative of the grizzly and the European brown bear. The size of the Alaska bear is probably due to his abundant food supply, the hordes of salmon that run all summer and the vegetable food available in late spring and fall. These bears are most active in the daytime and they are usually solitary except when drawn to a common source of food. The cubs remain with the mother for almost two years and apparently take six or seven years to reach full size and weight.

In the museum group, the huge bear standing on his hind legs, seeming to sniff the air for danger scents, is more than 8 feet in height and weighed 1,400 pounds. The female, beside him, has stolen a salmon from an otter shown in the background. The painting of the volcanic Aghileen Pinnacles is authentic. Stones and pebbles in the foreground are water-rounded igneous rock brought down from the mountains.

Another striking ensemble is the bison group. It represents a buffalo trail on the North Platte River in Wyoming. Brilliant summer



**Applying finishing touches to the clay model of the huge Alaska brown bear from which molds are made for casting the body**

Elk shed their Cellophane wrappings before the "show" goes on





To make a tree trunk, wooden framework is covered with a wire mesh, burlap, plaster of Paris and bark



Painting in herds of bison, scattered by the thousands on the plains. Note buffalo grass in foreground

sunlight beats upon a flat plain and a herd of dust-covered buffalo feeding on the buffalo grass. Specimens of pronghorn antelope are also in this group. The expanse of the exhibit permits the delineation of a great herd of bison in the background painting; the animals seem to stretch off into the distance in countless thousands, a scene which has already vanished from this world.

Only years of work made a group like this possible. After an interval of negotiation with federal authorities, the museum obtained permission to collect—which means shoot—the required number of bi-

son from government herds which now number around 5,000 head. At one time the herds reached the critically low figure of 319 and bison were very nearly extinct.

This collection had to be timed so that the coats of the animals would be glossy, since the bison shed and become ragged in certain months. They also had to time the shooting so that the calves would be of the right age and the surroundings had to be seasonally in harmony with the coats and the age of the calves.

One of the most difficult problems in connection with this group was supplying the correct kind of buffalo grass, the grass on which the huge herds of bison once thrived and the loss of which brought about dust bowl conditions. The long and tenacious roots of this grass kept the soil together until farming and plant diseases destroyed it on much of the western plains.

To find the right kind of buffalo grass it was necessary to consult government authorities who directed the museum experts to a section of Kansas which would also serve as territorial background for the exhibit.

As is customary, the museum experts went after their animal and plant quarry in a group of three. One was the hunter who preserved the skins of the animals until they could be transported to the

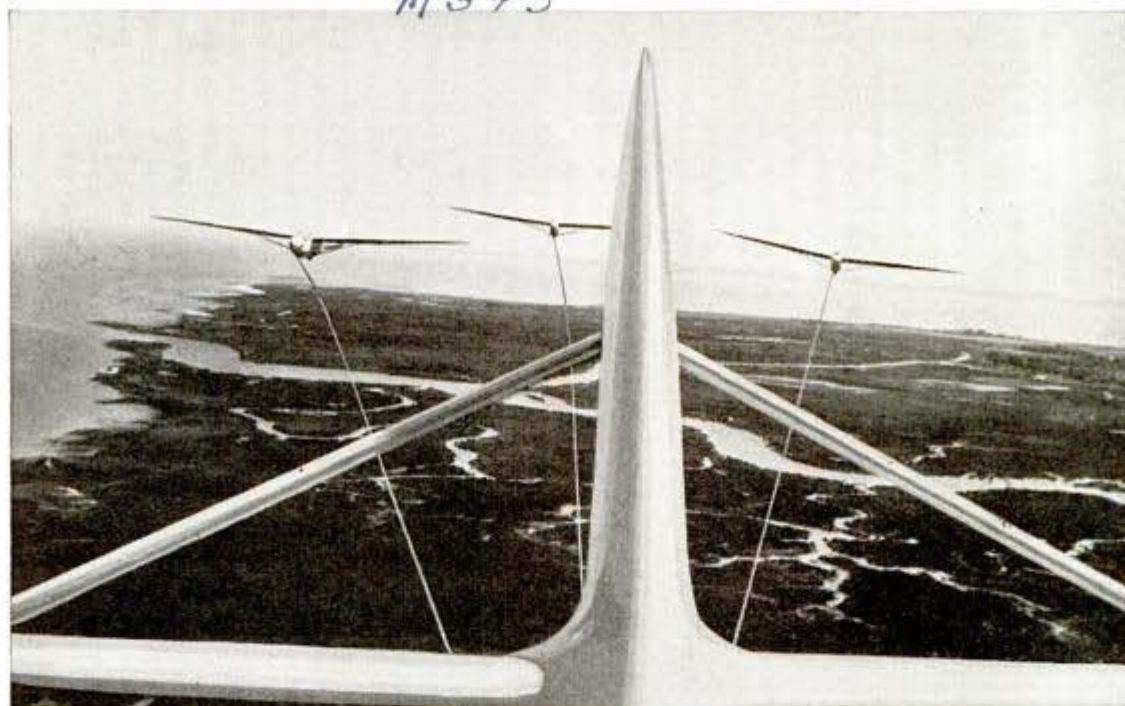
(Continued to page 163)

The sky and clouds are copied from photographs taken at the scene reproduced in exhibit they will cover



# Planes Tow Squads of Troop-Moving Gliders

M 543



Multiple passenger gliders are on the way and this is how the "air infantry" will be towed in glider squadrons for a surprise attack. At right is a winch sometimes used to tow the gliders to a takeoff. Note headphone on man, right

Two passenger planes are used to tow "squadrons" of troop-carrying gliders at the U. S. Marine Corps Glider School on Parris Island, S. C. Glider pilots acquire skill in the manipulation of their craft as they are towed in groups of three or more at varying distances behind a plane. Winches are also used at the school to tow gliders to a takeoff. Multiple-passenger gliders now being built will be used to transport large units of air-borne infantry and paratroopers for surprise attacks on the enemy.



## "Shotgun" Rocket Projector Used by Russians Fires 30 Shells at Once

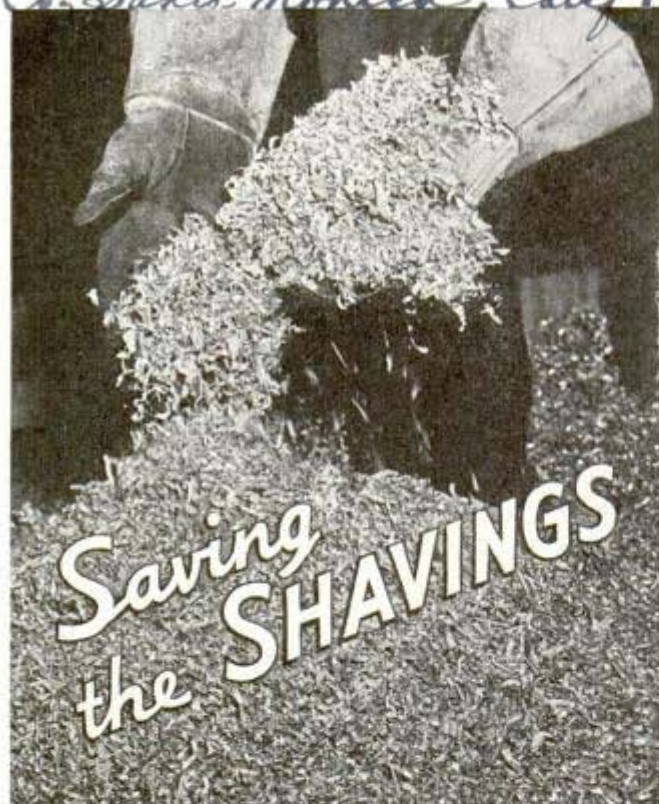
German tanks are finding it difficult to dodge shells fired by multiple rocket projectors used by the Russians, according to Prof. George B. Kistiakowsky, ordnance expert at Harvard University. The big projectors fire 20 or 30 shells at once, like a shotgun discharge. Two other rocket weapons are being used on airplanes. One is used against other planes or ground tar-

gets; the other, an "upside-down" rocket employed by the Germans in the bombardment of Malta and against armored ships, is used only for ground targets. The latter has the attraction of gravity added to the force of the rocket-stream push. Since rocket projectiles can be fired without recoil, a heavier shell can be fired from a plane than is possible with a light cannon.

SEPTEMBER, 1942

Reported by Prof. Geo. B. Kistiakowsky,  
Ordnance Expert, Harvard Univ., Cambridge, Mass.

Cont: Don Black, Publicity Dept., Douglas Aircraft Co., Santa Monica, Calif.



Photos from Douglas Aircraft Co.

M 364

**T**HEY used to say the meat packers used everything but the pig's squeal. That's nothing to what the war factories are doing. They sweep up millions of dollars' worth of metal dust from the floor and convert it into hundreds of planes and war machines. Westinghouse Electric reclaims scrap alu-

**P**lexiglas and Lucite scrap, being thermal plastics, are easily reworked or converted into novelty items

Metal shavings and dust like this are more precious than gold to the war industries

minum at a rate of 120,000 pounds a month—nearly 1,500,000 pounds a year; and that is less than half the aluminum salvaged in the Douglas Aircraft plant.

Last year Buick piled up a 244,-000,000-pound scrap heap, but it didn't go to waste. Buick even saves exhaust steam, uses it again and again, then converts it back to water. They say that Ford even salvages the echo from the plant whistle, catching it on a phonograph plate.

And speaking of phonographs, Douglas collects the shavings from Dictaphone records—for there are several precious chemicals in those wax cylinders. Most of the scrap at the Douglas plant is sheet metal, and this is carefully segregated into seven classifications according to alloy content, baled and shipped to the source factories as part payment on new sheet metal.

But there is also a vast pile of salvaged metal clips, electric furnace dross, culled pistons, forge flashings, short ends of rods, tubes, extrusions, stampings and other material. Some 23,000 pounds of rivets were picked up from the floor last year, re-sorted and re-inspected for use. After sheet metal and rivets, the principal

**B**oxes that brought airplane engines west to Douglas plant go back east with salvaged electric wire



Handwritten scribbles and signatures at the bottom of the page, including the name 'Don Black' and other illegible text.





scrap items at Douglas are Lucite and Plexiglas, the transparent phenol plastics used in bomber turrets and cockpits; being thermal plastics, these are easily reclaimed, and large pieces are in demand for making cigaret cases and similar decorative novelties. Sawdust is reclaimed to be turned into briquets, sweeping compounds and bonding material for adobe bricks. Odd items such as nuts, bolts, springs, and screws go to a store where Douglas employees can buy them at bargain prices—and these gleanings bring \$6,000 a month in cash.

General Electric is "panning" nickel dust by a new process, recovering 20 percent of requirements for one big plant.

There's pay dirt in the industrial ash cans these days, and it's getting no vacation. It's put right back to work.



Shoveling scrap into the baler press. The salvaged metal is turned in as part payment on new metal

Discarded as imperfect, these small castings have been segregated for return to the foundry furnaces

Baled scrap is trucked to the rails for shipment back east. It has first been sorted according to alloys



Virginia Lincoln, Room 1001  
Furniture Mart, Chicago.

## Dining Table Becomes Seat When Top Is Raised

M479



Table top swings back on hinges to form back rest

Home furnishings designed for multiple uses during wartime include a small dining table which is converted into a bench by raising the top, hinged to form the back rest. The seat is a flat wooden piece between the legs which are inset from the table's edge. When the top is raised the bench may be backed against the wall.

## Cork Jacket Shields Young Tree From Sun Scald and Rodents

Protection for young trees is offered by an insulating sheet which wraps about the



M413

Jacket is rolled about tree and held by wire loops

80 Serviced Products Corp  
6051 N. 65th St, Chicago, Ill.

Distr: Steffen's Rubber Co.  
15 N. Van Buren, Chicago.

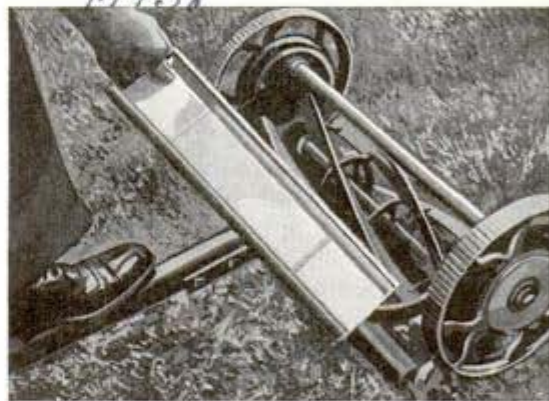
tree trunk like a jacket. Consisting of an asphaltic-saturated felt back with cork granules distributed over one side, the jacket is placed with the cork side toward the tree, thus acting as a heat distributor during warm days in winter and spring when unprotected trees may be damaged by the sun heating one side and causing the sap to flow, while the other side remains dormant. The cork insulation permits even circulation of air and admits a sufficient amount of rain water at the top to keep the bark moistened. Trees wearing the jacket are guarded against sun scald, rodents, borers and certain diseases.

Account  
insert

## Abrasive Puts Edge on Mower While You Push It

Sharpening a lawn mower is reduced to the simple process of pushing the machine after hooking a sheet of metal coated with

M438



Handy sharpener hooks over the cross piece of mower

carborundum over the cross piece. The revolving blades scraping against the sharpener at the correct angle are sharpened with a few movements of the mower.

## Plane Gunner Rides a Turntable To Fire in Any Direction

M500

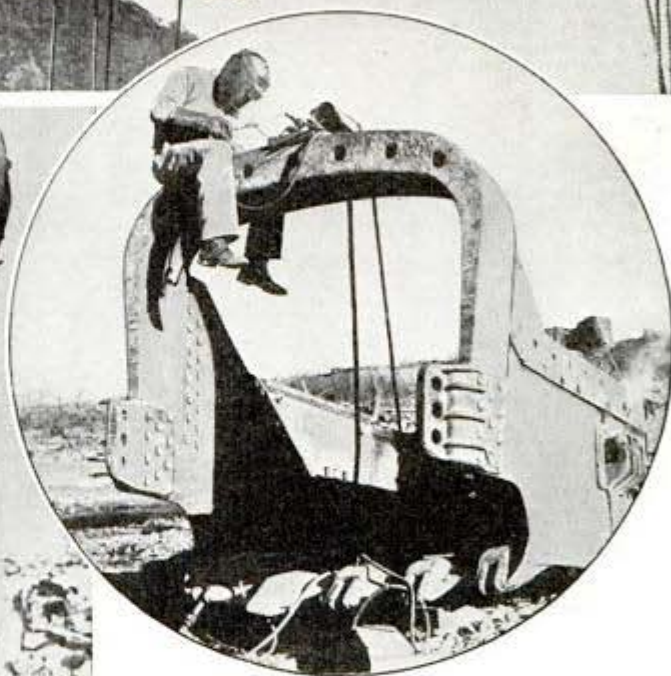
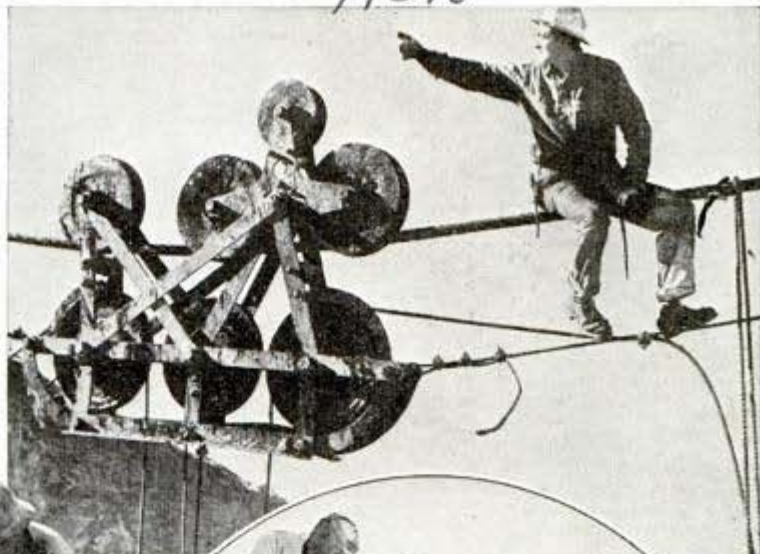
Rear gunners in airplanes will be able to fire at almost any angle with a mount for machine guns invented by Alexander P. de Seversky, noted aeronautical engineer. With this mount the gunner can swing himself and his weapon around and shift the gun from side to side. The gunner's seat is suspended from a carriage that runs on a track circling the cockpit. An arch-shaped girder mounted on the same wheeled frame carries the machine gun which may be locked in any position.

POPULAR MECHANICS

Inv. Alexander P. de Seversky, Northport, N.Y.

# Builders of Dam Risk Lives to Harness River

Dangerous jobs such as inspecting a highline (right) stretched across a canyon, or drilling on the side of a lofty cliff (below) are all in the day's work for builders of the great Shasta Dam that will harness the water of the Sacramento River and supply power for war plants. In circle, repairing a bucket



Drilling a hole for a dynamite blast high on a rocky abutment, inspecting a highline stretched across the Sacramento River Canyon, or repairing a giant bucket used to excavate gravel are only a few of the hazardous jobs performed by skilled

workmen in building the great Shasta Dam in California. These "men behind the lines" are wielding giant tools to speed the project that will increase America's supply of electric energy and turn new wheels for war production. The concrete and steel of Shasta Dam will check the ravages of the Sacramento River and harness its waters to supply power and irrigation.

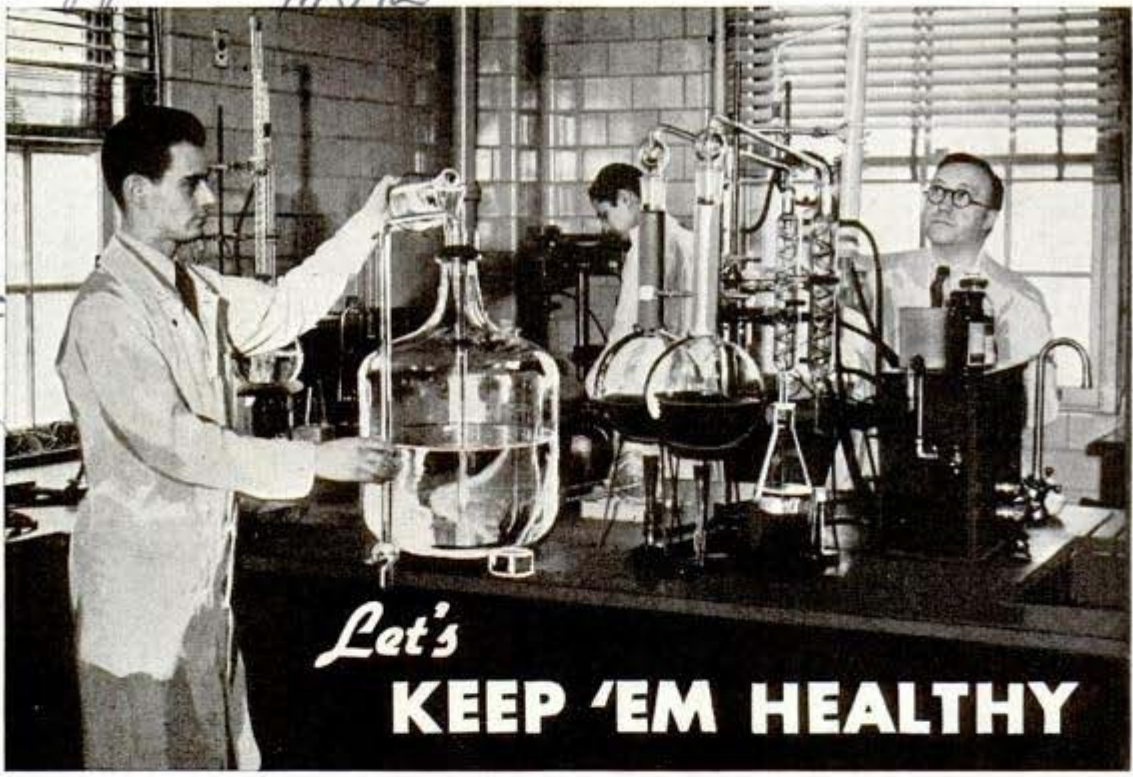
## Cutting Impure 'Gum' From Sorghum May Add New Source of Sugar

Sorghum may yield as much sugar as Louisiana cane in the future due to an invention for removing impurities from the syrup. The process, developed by chemists of the U. S. Department of Agriculture, prevents the formation of "gums" when the

symp is boiled down, allows crystallization of sugar, and recovers starch, calcium and aconitic acid as valuable byproducts. Sorghum can be planted in the spring and harvested in the fall, while sugar cane requires two years to mature.

Mr. Leggett M.312

Ref: U. S. Public Health Service, Natl Institute of Health, Bethesda, Md.



*Let's*  
**KEEP 'EM HEALTHY**

**Guardians of the health of millions of defense workers test the effects of new chemicals used in industry**

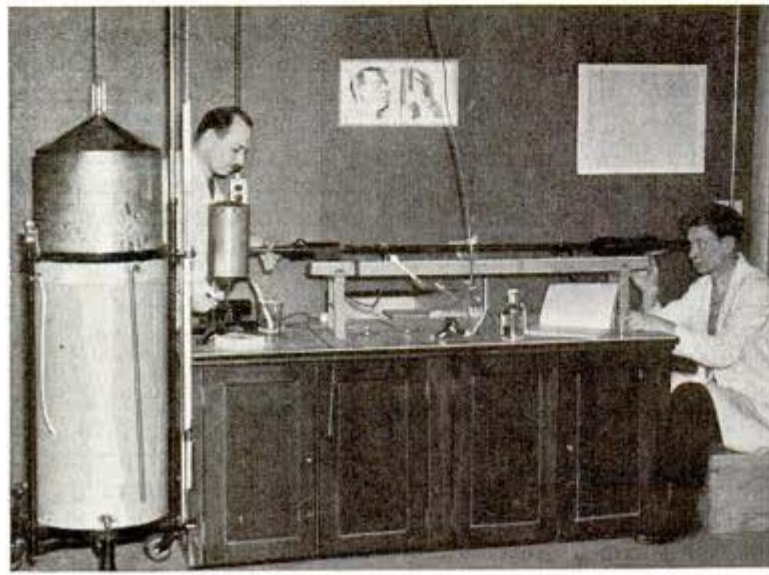
ONE of the war's greatest battles is raging just outside Washington—a battle to conserve the health and strength of America's rearguard army of some fifty million workers, the machinists, welders, riveters and others doing the jobs so vital to victory.

On one side in this struggle is a terrible enemy, sickness. When this nation's industrial legions go to the factories, shipyards and mines each day, a million men are missing because of this enemy. Thus

are lost some four hundred million days of work per year, a period in which 164,000 tanks could be built—a line of tanks that would present a solid front more than 200 miles long.

Ranged against the enemy are the National Institute of Health of the United States Public Health Service, numerous governmental agencies, state and municipal health departments and the medical and safety departments of hundreds of factories—all allied in the cause of keeping 'em healthy and keeping 'em working.

There are many reasons for this astounding loss of time. The old ones are that some jobs are dangerous and some workers are careless. But there are new reasons; new developments in industry, new machines and materials are creating hazards that challenge the old safety controls. And war production has brought the necessity for speed



**Measuring gas in sealed chamber, while human guinea pig, in window, reads temperature**

Exhaling into a machine which charts the amount of poison a man retains in gas-filled room

and strain that spell danger. To keep the workers on the job, these hazards, both old and new, must be controlled. But how?

That's the question on which all these allied agencies are working frantically. Speedy solution of the problem is the key not only to victory over sickness on the home front, but also over our enemies on the battlefields of the world.

A few miles from the nation's capital, the division of industrial hygiene of the National Institute of Health is leading the search for answers to the many phases of the question, "How can these wasted days be saved?" Swiftly working scientists are hunting for the answers in the laboratories there, seeking for a better understanding of metal poisoning, for ways to fight dust hazards and fatigue, for more information on the effects of ventilation and lighting on workers' health.

The laboratories of the division of industrial hygiene are crammed with scien-



tific equipment for studying almost any problem that may arise in this struggle to keep the workers working. Bell jars and cages full of small animals, white mice and guinea pigs, make easy preliminary studies of gas fumes, dust and many other things that may affect man's efficiency at the machine. All sorts of analyses can be made. In the division's pressure chamber, the temperature and pressure of different altitudes can be reproduced so that here, on solid ground, the effects of flight and thinning air on the airplane pilot can be ob-

This laboratory on wheels—a Westinghouse X-ray bus—is brought to the gates of a war plant to save time





If the needle reveals eye strain, the worker will get vitamin A capsules

served and studied and perhaps the answers found to the dangers of sudden climbs to high levels and swift dives. Then there is the cold chamber in which clothing can be tested to determine which is best for protection of the ground worker in the Arctic and which for the bomber crew fighting at 30,000 feet.

Here is the way the fight goes on. A call comes from the War Department to Dr. J. G. Townsend, chief of the Division of Industrial Hygiene, for a certain type of investigation in a government-operated



arsenal. A quick discussion of the problem brings a decision to put a field unit on the job. Testing apparatus is checked carefully and loaded. The doctor and engineer, the field unit crew, leave for the arsenal ready to track down the cause of a high accident rate, or a strange skin rash, or dizziness and fatigue that suddenly have attacked a group of workers. In a majority of cases, the answer will be found by the field unit and safety precautions applied immediately.

There are more than 30 of these units working throughout the country, helping state and local health departments. Paid for by state and federal funds, these units stand ready to study any of the health problems of industry. Perhaps a call comes from a mine. Down the shaft go men and equipment to search out the hazard and to find a way of removing it. Dry drilling may be the means of extracting the mineral ore from this mine. Even the uninitiated can see at a glance the danger in the dust-filled air, but the engineer cannot guess. He takes a sample to find out exactly how dangerous it is. This is the dust that leaves scars on men's lungs, that gives them tuberculosis or silicosis and sometimes takes their lives. The engineer and his assistants make their tests, counting the dust particles in the air taken from the mine. They suggest a solution for the trouble—a stream of water to keep dust out of the air or an exhaust system to clear the air where workers may be bagging powdered mineral.

But there are conditions that cause illness in industry that are harder to find, harder to correct. Here, too, the mobile units do their work—analyzing gases, chemicals and metals; investigating the causes of sickness. And the simpler things, like recommending machine guards, shoes, gloves and goggles, also are part of the division's work.

Many state health commissions have

Transferring cancer cells from one test tube to another to study their growth under varying conditions

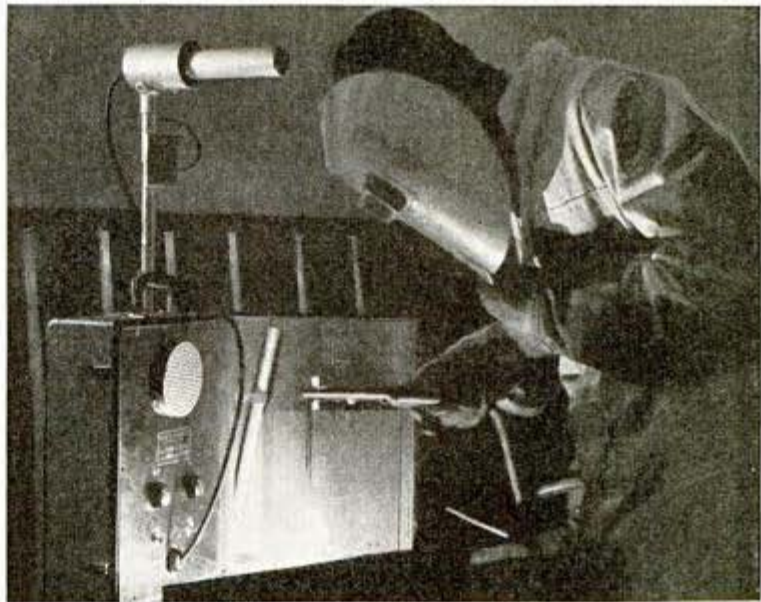
been expanding their work in industrial hygiene. Some are building trucks that make it possible to take the laboratory and the clinic right to the gates of the factory and to the mouth of the mine. In these trucks material can be tested, men X-rayed and examined and speedy answers found for problems that have caused lost time.

While the job of saving wasted days begins in the laboratory, it must end in the plant. Many industries, with the advice and assistance of the U. S. Public Health Service, are doing their part of the job with programs of their own. They are introducing pre-employment examinations which tell them if a man is physically fit for the job. And with a regular checkup, they make sure that the men who are healthy stay healthy and those who need treatment get it. Here the well-equipped infirmaries of industry are saving many days. They prevent a cut from developing into blood poisoning and other minor injuries from becoming serious. Their special equipment quickly performs work like aiding in the diagnosis of a twisted ligament or broken bone, thus pointing the way to treatment and early return to work.

Slips and falls are blamed for about one-fourth of all industrial accidents. One company devised a robot that "falls down" scientifically to measure the "skidability" of floor waxes—one phase in the campaign to reduce

(Continued to page 162)

SEPTEMBER, 1942



↑  
Samples of air about this welder are tested for purity by an electric machine that charges dust particles



←  
X-raying patient with a new fluoroscopic and radiographic instrument mounted in laboratory on wheels

↓  
The white rat is being de-fleaed with a vacuum tube to further the studies of endemic typhus fever



# Trick Movie Gun Fires "Bullet" Made of Earth

M 489



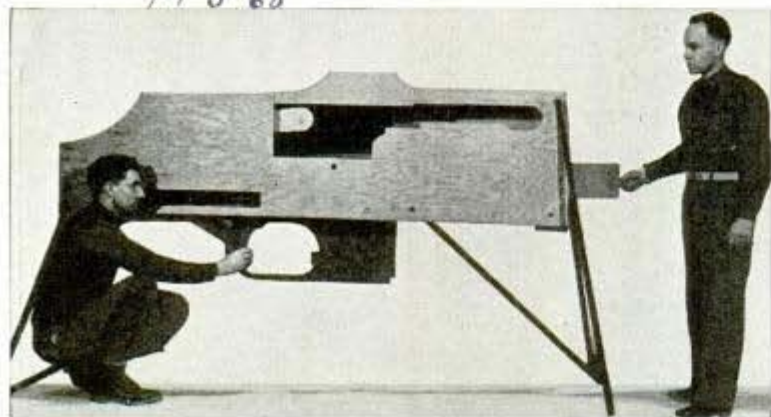
Out of camera range on the movie set a gun pumps "bullets" that smash against the target with a realistic splash of dust. The bullets are celluloid capsules filled with fuller's earth, fired by compressed air from a tank attached to the gun with a heavy rubber hose. Resembling a large rifle, the .38-caliber gun has a smooth-bore barrel, regular sights and a revolving cylinder at the breech which holds 12 capsules. The gun, invented by Roy Wade of Republic Pictures Studio, removes the hazard of ricocheting bullets.

Celluloid capsules are filled with fuller's earth and shot from this gun with compressed air from a tank that is attached to it with rubber hose. White earth is used for dark targets and brown for light ones to kick up dust that will send chills down the backs of movie audiences



# "Paul Bunyan" Model of Rifle Shows How Gun Operates

M 3 68



To make it easy for trainees to understand the mechanism of the Browning automatic rifle, Lieut. B. R. Porter of Camp Robinson, Ark., a former teacher of woodwork and industrial art, constructed a wooden model of the working parts eight times actual size. Although it does not include the stock and barrel, the model is more than eight feet long. It

Mechanism of rifle is easily demonstrated with aid of this big model

86 Blk. by: Lt. B. R. Porter of Camp Joseph T. Robinson, Ark.



has 31 parts, all of which function as in the regular rifle. In the complicated trigger mechanism alone there are 19 different parts. Various parts of the model have been painted in contrasting colors, enabling the men to distinguish and identify them from any place in the classroom.

### "Six-in-One" Table Changed in Jiffy By Shifting Top

One of the features of a coffee table with at least five other uses is a hinged square piece that may be lifted from the top and tipped to hold a book for reading. On the reverse side of the removable square is a checker board. The height of the wooden table is adjusted by slots along a single supporting piece that extends from the base through the top. This single support also makes it possible to place the table close to a bed for serving.

M 486



Hinged square piece is lifted from the table top and tipped to support a book; on reverse side is a checker board. Top adjusts to various levels

## Fire Cart Fitted for Air Raids Carries Own Water Tank

M 345



Completely equipped fire cart, handy for industrial plants and large buildings, can be wheeled in a hurry to any point endangered by bomb

Standard fire fighting equipment for air raid protection and incendiary bomb control is carried in a wheeled cabinet now available. The cart has its own storage and pressure tank that delivers a stream of water at 125 pounds pressure, throwing it three stories high or 100 feet horizontally. It can also produce a fog which is particularly effective in combating incendiary bombs and extinguishing fires in volatile

liquids. It carries chemicals, fire extinguishers, a large bin of sand, rope and chain, salvage cover and tarpaulin, as well as fire ax, fire pick, shovels, fire department fittings, lanterns, asbestos helmet, gloves, goggles and gas mask. Ample space is provided in the cabinet for storing additional equipment to meet special hazards.

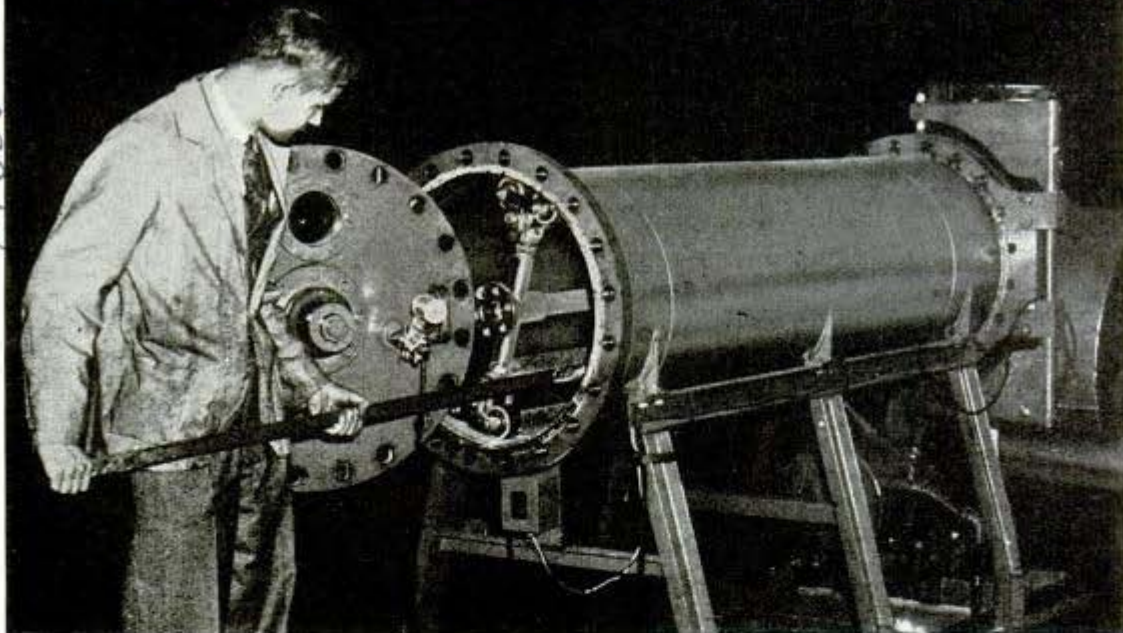
You can obtain additional information about products described in this magazine by writing to the firms listed in the Where-to-Buy-It index. Say You Saw It in Popular Mechanics.

SEPTEMBER, 1942

distr. Steinmetz & Kelly, Mdse. Mart, Chicago

Chicago Fire Equipment Co., 546 N. Lake St., Chicago, Ill.

# DUST *the* DESTROYER



Dust and air are mixed in predetermined quantities and then exploded in this test "bomb" at the Underwriters' Laboratories

Finely divided wood, flour, carbon black, metallic and other dusts are sprayed on this dust-tight lamp to test its safety



**D**UST is dynamite. Any kind of dust, from the household variety to the dust in mines and metal-working factories and grain elevators.

In a Texas grain mill, workmen were cleaning white corn to prepare it for milling when dust set off a tremendous explosion that killed one man, injured four others and destroyed nearly \$200,000 in grain, building and equipment.

A woman about to bake a pie in her third-story apartment found the flour unfit for use and promptly dumped it into the incinerator. Flour particles filled the incinerator shaft and in the few seconds the fire at the bottom touched off a blast that blew off the cast iron incinerator doors on every floor of the apartment building. The damage was extensive, and the woman who unthinkingly caused the accident was struck by the iron door in her kitchen and painfully injured.

In Baltimore a huge grain elevator was destroyed by a dust explosion that cost seven lives, property damage estimated at \$1,500,000, and 22 men were injured.

Dust—in the right proportions and the wrong conditions—is as dangerous as gasoline. As a matter of fact, if there weren't better fuels, more easy to control, you could run an engine on the power packed in dust.

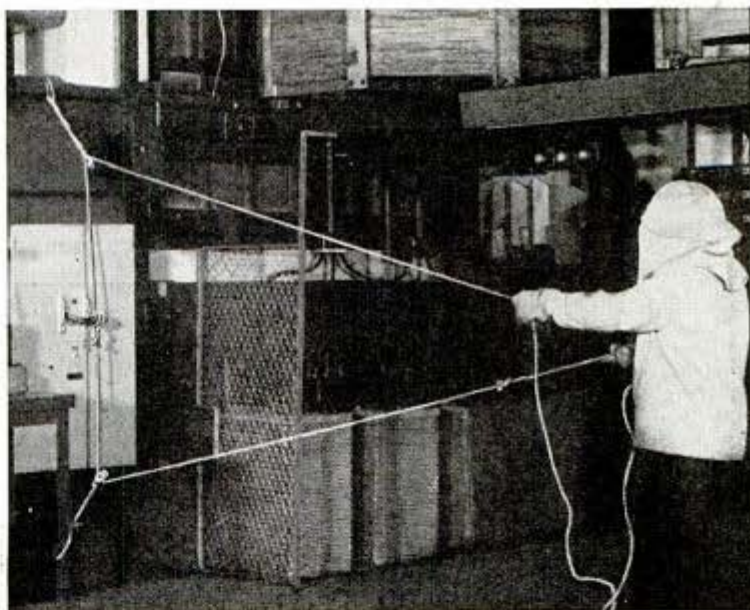
But dust must be controlled—particularly today, when disruption of a war industry by a needless explosion could cause serious curtailment of production. Dust particles, suspended in air, are easily ignited by a tiny spark which might even be caused by friction. It is estimated that some 28,000 industrial plants in the United States are confronted with a dust explosion hazard. Woodworking and cabinet making shops have serious dust risks.

Almost all common types of dust are combustible in air and therefore produce an explosion hazard. Among these, apart from metal, grain, flour, and ordinary house dust, are wood, starch, and coal and coke dust, to name only a few. Dust from black powder and TNT in war plants is an outstanding hazard. There are a few non-inflammable dusts, one of which is sodium bicarbonate.

Incomplete figures, covering only indus-

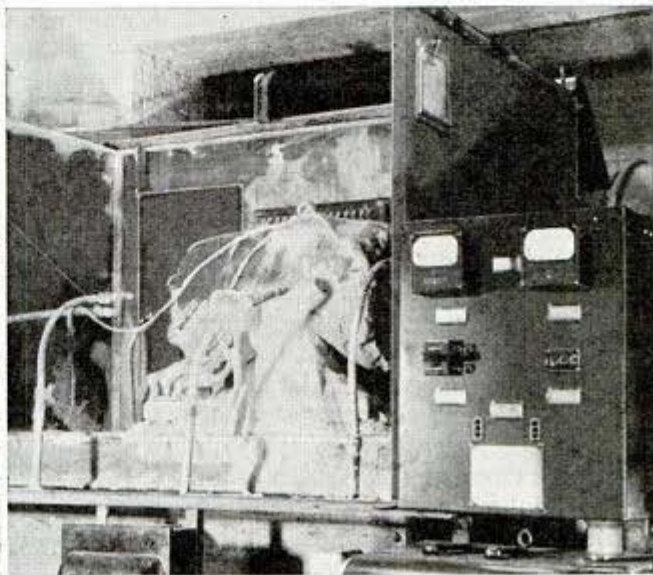
trial plants, show that in the last 20 years, dust explosions have caused a \$28,000,000 property loss, and killed or injured hundreds. Nearly 400 dust explosions have been recorded in industrial plants alone.

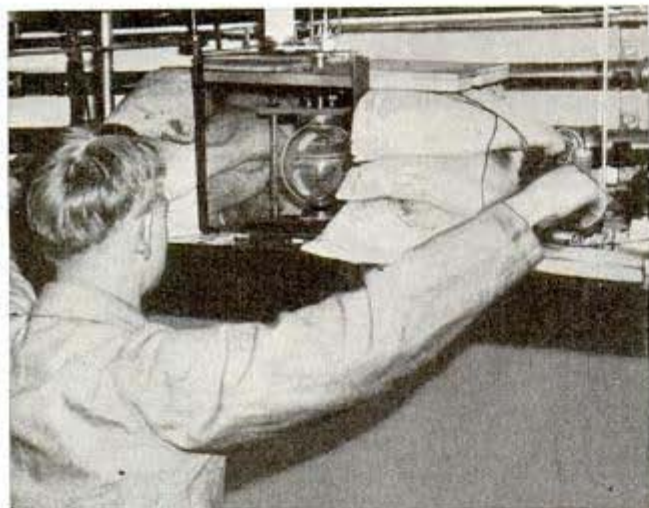
The growing menace of dust has brought about a vast amount of research and experimental work having as its objective both the elimination of the hazard and the effective control of the explosions themselves. An organization that is playing an important part in these activities is Underwriters' Laboratories, Inc., which has chemists, engineers and electrical experts



Asbestos-clad engineer tests a heavy-duty electric switch for fire, shock and explosion hazards after it has been put to "dust chamber" test

Electric motors destined for use amid dust hazards, as in grain elevators or starch plants, are given an overwork test in an atmosphere of dust and under a blanket of dust at Underwriters' Laboratories





This small dust "bomb" has walls of thick glass which permit view of the dust explosion

at work on the problem in laboratories in Chicago, New York and San Francisco, as well as in actual plants with dust problems.

Since explosions are a danger only when dust concentrations in the atmosphere are between an "upper limit" and a "lower limit," depending on the type of dust present, much of the work involves methods of finding out how much or how little dust, of any specified kind, will cause an explosion. Just completed by Underwriters' Laboratories is the newest means of testing the explosive limits of dust concentrations. It is called a "bomb" but in reality is a reinforced steel cylindrical chamber with a capacity of 21 cubic feet into which given amounts of any type of dust can be introduced, mixed with the atmosphere, and then actually exploded.

Because of its size, this bomb gives a better and clearer picture of dust explosions, as well as explosive pressures developed, than any other artificial method yet devised. It is used principally to determine the "upper limits" of dust concentra-

tions. It is possible for air to become so saturated with dust that explosions no longer are a hazard. The bomb determines where the saturation point occurs with various types of dust. The "lower limit" of dust concentration, or the minimum amount that will cause an explosion, is less difficult to determine.

The value of the information disclosed by tests in the dust bomb is obvious. The owner of any factory or other establishment, knowing the kind of dust most likely to be present, can learn the degree of concentration of that dust which constitutes a definite explosion hazard. Then he can test the atmosphere in his plant to find out just what dust concentration exists, and take suitable steps to eliminate or control the hazard. Several instruments for testing dust concentrations are available. One operates on the principle of directing a stream of air, in given volume, through a cloth or paper "thimble" and determining, by weight, the amount of dust present. Another filters dust laden air through a water chamber.

Eliminating or controlling dust explosion hazards, however, is no simple matter. The first



Testing a fluorescent light fixture to be used in factory with a dust hazard

Electric switch may undergo as many as 10,000 tests to be certain of safety



and most important safeguard, according to Underwriters' Laboratories engineers, is to strike at the danger at its source which means minimizing the possibility of any initial spark or flame near the area of dusty atmosphere.

To achieve this safeguard, close attention must be paid to the type of electrical fittings, fixtures and equipment used. One of the activities of Underwriters' Laboratories consists of testing such equipment for dust tightness.

Among the items of equipment tested and approved are circuit breakers, conduit fittings, including outlet and wiring connection boxes, elevator interlocks and appliances (there is considerable danger of dust concentrations in elevator shafts), lighting fixtures and fittings including portable lighting equipment and fluorescent fixtures, industrial motor control equipment, motors and generators, panel boards for light and power, plug-in receptacles, portable tools, switches, signal appliances, relays, temperature indicating appliances, and a host of others.

Tests take into consideration that sparks may be caused by overheating, by friction, by static, by lightning, by improperly designed or protected electrical equipment. Grounding of all metal parts is, of course, recommended. Even electrical conducting floors (also grounded) are used to reduce static hazards. Special consideration has been given to efficient lightning protection systems, especially in cases of grain elevators and other rural buildings.

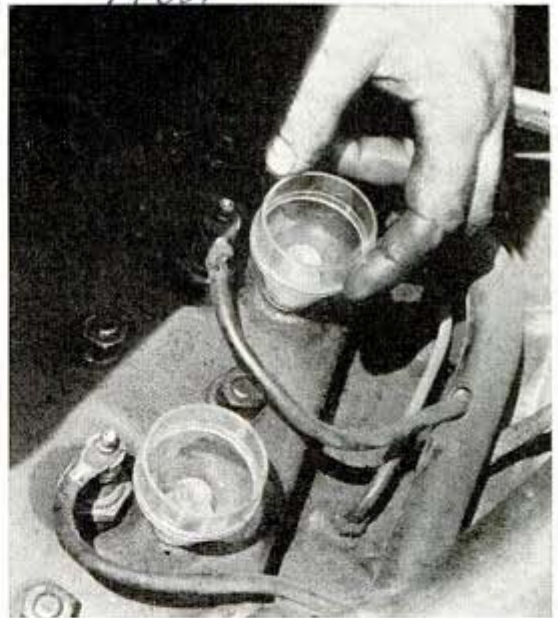
Good housekeeping measures in factories are strongly advocated. Maintenance, cleanliness and the elimination of natural or structural "dust collectors"—even cobwebs in grain elevators—are important in reducing the amount of dust likely to become concentrated in the atmosphere. In addition there are several systems of collecting or disseminating dust already gathered in the atmosphere. The most common systems are those of ventilation or air circulation. Another new way is to precipitate dust by electricity.

Some plants have a far greater dust explosion hazard than others. Such products as food starch, alkali starch, corn dextrin, corn sugar, grain and flour, all of which are dust producing in the extreme, are carried in enclosed conveyor systems from one part of a factory to another, or from

(Continued to page 166)

SEPTEMBER, 1942

*Distr: Anti-Rust Coop.*  
*340 Canal St., N. Y. C.*  
**Plastic Cup Feeds Solvent**  
**To Free "Frozen" Studs**  
*M 381*



Cup dispenses solvent to free sticking auto stud

Penetrating solvent to loosen the heat-hardened formation around the studs on "frozen" automobile cylinder heads, may be fed into the right place through perforations of an injection-molded plastic cup. The cups are built for long service, being molded of sturdy cellulose acetate plastic.

### Frying Pan Made of Pottery Doubles as Serving Dish

Material that was formerly considered worthless by the ceramic industry is used to make a new type of pottery for both cooking and serving. It withstands a direct flame, is attractive enough for table use and is easy to clean. Various types of cooking utensils are made of the ware.



New type pottery used for cooking over open flame

*Joaquin Potteries*  
*P.O. Box 522, Stockton, Cal.* 91

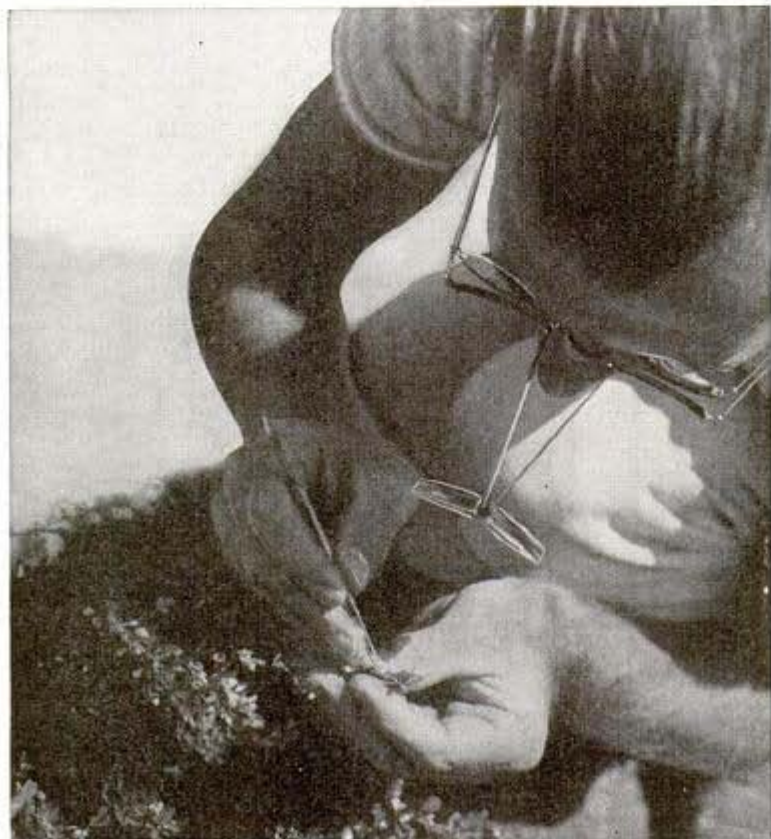
# NEW CROPS for AMERICA

*Mr. Leggett*

*M 253*



Preparing sorghum flower for crossing to help relieve the sugar shortage  
Nature gets a hand with artificial pollination to boost yield of grass



U. S. Department of Agriculture photos

AT AN annual cost of about \$130,000,000, the United States has been importing drugs, spices and oil-yielding materials, part of which could be grown successfully in this country—materials that have been cut off by the war.

The knowledge that the American farmer stands to share in the money formerly spent abroad and that the shortage in these materials assures a market as long as the war lasts, perhaps longer, gives him a double-barreled reason for investigating this situation. In addition to supplying the immediate demand for these products, he may wish to produce a small surplus with which to experiment. From experimentation may come more valuable information like the discovery that an odor identical to that of the costly oil of rose can be made from coriander oil.

These materials include aromatic plants and essential oils, drugs, spices, gardening and forage seeds, edible oils and quick-drying oils for the paint and varnish industry. Although most of them show unusual possibilities for cultivation in this country, no farmer should embark upon this venture blindly; it's no get-rich-quick scheme. Some could be grown in the subtropical regions, others in the northern states. The farmer should determine which can be produced in the climate and soil conditions of his section.

Marketing conditions likewise should be inves-

tigated. There is sufficient demand for some crops to warrant cultivation on a large scale, but others are marketable only in small quantities. Complete information, such as selection of a crop, planting, cultivation, harvesting and marketing, may be obtained from the U. S. Department of Agriculture and its agents throughout the country. However, the department cannot supply seed for planting stock.

Experimentation has proved that specialty crops such as these can be cultivated in this country. Scientific implements and agricultural knowledge enable American farmers to produce crops more cheaply by our machine methods than they can be grown and harvested in foreign countries where labor is available for a few cents a day. Thus, we can grow rice more economically than we can buy it from China. On some large specialty crops machinery built for other purposes might be used with minor changes. Small specialty crops do not lend themselves to mechanized harvesting.

In stressing the value of experimentation, the National Farm Chemurgic Council points to the soybean. Brought from Asia to this country nearly 150 years ago, only in the past 25 years has it come to be such an important crop that 10,000,000 acres are now cultivated not only for agricultural purposes of hay, pasture and silage, but for extensive



Feeding a tung tree planted in jar reveals its soil requirements



Soybeans, first grown in U. S. as forage, now developed for table use and source of cooking oil, flour, plastics

← Cutting leaves of digitalis, medicinal drug which has been successfully cultivated in many of the northern states





↑  
Planting golden seal roots for cultivation; this wild U. S. herb supplies drugs used in tonics

use of the extracted oil as an edible product and for wide industrial applications, including the making of plastics and a wool-like fabric.

Domestic mint oil had not been considered seriously as a source of natural menthol as long as Japanese mint oil was available at low prices. Also the two oils were different chemically and physically in so far as the menthol constituents were concerned. Our production of citrus oils is almost sufficient to supply our needs and production of domestic lemongrass oil is a still more recent enterprise.

Among 131 crops listed by the chemurgic council as having possibilities in this country is pyrethrum, the flowers of which are the source of a poison useful in insecticides. Imports have amounted to about \$3,000,000 per year, part of which came from Japan. The plant can be grown successfully in southern California, Colorado and in the northern United States, but much hand labor is required in harvesting unless a recently developed picking



machine is used. The U. S. Department of Agriculture has developed a mechanical harvester for operation by two men. Its capacity is three to five acres per day. In a similar field is red squill, of which some 500,000 pounds per year have been imported for making rat poison. Red squill, known in the wild state as the sea onion, might be grown in the sandy coastal regions of this country where the climate is mild, and particularly where bulbs are cultivated most successfully. There are two drawbacks. It takes five years to develop a marketable bulb, and the volume of business is not large enough to engage many growers. Right now, it probably would be difficult to get stock for planting because red squill has been gathered from wild

← Hardy alfalfa, left, resists disease which has withered standard variety at the right

↓  
Soybean seedlings are grown in quartz gravel to study effect of varied plant food





Lumelite Corp., 261-5th  
av. N.Y.C.

## Plastic Reflectors on Stairs Are Handy in Blackout

M 463

plants along the Mediterranean shores. Species and varieties of so-called drug and medicinal plants collected from all over the world and used in the United States number several hundred. The Department of Agriculture points out that possibly not more than 3,500 acres would be required to grow our essential drug plants and for this reason, only people in the most favored circumstances for cultivation will find their production a profitable enterprise. There are many cultural, soil, disease and harvesting problems which must be considered.



Disks that glow in dim light help prevent accidents

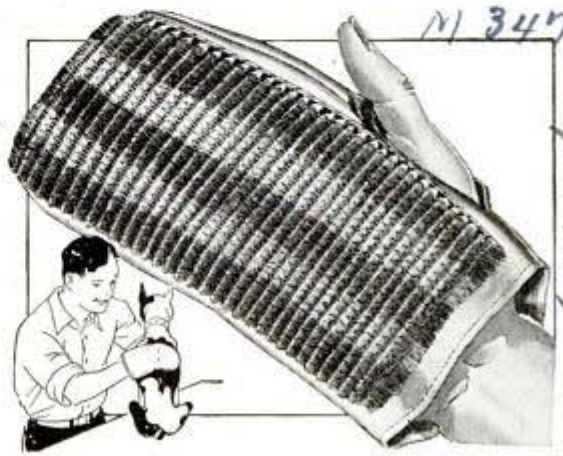
One of these drug plants is belladonna, of which the United States has been importing about \$18,000 worth per year. It can be grown in the northern states and California. Harvesting requires hand labor and there must be facilities for drying and curing. S. B. Penick & Co., one of the world's largest drug houses, has begun cultivation of several hundred acres of belladonna with the approval of governmental agencies. Another is digitalis, which has been collected from plants growing wild in the Pacific northwest. Only a small amount of digitalis is needed. Stramonium, which has uses like those of belladonna, grows almost anywhere in this country. Here it is known as Jamestown weed and Jimson weed. One drawback is that only 250 acres, cultivated efficiently, would be required to supply all demands.

Plastic disks that glow in dim light—such as cast by a "blackout" flashlight—and prevent stumbling on stairs or other objects, are now on the market. They are of penny-size with a hole in the center for tacking. Available in crystal, amber, red or green, the reflectors are virtually unbreakable and weather resistant.

Condiment plants comprise another group to which the American farmer has paid little attention. Coriander is a typical example. Some \$60,000 worth of the seed is imported annually. A short-season crop adapted to a wide range of conditions, it has possibilities as a winter or spring crop in irrigated valleys. The seeds, harvested by machine in Russia, are used for condiment purposes, in the medicinal field and in the making of oil useful in flavoring, condiment sauces, mayonnaise, canned foods, chili sauce and candies. Another in this class is caraway, the seed of which has been an annual import item of about \$400,000. Cultivation is considered possible in the northern Pacific coast states and perhaps as a winter crop in the northwest.

## Mitten Brush for Grooming Dog Is Worn on Either Hand

Its surface covered with bristles to form a brush, a mitten for scrubbing and grooming the dog protects the hand and saves



Brush is worn like a mitten when grooming the dog effort. Recommended specially for short haired dogs, the brush has slits in the sides permitting the thumb to protrude.

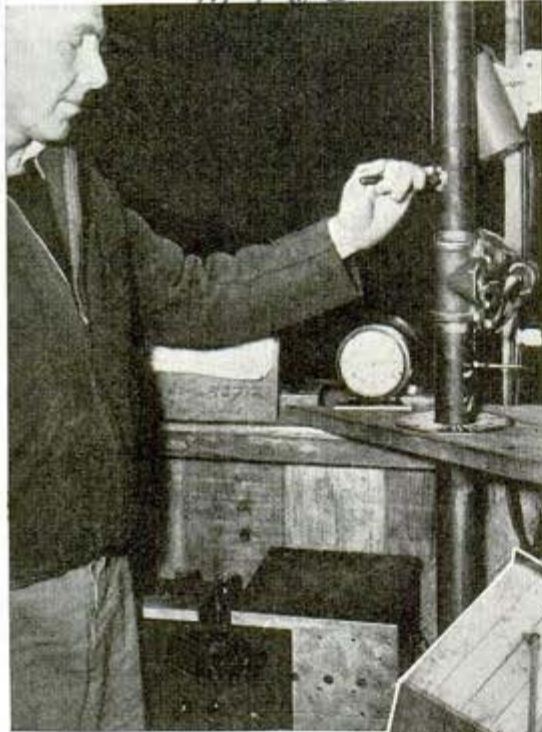
Licorice, another of the condiment plants, might be grown in the southwest and in California. About \$1,300,000 worth of licorice has been imported each year, making this a crop worth experimentation. The

(Continued to page 164)

1831 Randolph St., Chicago, Ill.  
Coughlans Seed Store

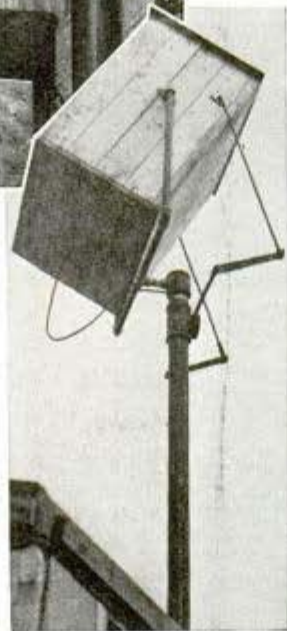
# Homemade "Ear" Spots Plane Eight Miles Off

M465



If an enemy plane gets within eight miles of Yuba City, Calif., the sound of its motors will be heard through a homemade listening device designed by air raid watchers. A boxlike receiving unit made from a loud speaker and powered by a radio extends above a glassed-in tower atop a small structure used as a "cook house." A 2½-inch pipe which may be turned around with a handle is used as the main mounting for the receiving unit. Another handle attached to a half-circle ratchet with a rod extending up through the pipe to the detector permits tipping the device up and down. The turning pipe and the ratchet enable the watchers to point the detector in any direction.

Air raid watcher adjusts listening device with a handle attached to pipe (above) which extends to boxlike unit mounted on top of "cook house" and watch tower built and used by civilian workers, at Yuba City, Calif. It turns in any direction



# Individual Ash Trays Hold Chips in Stacks on Card Table

M407



For use with games requiring counters, as in some card games, a set of four ash trays, each holding an assortment of chips, keeps the chips in tidy stacks instead of permitting them to scatter about the table top. When not in use, the trays are stacked as a unit and held together by a strong spring clamp.

**IF YOU WANT TO BUY IT—**

Write to the manufacturer or distributor listed in the Where-to-Buy-It index to learn more about commercially available products described in this magazine. Say You Saw It in Popular Mechanics.

Ash trays keep chips in order for card players

96 Distr: Mandel Bros., State & Madison, Chicago, Ill.

POPULAR MECHANICS



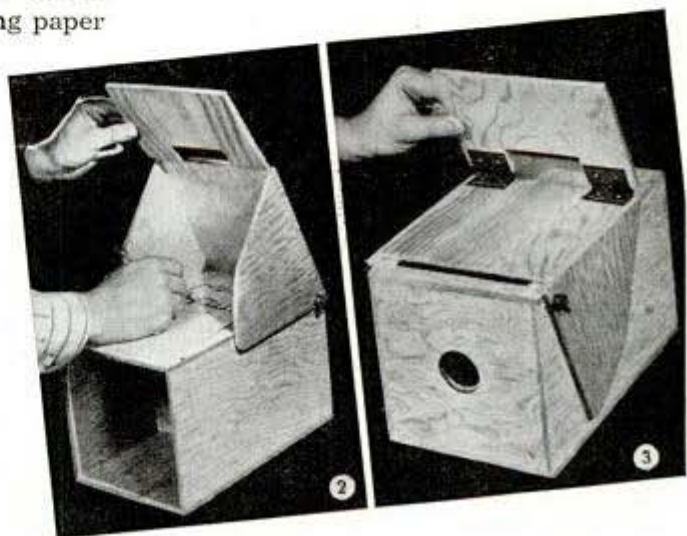
# The CRAFTSMAN

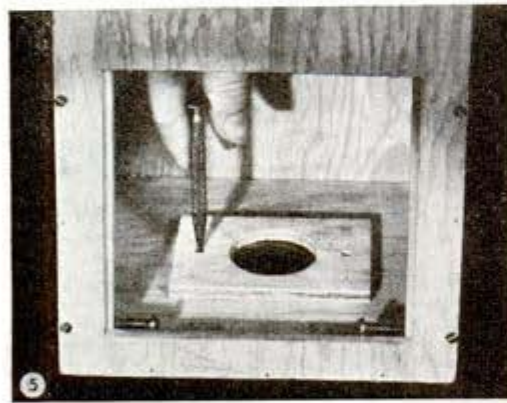
## TRACEOGRAPH *aids in sketching*

A "drawing camera" that enables you to trace people or scenes. It consists only of a ten-cent lens, a small mirror and some plywood

THE simple sketching box shown in Fig. 1 makes it easy for youngsters and others having some artistic ability to copy people and landscapes in true proportion, using regular tracing paper which is placed on a hooded window in the top and is held in place securely by the hood when the latter is locked in position. The objects to be drawn should be in bright sunlight. A ten-cent lens gives good definition at the center, but if sharp definition at the edges is desired, a lens of better quality, such as a good reading glass, will be required. The lens throws the image on a mirror set at a 45-degree angle, which in turn projects it on the tracing paper. While the picture sketched will be a reverse of the actual scene from left to right, the tracing paper can be turned over and the picture traced on the opposite side.

With a lens having a focal length of about 6 in., the box can be made according to the dimensions given, but in case one of greater focal length is used, it will be necessary to experiment with the exact location of the mirror and the tracing window. This can be done by using a temporary top board and adjusting it and the mirror unit back and forth until the point is found where the image will be sharp. With a lens of 6-in. focal length,

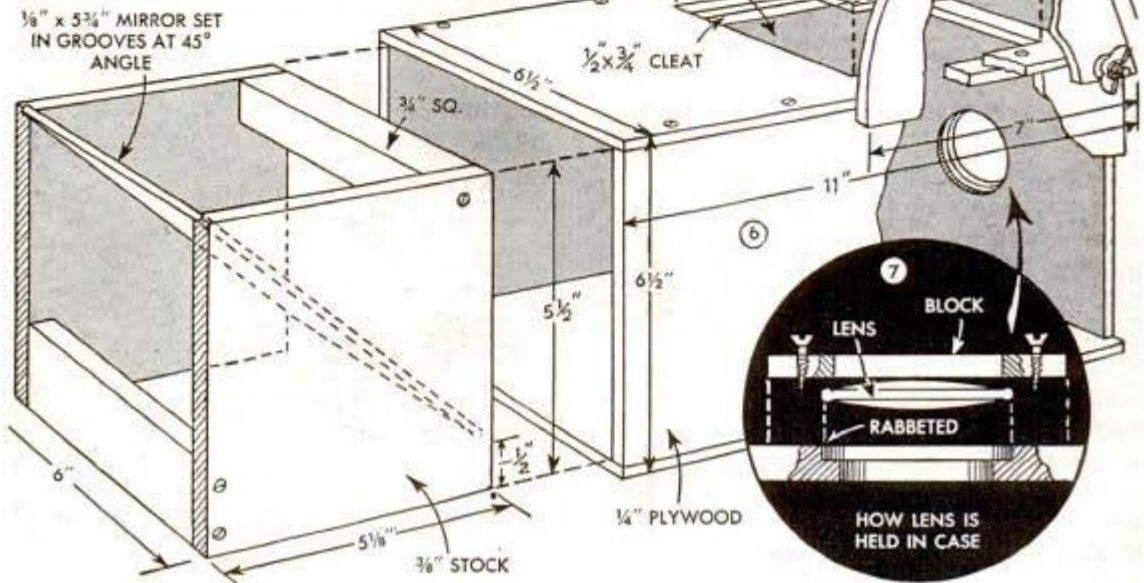




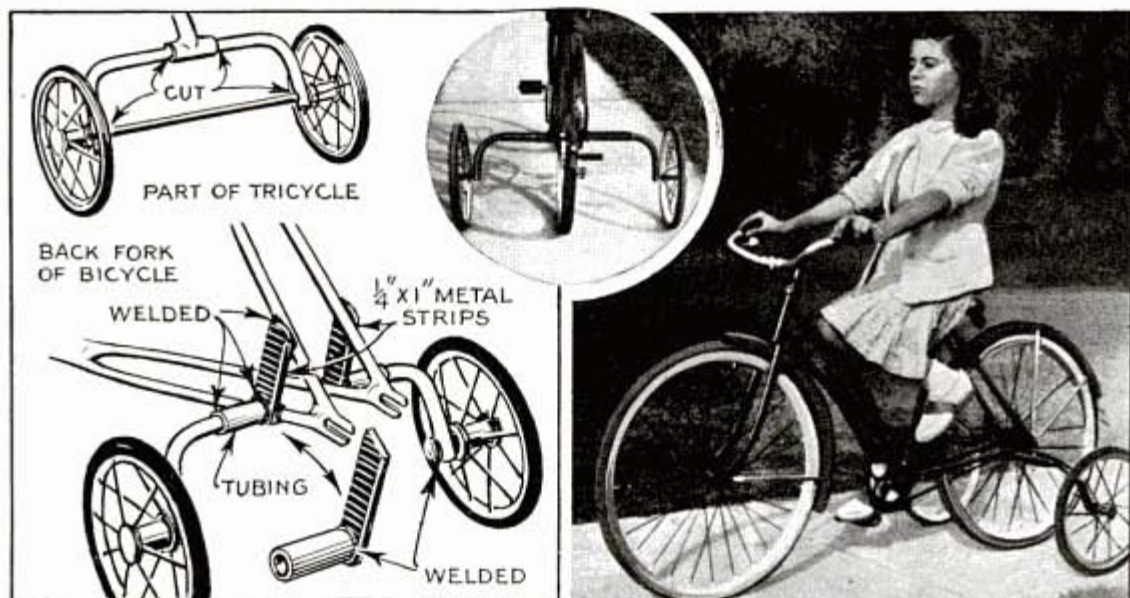
the center of the mirror should be 3 in. from both the lens and the tracing window.

The cutaway view in Fig. 6 shows the general construction of the camera. Practically all parts are of plywood. The mirror unit, which is assembled to slide snugly in the open end of the box as in Fig. 4, must be of a height to allow the unit to pass under the cleats that support the tracing-window glass. Figs. 5 and 7 show how the lens is held in place in the center of the end. The 1½-in. reading glass used in the original was the type having a one-piece plastic rim and handle, the latter being cut off close to the rim to make it fit flush in the lens hole. An expansive bit can be used to cut the rabbeted lens hole by first boring the largest diameter part way, and then reducing the cutting radius of the bit ¼ in. before continuing. The hood in which you look through an opening at the top, also serves to hold the paper in place as it bears against the top of the box when locked in a raised position. Figs. 2 and 3 show how the hood can be folded flat over the window when not in use. Note that the leather-hinged flap provides an opening for the hand. If you should want to shield the picture still more, a cloth bag having an elastic in the hem to fit the wrist could be attached around the hand opening.

3/8" x 5 3/4" MIRROR SET IN GROOVES AT 45° ANGLE



# Tricycle Wheels Give Added Support to Bicycle



One father, discovering that his child could pedal a bicycle but could not balance it, due to a physical handicap, simply added a couple of tricycle wheels to the rear fork to provide extra support. The same idea can be applied in similar cases or where a child is too young to balance, it being possible to remove the added parts later. The frame and axle of the tricycle are cut off at the points indicated in the

upper left detail, and the short ends of the axle are welded to the lower ends of the curved frame members. The upper ends of the latter are set into short lengths of metal tubing or pipe attached to strips of flat iron on the bicycle fork, these parts being welded together securely as indicated. In assembling the parts they must be placed properly so that all three wheels will touch level ground.

## Portable Lawn Shower Is Fun for the Whole Family

Pushed into the ground, this shower not only provides fun for children as well as adults, but it also saves water, which goes on the grass instead of down the drain. The shower consists of a length of pipe bent as indicated, and fitted with a spray head at one end and a tee at the other. An adapter for connecting a garden hose, and a pipe plug drilled and tapped for an iron rod, are fitted to the tee openings as shown in the detail. If you are unable to obtain a shower-bath head, you can make a suitable one easily from an evaporated-milk can.



### Making Grips Stay on Handlebars

To prevent bicycle handlebar grips from slipping off, wrap friction tape around ends of the handlebars. Then dip the grips in turpentine, gasoline, or kerosene. This allows the grips to slide over the tape. When the turpentine or gasoline evaporates, the grips will shrink to their original size.

## Snap-On Skirt for the Sewing Box Keeps Accessories at Hand



To increase the capacity of her sewing box and to make it possible to keep the most-used accessories where they could be reached easily, one seamstress made a cloth skirt having many pockets, which she snaps around the sewing box while working. Large-size dress snaps are used for attaching the cloth, the snaps being fastened to the sewing box with small brads. When not in use the skirt is rolled up and stored in the box.

## Comb Used to Make Dotted Lines

When it is necessary to make a number of dotted lines on paper, and there is no typewriter available for the job, you can



do it with a comb and stamp pad. Press the end of the comb teeth on the pad and then on the paper just as you would an ordinary rubber stamp.

—William Swallow, Brooklyn, N. Y.

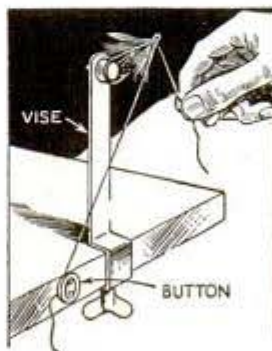
## Clamp to Hold Band-Saw Blade Made From Slotted Pipe

Slotted and bent as indicated, a short piece of  $\frac{1}{2}$ -in. pipe makes a handy vise clamp for holding band-saw blades while sharpening them. The projecting ears formed on the piece of pipe rest on the upper edges of the vise jaws and prevent the clamp from falling out of place when the jaws are released to remove the blade.



—G. E. Hendrickson, Argyle, Wis.

## Button Aids in Tying Fishing Flies

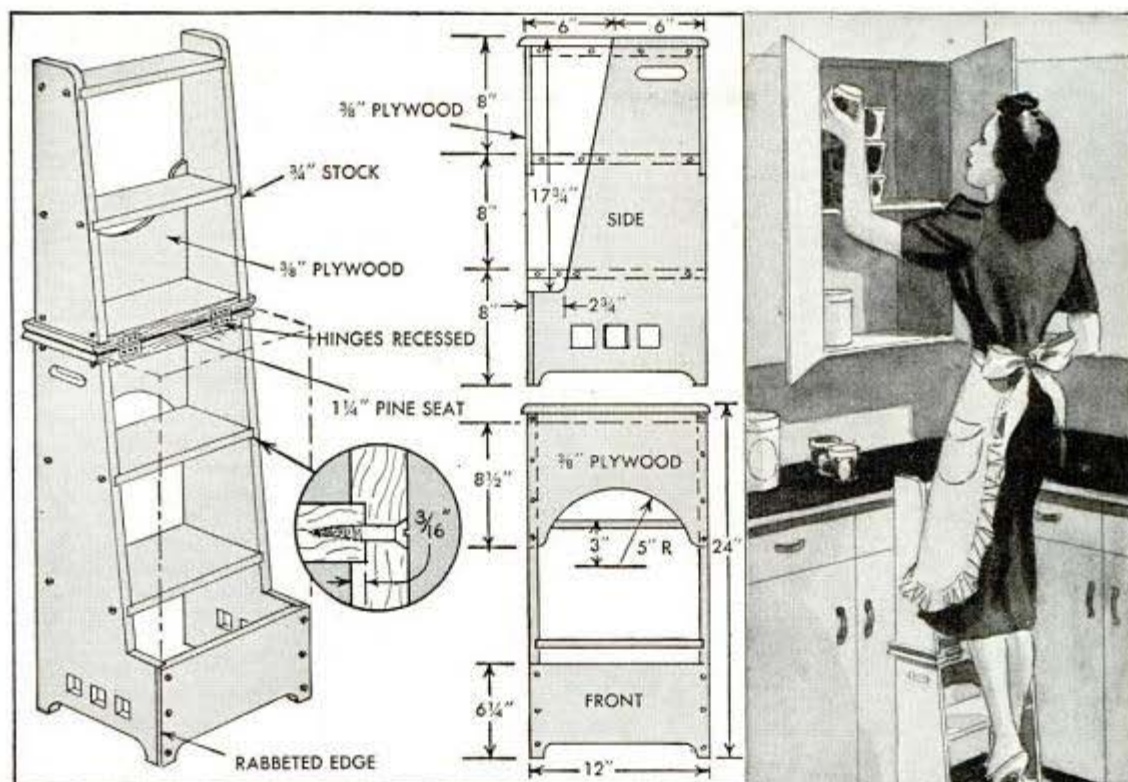


Nailed to the base of a fisherman's fly vise, a large button serves as a holder for the end of the thread to keep it taut when desired. The button is pulled up tightly, and in use the end of the thread is merely given a few turns around it. This makes it easy to attach or release the thread.—Duwaine Starck, Monett, Mo.

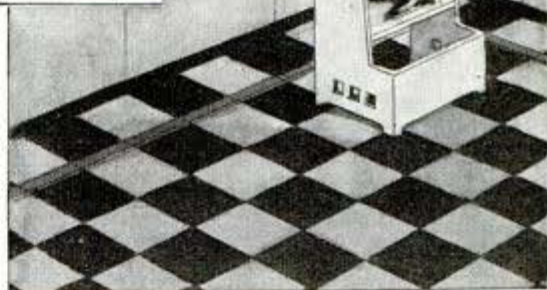
## Papering Calcimined Walls

Never attempt to hang wallpaper directly over calcimine. All calcimine should first be removed by thoroughly wetting and rewetting, applying water with a large brush, then scraping until the original surface has been exposed. For best results, size the wall with cold-water size, mixed according to manufacturer's directions. Paper, when hung may stick for a time to calcimined surfaces, but shortly the calcimine will pull away from the walls.

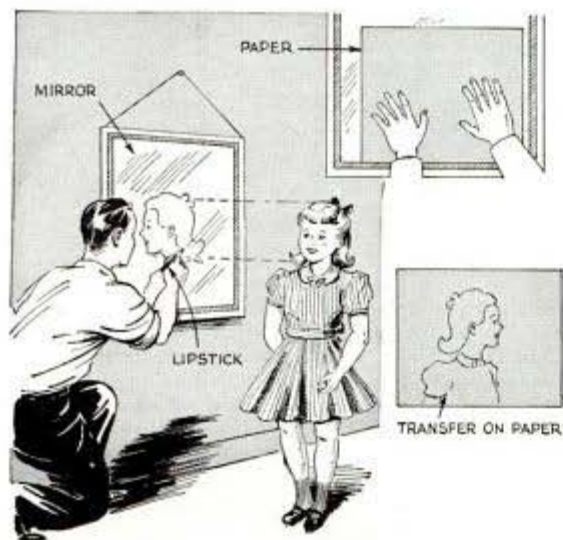
# Compact Kitchen Step-Stool Opens Into Ladder



Kettles and other seldom-used utensils stored on high cupboard shelves are reached easily with this double-duty stool, which opens up into a sturdy 40-in. step-ladder. Except for the seat, plywood may be used entirely or combined with solid stock. Run the grooves for the treads in the side panels first, then tack both together and saw out the section that swings up on top of the seat. Glue and screw the treads in place and hinge the two-part seat to bring both sections flush when folded. Rubber-headed tacks will keep the stool from slipping on waxed floors



## Your Profile Traced on Mirror and Transferred to Paper



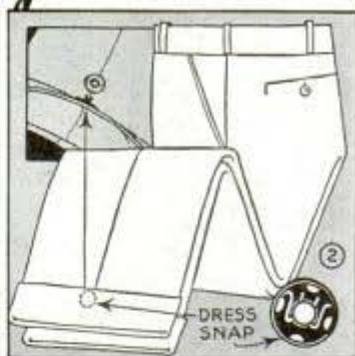
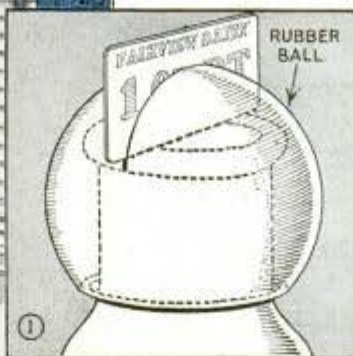
You can have a lot of fun at parties, or entertain the younger members of your family by tracing their profiles as seen in a mirror. To do this, have the subject stand in front of the mirror. Then trace around the image with lipstick or a grease pencil, and fill in the features as desired. You can even fill in the eyes, hair line and eyebrows with ease. If you desire, the profile can be transferred to a piece of paper by pressing the latter over the lipstick outline to take the impression. The lipstick can be removed from the mirror with soap and water or any other glass cleaner.

☛ If you wax floors before painting the walls and woodwork of a room, any paint dropped on the floor will not stick.

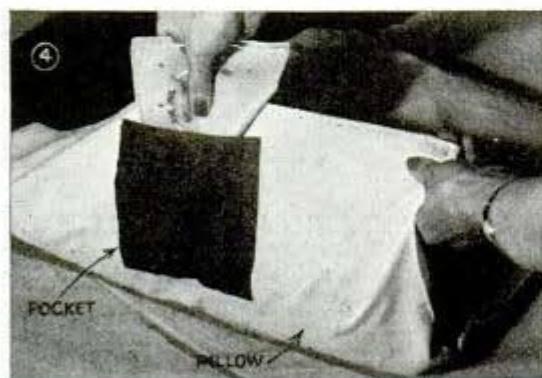
# Solving HOME



3. Besides keeping a sheet in place at the foot of the bed, increased sleeping comfort is claimed if a bed is made up with a fold in the sheet as indicated. The slack produced by the fold prevents one's feet from working out beneath the sheet



1. When milk bottles are left at the doorstep, part of a hollow rubber ball slipped over each one, will assure a greater degree of sanitation against prowling animals. A slit in the top provides a handy place to put a note or ticket. 2. Dress snaps used in place of stitching on the cuffs of wash trousers simplify the job of letting the cuffs down for laundering. Place the snaps, one at each seam, a little below the cuff edge so that they will be unnoticed

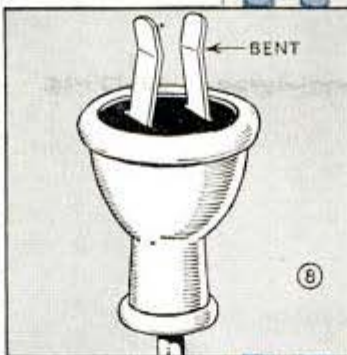
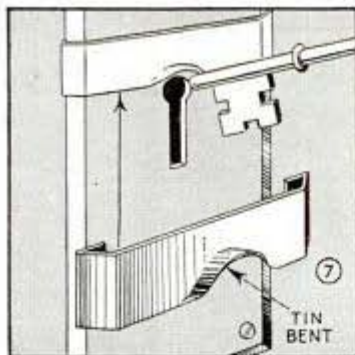


4. Loss of a handkerchief among bedclothes is unlikely if you provide a pocket for it on the underside of the pillow. 5. A hairnet of the type used for keeping a finger wave in place makes an excellent holder for crochet thread as it can be hung from the arm where the ball will be always close at hand. 6. Using a glass pie plate as a cover when cooking dumplings enables you to keep them from "falling" and becoming soggy as you can watch them rise without raising the lid and admitting air





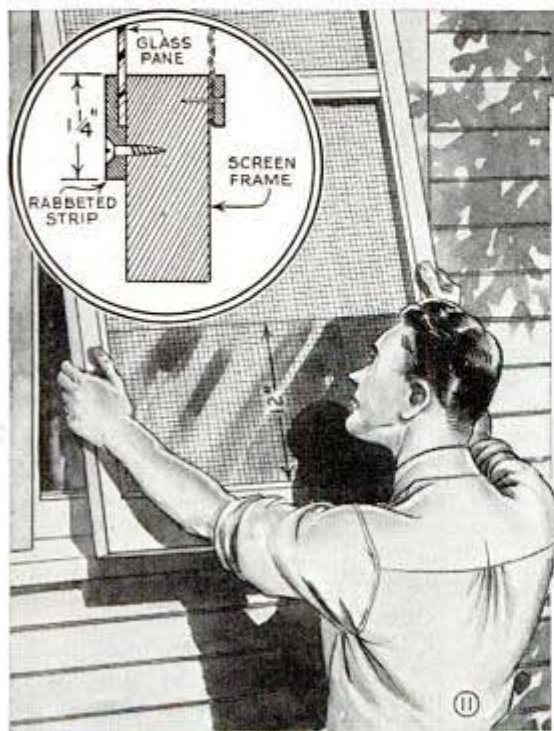
# PROBLEMS



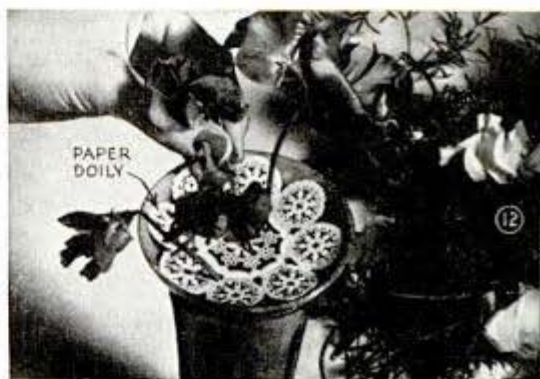
7. Less time will be spent in locating an outside key-hole in the dark if you provide the lock escutcheon with a key guide like the one shown, which is a piece of tin or wire to slip under the plate. 8. Spreading the prongs of an electric plug with the fingers to improve contact in a wall outlet often loosens them in the base. A better way to make the prongs fit snugly is to bend just the ends outward as shown, with a pair of pliers



9. Entry or departure from an open-end porch which is fitted with a full-width drop awning, will not require raising the entire curtain if you provide a "doorway" at one side. Simply cut a 3-ft. strip from one edge of the awning, tack it to a window-shade roller and mount it to overlap the drop curtain



10. When washing fails to remove oven stains try using ammonia. Saturate a cloth pad placed over the stain and let stand. After 2 hrs. you can wipe away most or all of the stain with a cloth, after which the oven should be given a thorough washing with soap suds. 11. You can keep a bedroom partially ventilated during threatening weather and still be protected from entry of spasmodic rains by fitting a glass deflector to the inside of the screen frame. Thin rabbeted strips hold the glass on three sides. 12. Attractive arrangement of cut flowers in a wide-mouthed vase is made easy if a paper doily is used as a "frog" to hold them in the desired position



## Sliding Gauge on Tape Measure Helps Mark Duplicate Pieces

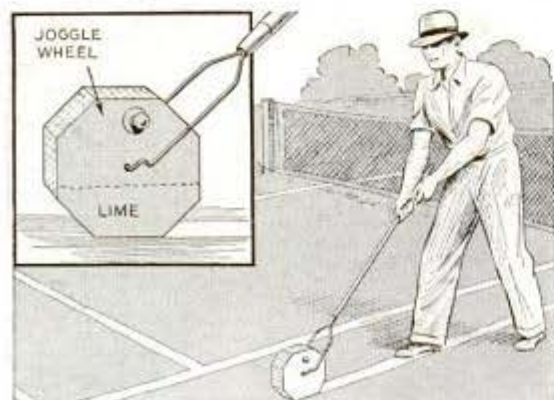


When marking a number of duplicate pieces before sawing, one craftsman uses an adjustable gauge on his steel tape measure to speed up the job. The gauge is nothing more than an ordinary paper clamp or clip, with a slot cut between the handles so it can be slipped over the tape. It is adjusted quickly by squeezing on the handles and moving it to the desired position, which in some cases, may be done more easily if the clamp is reversed so that the blades are toward the end of the tape.

—Opie Read, Jr., Chicago.

## “Joggle Wheel” Lime Duster Lines Tennis Court

You can mark off a tennis court quickly by using an octagonal-shaped container, or wheel, as shown. Pushed along the desired line, the bumping action of this duster shakes out the lime, thus making it unnecessary to go over the line more than once.



The container can be fitted with a handle by using a heavy piece of wire as a fork at the container, and a length of broomstick.

## Rivets Are Set With a C-Clamp

If a tool for setting hollow rivets is not at hand, you can do a neat job by using a C-clamp and ball-peen hammer as shown in the photo. By turning the clamp screw the peen end of the hammer is forced firmly against the rivet end, spreading and clinching it securely. If a ball-peen hammer is not available, you can use a ball bearing of the proper size.



## Notch Under End of a Pencil Clip Makes It Hold Firmly on Pocket



To make a pencil clip grip firmly on a pocket of thin material, such as a pocket of your shirt, cut a notch in the pencil where the end of the clip contacts it. If the clip is removed and the end bent downward and then replaced, it will press the fabric of the pocket into the notch and provide a good grip.

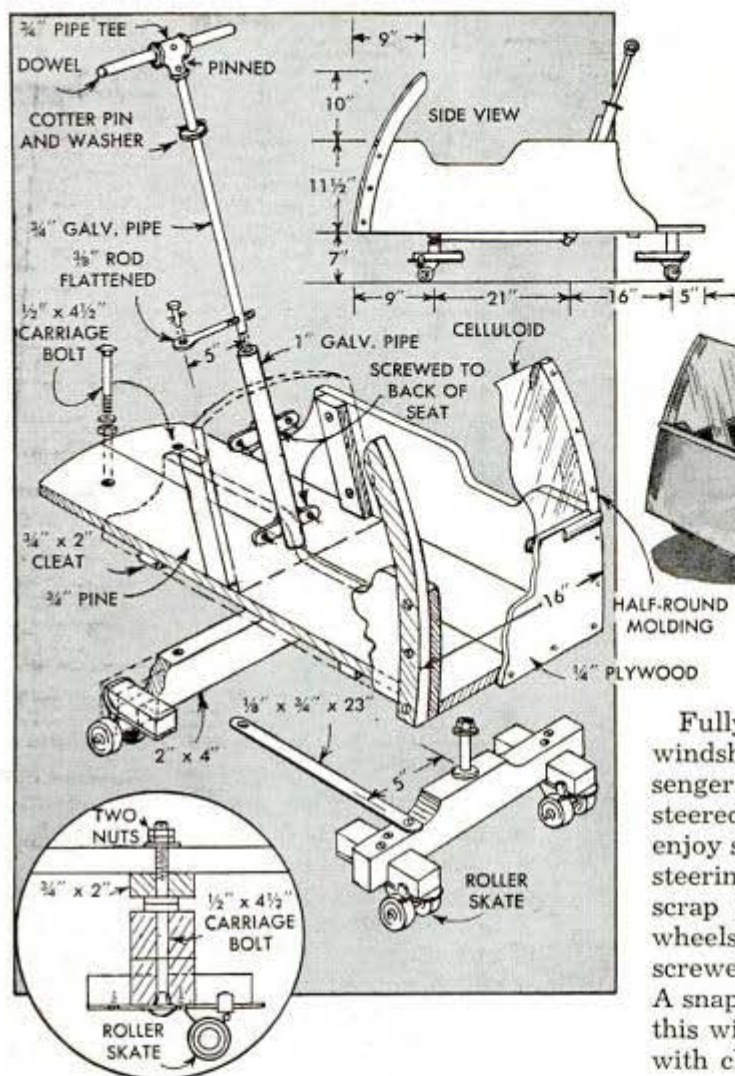
## Emergency Tips for Crutches From Pieces of Hose

Needing some rubber tips for his crutches and not being able to obtain them immediately, one man used short pieces of garden hose.

The ends of the crutches were whittled down to provide shoulders against which the pieces of hose rested when pushed over the reduced ends of the crutches. The hose should project beyond the end of the crutch at least  $\frac{1}{4}$  in. to provide a cushion effect.



# Taxi Scooter Has Seat for an Extra Passenger

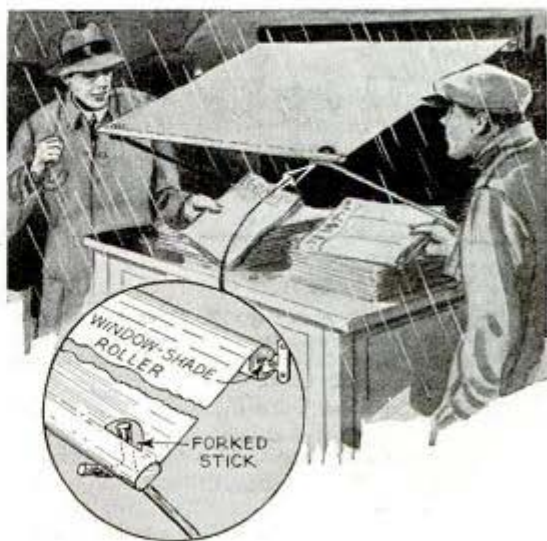


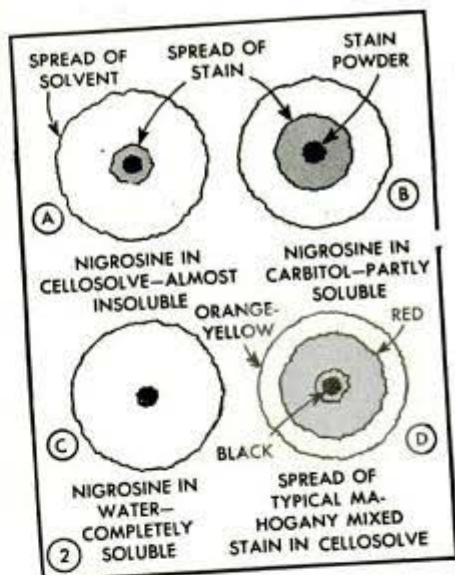
Fully equipped with a celluloid windshield and a seat for an extra passenger, this taxi scooter is pushed and steered by a "chauffeur" who can also enjoy swift rides on down grades. The steering unit is made from pieces of scrap pipe. Roller skates provide wheels, which are clamped and screwed in place on a sturdy chassis. A snappy paint job is recommended as this will make the scooter a sensation with children in any neighborhood.

# Simple Pull-Down Shelter on Newsstand Keeps Papers Dry

If you operate a street-corner newsstand that is unprotected, here's an easy way to keep your papers and magazines from becoming soaked during light showers. Just tack a piece of oilcloth on an ordinary window-shade roller of the required length and mount it over the stand as shown. Then look around for two forked sticks to support the lower end of the oilcloth when in use. In this way, the shelter is always conveniently at hand and requires only a few seconds to pull down or raise whenever desired.

☛ Before heating coffee over an open fire, rub both the bottom and sides of the coffee pot with soap. Then soot that collects on the pot can be removed more easily.





# STAINS

By Sam Brown

**PENETRATING OIL STAIN**  
Add to 1 oz. oil soluble stain powder, 1 qt. warmed, light oil (benzol, turpentine, naphtha, gasoline) or a blend. Half and half benzol and VMP naphtha is recommended. A small amount of asphaltum or 4-hour varnish (1/8 to 1/2 pt.) can be added for body if desired.

**POWDER STAIN (OIL SOLUBLE)**  


**WATER STAIN**  
Add to 1 oz. water soluble stain powder, 1 qt. of hot but not boiling water. Allow to cool and then strain. Keep in glass jar.

**NON-GRAIN-RAISING STAIN**  
Add to 1 oz. water soluble stain powder, 1 qt. Carbitol or Cellosolve (see text). Keep in glass. Dilute as used with denatured alcohol but not over 3 parts alcohol to 1 part stain.

**HOW TO MIX POWDER STAINS** 3

**4 OTHER TYPES OF STAIN**

**Pigment Oil Stain:** 4 oz. any color pigment ground in oil with 1 pt. of benzol, turpentine and boiled linseed oil in equal parts. Under lacquer, use colors ground in japan and mix with turpentine.

**Wiping Stain:** Same as above.

**Shading Stain:** 1 oz. oil soluble stain powder to 1 qt. lacquer thinner. Add to clear lacquer in any proportion.

**Staining Filler:** Color regular paste wood filler with penetrating oil stain.

**S**TAINING is the first and most important step in applying a clear finish on wood. It gives the wood color and enhances the beauty of the grain. No other step in finishing brings about so radical a change in the appearance of the wood.

**Types of stains:** Essential ingredients of any stain are a liquid or solvent, and coloring matter. The solvent usually is water, oil or alcohol, and the general description of the stain is the same as the solvent used, that is, water stain, oil stain, spirit stain. There are several branches of these main groups, including non-grain-raising stain, wiping stain, shading stain, etc. The coloring matter usually is an aniline dye, which is available as a dry powder in numerous colors, and comes in cans as small as 1 oz. All types of stains can be made by mixing the dry powder with the required solvent. Also, all types, except water stain, can be obtained in liquid form if a ready-to-use product is desired.

**Mixing powder stain:** Directions for mixing powder stains are shown in Figs. 3 and 4. As a general rule, 1 oz. of powder will make 1 qt. of stain. The powder dissolves better if the solvent is warmed to about 160 degrees F. Where inflammable oils or alcohol are being used, the bottle containing the solvent can be placed in a



## *in wood finishing*

pan of hot water as shown in Fig. 5. It is good practice to strain all stains through muslin or cheesecloth after they have cooled to room temperature. This removes impurities and filters undissolved pigment.

**Non-grain-raising stains (NGR):** These are made from water-stain powders dissolved in a synthetic chemical. The result is a stain with all the good features of water stain, but minus the grain-raising fault. The solvents Carbitol and Cellosolve mentioned in the lower right-hand corner of Fig. 3, are the commercial names for diethylene glycol and ethylene glycol respectively. Both are obtainable from finishing supply houses, and are of the alcohol family, miscible in all proportions with water and each other. They are solvents for practically all of the water-soluble powders. However, two important exceptions in solubilities should be remembered. Cellosolve is not a solvent for walnut crystals or nigrosine and Carbitol is not a solvent for walnut crystals, and only a partial solvent for nigrosine. If these solvents are used in mixing a powder containing any part of nigrosine, the resulting color will be lighter than the same powder mixed with water, as the black (nigrosine) will not dissolve. As manufacturers of stain powders generally favor the purer form of mixing colors from the primary colors (red, yellow,



### ⑥ TREATMENT OF VARIOUS WOODS

WALNUT and MAHOAGANY	Often finished natural, without stain. Stain used for wide variety of brown and red tones. Preferable stain, water or NGR; seldom oil or spirit. Excellent for bleaching, after which wood may be stained light amber, straw, etc., or sufficient color can often be obtained by filler alone.
OAK	Seldom finished natural or red. Attractive in any brown tone. Grain raising very bad with water stain, hence NGR preferable. Excellent for bleaching. Good for novelty effects.
PHILIPPINE MAHOAGANY	Same as mahogany, NGR stain preferable. Sometimes filled direct on bare wood with an orange-brown filler (pigment coloring, not dye) and further toned by adding shading stain to first finishing (sealer) coat.
FIR SPRUCE CYPRESS BASSWOOD POPLAR REDWOOD PINE	Usually stained mahogany or walnut color, using penetrating oil stain, which brings out grain. To kill grain, use wiping stain. Water stain not commonly used but if used will penetrate better on resinous wood if work is first washed with an alkali solution (4 oz. of sal soda, 1 oz. washing soda per gal. of water).
MAPLE	Use water or NGR stain. Add further color with shading or wiping stain between finishing coats. Often stained with wiping stain on bare wood.
POPLAR BIRCH GUM BEECH	Commonly used in combination with walnut or mahogany. A uniform color is obtained by spraying NGR stain overall; heavy on birch or gum; light on walnut or mahogany. After filling, birch or gum can be darkened to match by using shading or wiping stain.
CEDAR	Always finished natural. A red wiping stain can be used to blend or smooth any excessive contrast between the white and red wood.



PROTECT INLAYS WITH SHELLAC

blue), it is not likely that much trouble will be encountered in this respect. When mixing stains, a deep blue-violet will answer all color requirements for a black. Walnut crystals are mixed usually as a single color to produce a walnut brown for which there are many good browns as substitutes.

**Solubility rings:** A good check for solubility when making NGR stains is as follows: Take a blotter or a folded facial tissue and place a small pinch of the powder on the paper. If you are checking more than one solvent, put down a separate pinch of powder for each. Now, wet each

mound of powder with several drops of warm solvent, so that the wet ring of solvent makes a circle about 2 in. in diameter, as shown in Fig. 1. Observe the stain color obtained. If it spreads instantly in a uniform color to the fullest extent of the wet solvent ring, the powder is very soluble in the solvent being tested. A color spread of about two-thirds the diameter of the wet solvent ring can be considered satisfactory. Note the examples in Fig. 2. Data contained in the tables of Figs. 6 and 8 should enable the finisher to make a satisfactory selection as to the type

of stain he should use for any particular job.

**Application of stain:** One rule that applies to all types of stains is to start on less important parts. When using water stain, sponge the wood with warm water just enough to dampen it, Fig. 13, and sand smooth when dry as in Fig. 14. Apply the stain with brush or spray. Use a fairly large brush and apply the stain freely and rapidly, shaking out the brush after finishing each surface. Brush lightly with the grain to obtain a smooth color. End grain should be brushed with water immediately before staining to prevent darkening. Touch up sap streaks to same color as

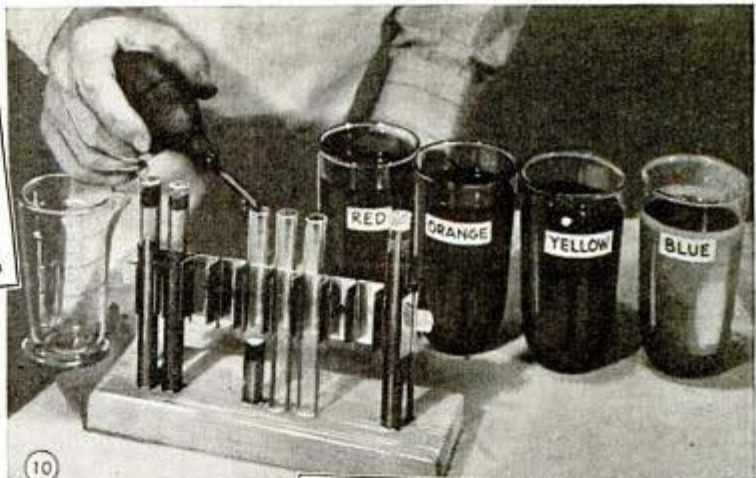
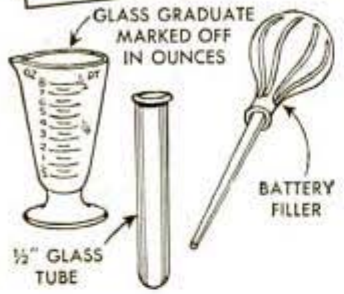
		⑧ TYPE OF STAIN				
		WATER STAIN	NON-GRAIN-RAISING STAIN	PENETRATING OIL STAIN	PIGMENT OIL STAIN	SPIRIT STAIN
CHARACTERISTICS OF STAIN	COLORING MATTER	Water-soluble aniline powder	Water-soluble aniline powder	Oil-soluble aniline powder	Pigment colors in oil	Alcohol-soluble aniline powder
	SOLVENT	Water	Carbitol or Cellosolve plus alcohol	Benzol, turpentine, etc.	Benzol, turpentine, naphtha	Denatured alcohol
	COST	Low	High	Medium	Medium	High
	APPLICATION	Brush or spray	① Best sprayed but can be brushed	Brush and wipe with cloth	Brush and wipe	Spray only
	GRAIN RAISING	② Bad	③ Very little	None	None	③ Very little
	CLARITY	Excellent	Excellent	Good	Fair	Good
	BLEEDING	None	None or very little	⑤ Bad	None	④ Bad
	PERMANENCE OF COLOR	Excellent	Excellent	Fair	Excellent	Poor
	EFFECT ON TOP COATS	None	Possible slight bleeding	⑤ Bleeds. Must be sealed with shellac	⑥ None	④ Bleeds
	MIXES WITH LACQUER	No	Yes	Yes	No	Yes
	MIXES WITH VARNISH	No	Yes	Yes	Yes	Yes
	DRYING TIME	12-18 hrs.	1-4 hrs.	⑦ 2-18 hrs.	⑦ 6-18 hrs.	1 hr.
PRINCIPAL USE	Staining quality hardwoods	Same as water stain. Also for refinishing	Staining softwoods	Softwoods. Also as a glaze coat or wiping stain	⑧ Patching and quick work	

**Notes Applying to Table Above:**

1. Some types, factory mixed in liquid form, dry very quickly and are difficult to brush smoothly.
2. The only fault of water stain — water solvent causes wood fibers to lift. Work must be resanded smooth when dry. The addition of up to 25% Carbitol or Cellosolve will help correct this fault.
3. Alcohol solvent absorbs moisture from air causing slight grain raising in muggy weather.
4. Refers to own-mix stain. Some factory-mixed stains of the alcohol series are strictly non-bleeding.
5. Seal with shellac when used under varnish. Do not use under lacquer.
6. Refers to factory-mixed product, made with specially treated oils to work under lacquer.
7. Use benzol as solvent for fast-drying. Retard drying with turpentine or turpentine substitute.
8. Non-grain-raising stains answer all requirements for a spirit stain and the colors are more permanent.

**9 BASIC COLOR RULES**

- Blue and yellow make green
- Blue and red make purple
- Yellow and red make orange
- Black and red make dark brown
- Green and red make brown
- Black, red and yellow make light brown
- Brown and yellow make light brown



**10 COLOR MIXING**

**11 STAIN COLORS BY LIQUID PARTS**

Color **	Yellow	Orange	Red	Dark * Blue	Black *
Sheraton Mahogany (Lt. Red)	—	12	5	3	—
Medium Red Mahogany	2	6	6	—	3
Red Mahogany	—	9	7	4	—
Dark Red Mahogany	2	6	7	—	4
Brown Mahogany	1	18	—	4	—
Light Walnut	—	12	1	—	4
Medium Walnut	—	14	1	—	6
Oriental Walnut	—	3	—	—	2
Light Oak	1	10	—	2	—
Dark Oak	2	10	—	5	—
Golden Oak	—	22	1	3	—
Honey Maple	4	11	—	2	—

heartwood before staining the entire surface. Stain should dry 12 hours. Then a wash coat consisting of shellac, 1 part and alcohol, 6 parts is applied and sanded smooth, after which the work is ready for filling if the wood is open grain, or for finishing if it is close grain. Non-grain-raising stain is handled the same as water stain except that preliminary sponging with warm water is unnecessary. This stain usually is sprayed. Penetrating oil stain is sprayed or brushed on. No particular care is needed in application. The color is spread uniformly by wiping with a cloth 10 to 15 min. after application.

\*\* Lighter tints of same color can be obtained by diluting with solvent.  
\* Add dark colors last.

For Mahogany or Walnut—Van Dyke Brown  
WIPING For Red-Orange Maple—Half and half raw  
STAINS Sienna and Burnt Umber  
For Brown Maple—Burnt Umber

**Color palettes for mixing stains** 12

Color	Water Stain and NGR Stain	Penetrating Oil Stain	Spirit Stain	Pigment ** Oil Stain
Red	Brilliant Scarlet ZR Azo Rubine	Oil Red Oil Scarlet	Fuchine Safranine Y	Alizarin Scarlet Crimson Lake
Yellow	Tartrazine Metanil Yellow	Oil Yellow	Auramine O	Alizarin Yellow Cadmium Yellow Golden Ochre
Blue	Acid Green B Pontacyl Brilliant Blue	Oil Blue Victoria Blue	Methylene Blue	Prussian Blue Cobalt Blue
Black	Nigrosine * (Use any deep blue, buffalo black) for NGR stains	Oil Black	Nigrosine	Mixture of Raw Umber and Ultramarine Blue
Brown	Walnut Crystals * Lautre Brown Sap Brown	Oil Brown	Bismarck Brown	Brown Ochre Raw and Burnt Umber Raw and Burnt Sienna
Orange	Orange A Grocetin Orange	Oil Orange	Chrysoidine	Alizarin Orange
Green	Naphthal Green	Oil Green	Malachite	Alizarin Green Transparent Green

\* For water stain only

\*\* Colors in oil—All others are powder stains



Immediate wiping of end grain will prevent darkening. Allow the stain to dry overnight, and then seal with shellac but do not use this stain under lacquer. Spirit stain dries almost instantly and must be sprayed. If necessary to brush it, add Cellosolve and shellac. It is best to spray the wash coat of shellac over stain as it must be applied deftly to prevent lifting the stain. Pigment oil stain is handled the same as penetrating oil stain. Also, it is used as a glazing or shading stain over the filler or between finishing coats. In either case, it is applied and wiped with cloth.

**Mixing stain colors:** While all standard colors are obtainable ready-mixed in powder form, the finisher may wish to mix his own color or modify the color of a commercial mixture. The table in Fig. 9 gives a few rules on color mixing that generally are useful, while Fig. 12 gives complete color palettes for all types of stain. The apparatus shown in Fig. 10 simplifies the job. Where two or more colors are given,

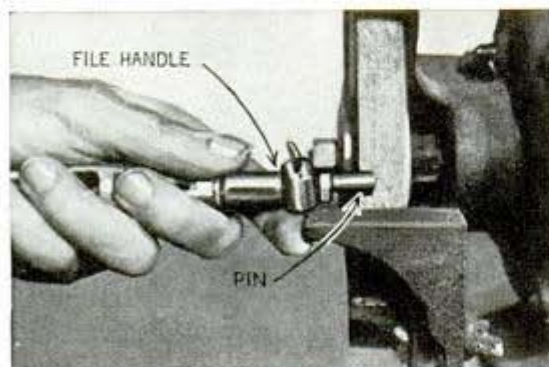


any one will be satisfactory. Fig. 11 shows how various standard wood colors are mixed, using liquid parts. As the exact color will depend on the original selection of basic colors, these formulas will not be exactly correct but will serve as a rough guide.

Mixing is done easily if a stock solution of each of the required colors is on hand. The unit or part for mixing can be any convenient measure, a drop for very small test runs, the cubic centimeter (c.c.) for accurate tests, and the liquid ounce for final measuring. Liquid stain is drawn by using a small syringe or rubber bulb battery filler. Wet pour-tests can be used as a preliminary in judging color, but the final selection should be made on the basis of a completely finished panel.

**Special applications:** Where it is necessary to stain over inlays, the wood, if light colored, should be protected with a coat of white shellac as in Fig. 7. The stain is brushed or sprayed right over the shellac, but will not "take" and is wiped off easily. An equally good method is to mask off the inlay with masking tape previous to staining. Tape or stencils can be used also for a two-tone effect, spraying stain lightly or not at all on the protected areas. Various highlighted and antique effects are obtained easily with wiping stain. The initial staining is done as usual with any type of stain. The wiping stain is applied over the sealer coat and is wiped to produce highlights as required. Similar work is done with shading stain. This is sprayed and is a somewhat different technique in that the wood is darkened in certain areas as desired by the finisher.

## File Handle Holds Pins Safely for Reshaping on Grinder

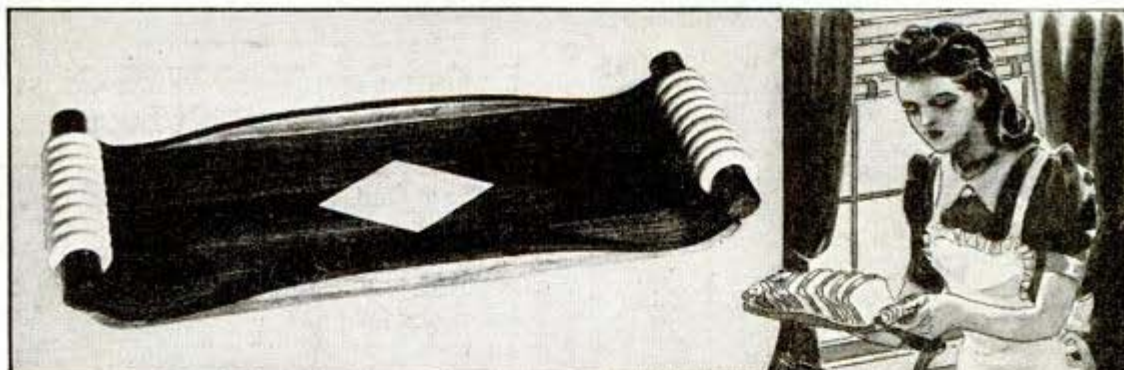


When it is necessary to dress down or reshape short pins, bolts, screws or other very short metal pieces on a grinding wheel, a cast-iron file handle having a thumbscrew attachment for holding the file tang is ideal for holding the work. A pin can be clamped in the holder in a second and is under perfect control at all times, while the fingers are safe.

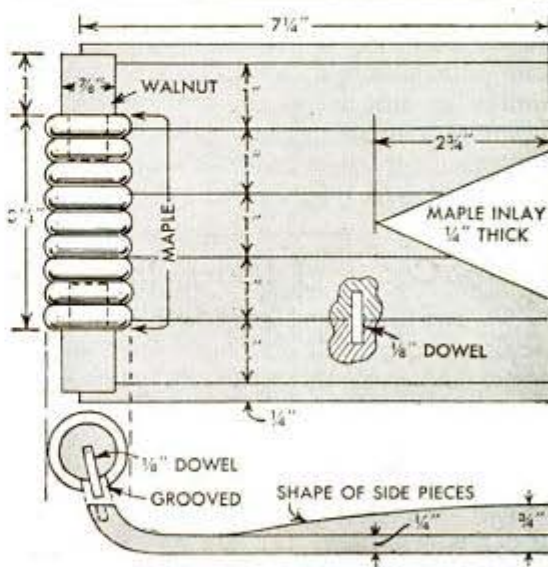
☐ If spinach is planted late in the fall, it will produce the first spring crop.



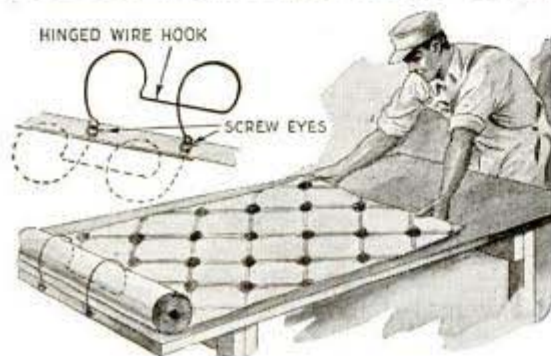
# Inlaid Bread Tray Combines Walnut and Maple



This smart tray is sure to bring pleasing comments from your guests. Five separate pieces, scroll-sawed from  $\frac{3}{4}$ -in. walnut to the shape shown and doweled together edge to edge, form the bottom of the tray. To make it, mark and saw carefully the inlay opening while the pieces are clamped together temporarily; then glue and clamp both inlay and strips together at one time. Before adding the tray sides, which curve from flush at the ends to  $\frac{3}{4}$  in. above at the center, sand the bottom smooth. The maple section of the handles in which the beads are formed is turned to  $1\frac{1}{4}$  in. in diameter, after which a  $\frac{5}{8}$ -in. hole is bored in each end to receive the tenons of the  $\frac{7}{8}$ -in. walnut plugs. By turning each pair of plugs from a  $4\frac{1}{2}$ -in. piece, after which the tenon is formed and cut apart, the lathe-center marks in the ends of the plugs can be used to remount the complete handle in the lathe for beading and trimming to length. The handles are attached to the tray with dowels after first grooving the maple section so it will fit over the curved end of the tray as shown in the side view. Note that the handles are not flush with the sides of the tray.



## Roll of Wall Paper Held on Paste Table by Pivoted Wire Hook



To keep a roll of wall paper in place on his paste table, one paper hanger uses a length of wire which is bent to form a double hook and pivoted to the end of the table with screw eyes. In use, the paper roll is placed under the hook and is unrolled by pulling on the end.

☛ A piece of crumpled Cellophane will make a cap hold its shape longer than tissue paper as it does not flatten easily.

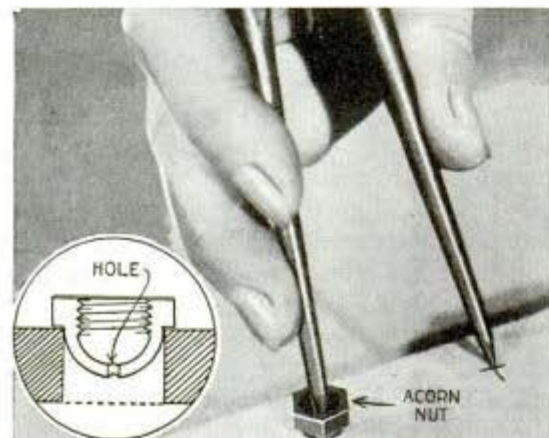
## Small Bell on Blind Man's Cane Helps to Summon Aid



Living in a large city where it was difficult to attract attention of people nearby to aid him in crossing street intersections, one blind man attached a bicycle warning bell to his cane as indicated. When he came to an intersection a ring of the bell usually attracted someone to aid him in crossing the street.—Charles J. Maier, Racine, Wis.

## Nut Centers Dividers in Hole

The next time you have to mark a circle or do spacing with dividers from the center of a hole, try this little trick of using an acorn nut as the center for the leg of the dividers. Drill a small hole in the closed end of the nut in which the divider can be placed. Then, using this as a pivot point



you can strike the desired arc easily. If much of this work-is done, it's a good idea to have acorn nuts of various sizes on hand.

## Burlap Bag Filled With Grass Locates Lost Fish Lures

To locate his expensive fishing lures that may be lost on the bottom of a lake or stream, one fisherman uses a small burlap bag filled with grass or leaves. This is pulled along the bottom of the stream at the ap-



proximate position of the lost lure, the hooks of which will stick into the sack. A stone is placed in the sack to make it sink.

## Emergency Pestle for Chemicals From Pencil and Thumbtack

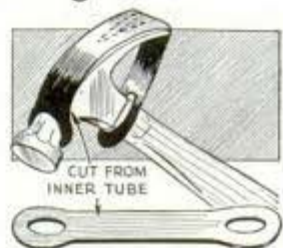


If there isn't a pestle at hand for crushing small amounts of chemicals, a pencil and thumbtack can be used in an emergency. The thumbtack is merely forced into the eraser of the pencil to provide a

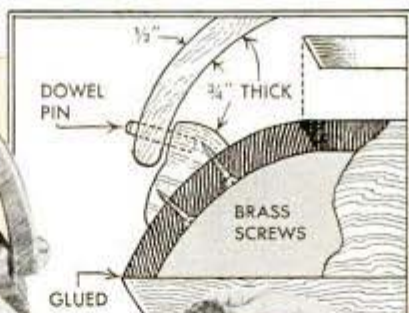
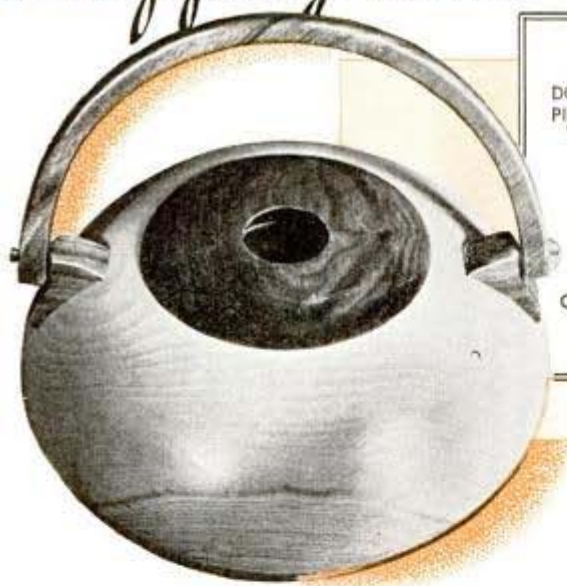
good end for crushing the chemicals when the pencil is pressed against them.

## Rubber-Sheathed Hammer Head Avoids Marring Work

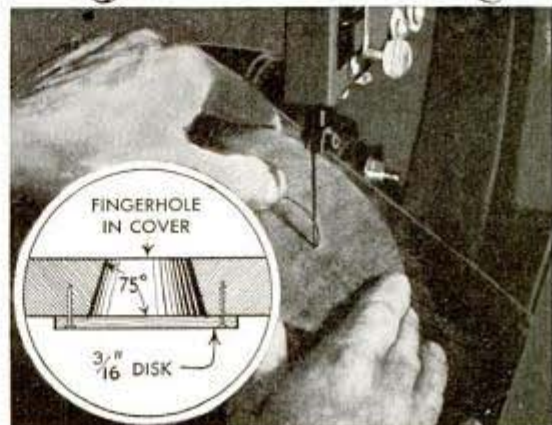
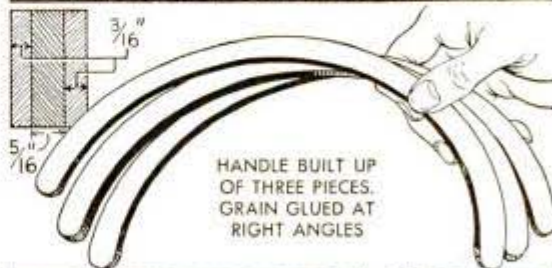
One cabinet maker uses a piece of inner tube, which he stretches over his hammer head as shown to help prevent accidentally marring finished work. This idea is especially handy when working in close places where it is almost impossible to avoid the claw end of the hammer striking the work.



# Chopping-bowl COOKIE JAR



**T**WO maple chopping bowls are used to make this novel cookie jar. About all you have to do is to replace the bottom of one with a cover, and add a handle. Scroll-sawing out the bottom is done with the table tilted 10 degrees to seat a walnut disk which you bevel at the same angle. A good way to cut down the edges of the bowls evenly so that a tight-fitting joint will be had when both are placed together, is to fasten several sheets of sandpaper side by side, to a flat bench top upon which you can rub each bowl back and forth until perfectly flat. Try to sand down each one the same amount so that the two will match flush. In gluing the bowls together, warping can be checked if you place them with the grain at right angles to each other. Watch to see that they do not shift and then weight them with a heavy object until dry. The handle, which can be built up of three separate pieces of solid walnut stock or simply cut from a piece of  $\frac{3}{4}$ -in. plywood, is attached to ears of maple which you fasten with screws from the inside. Apply paste wood filler to the walnut parts, let flatten and wipe off across grain. After 24 hrs. give the complete jar two coats of shellac followed by two of wax or varnish. Leave the inside surface of the bowls bare.



Large turnings made from solid stock will be more likely to retain their original shape if they are seasoned a few days after rough-turning to approximate shape.

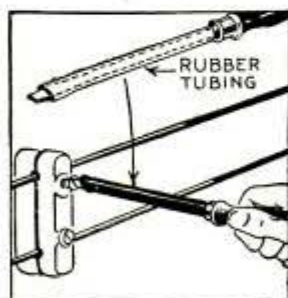
## Damaged Tape Measure Repaired By Flowing Solder on Crack



Steel tape measures that have been cracked at the end can be repaired easily by flowing a little solder over the crack. This does not affect the operation of the flexible tape and will make it as serviceable as a new one. Tape cases that are made in two parts will also last much longer if the joint is soldered together.

—Vernon Peterson, Bremerton, Wash.

## Screwdriver Shielded to Avoid Electrical Shocks



Slipped over the blade of a screwdriver, a length of small rubber tubing provides a shield that helps prevent accidental electric shocks when working around "hot" wires. Such a screwdriver is used by an electrician in Phoenix, Ariz., when he must work in places where there is a possibility of inadvertently touching the wires.

## Further Use for Worn Auger And Dowel Bits

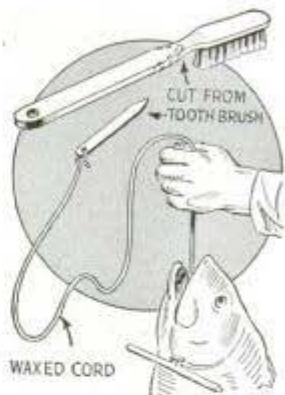
When auger and dowel bits used in a brace become unsuited for use, the square tang on the end can be cut off with a hacksaw, leaving a straight shank that will fit

into a drill-press chuck. Under speed, the bit will cut clean holes in the wood. In a drill press, the spur center cannot be used to feed the bit into the wood. A pilot hole, about the size of the diameter of the spur is drilled first and the auger bit fed by hand pressure as in metal drilling.

## Improving Your Fish Stringer

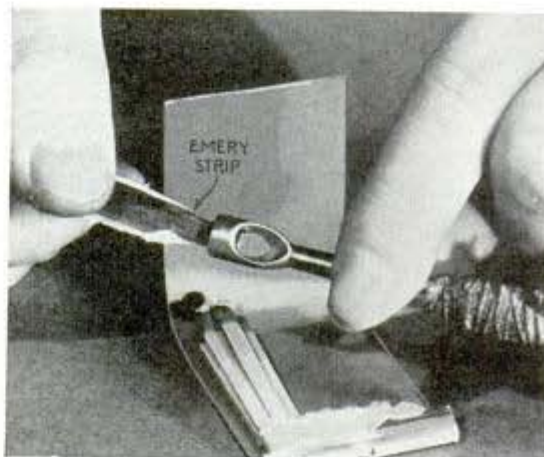
Instead of using a piece of wire or wood on your fish stringer, get an old toothbrush handle and use it for the purpose. Just cut off the bristle portion of the brush and point one end of the handle. Usually the other end is already drilled so that the stringer can be tied to it. This makes a strong, serviceable point for the end of the stringer.

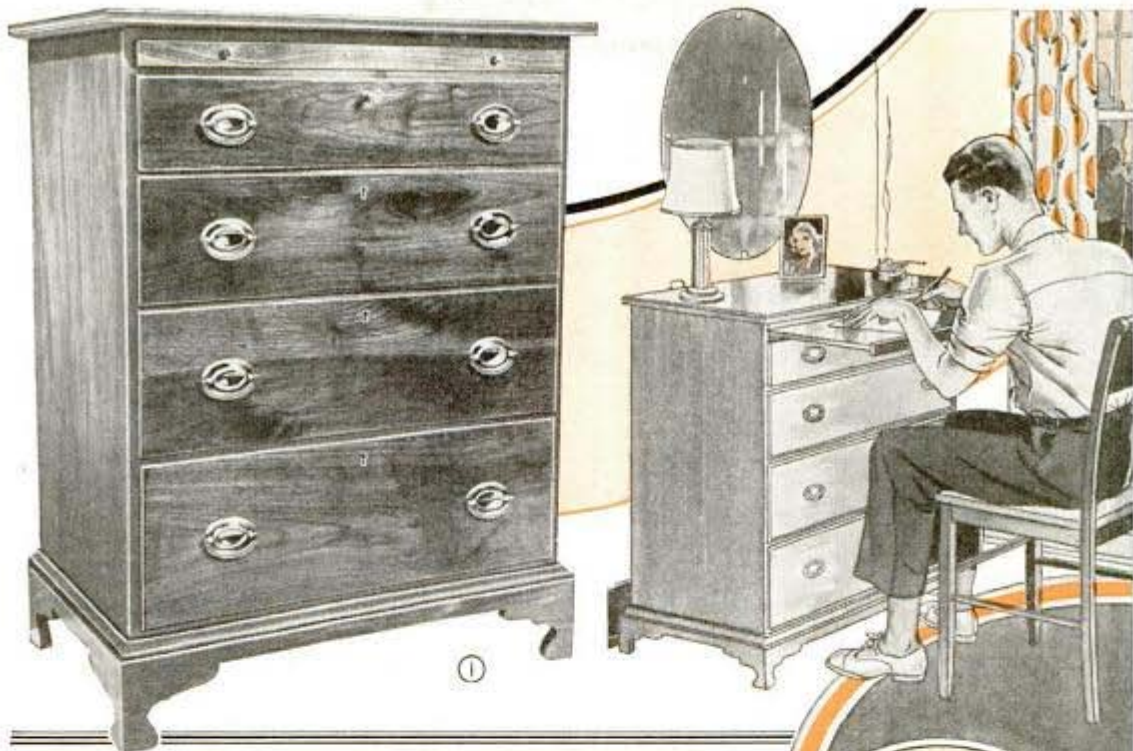
—Everett Hanson, Argyle, Wis.



## Emery Paper From Match Book Smooths Fishing-Rod Tip

If your fishing rod has a metal tip or guides that have become roughened to such a point that they might wear the line, you can smooth them easily with a strip of emery paper torn from the end of a match box. Roll the strip into a cone and insert it in the tip or guide with a twisting motion, repeating this procedure until the metal is smooth. The strip will also serve to clean the ferrules of a jointed rod, if they become corroded.





## BACHELOR CHEST

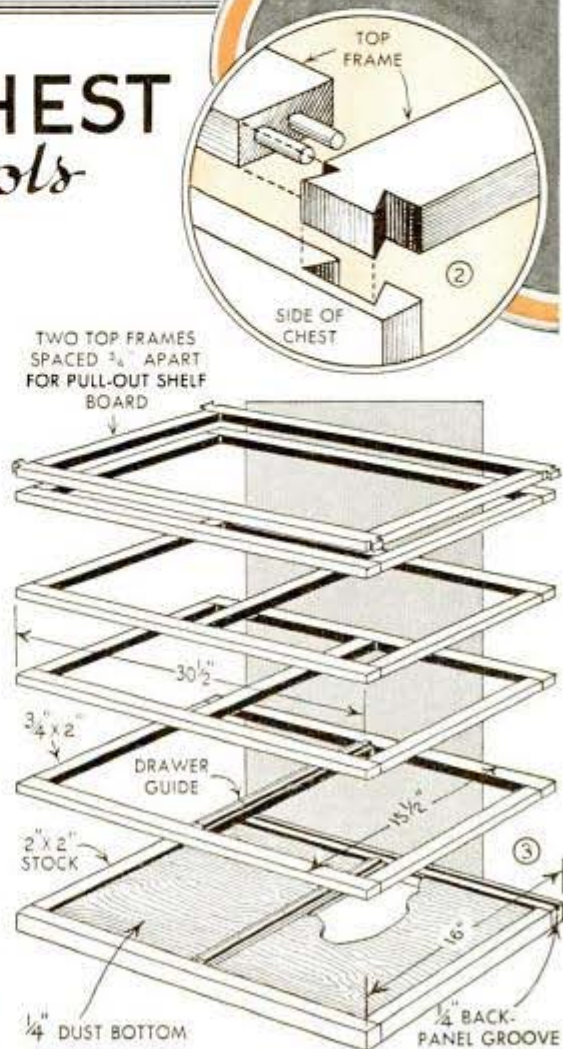
*built with hand tools*

Low, four-drawer chest of Colonial design has a pull-out leaf under the top to provide a handy place for writing

By W. W. Buffmire

**I**DEAL for the man who does occasional writing, but whose room will not accommodate both a chest and a desk, the attractive chest shown in Fig. 1 combines both. If the chest appeals without the desk feature, the pull-out shelf can be omitted and the overall height increased to a full-size chest.

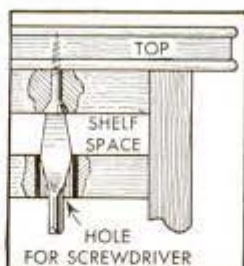
For economy, rip the front rails of the six drawer frames of finished stock and the inner members of less expensive material such as birch or gum. From Fig. 3 you will see that the bottom frame differs from the others by being of thicker stock, wider and fitted with a dust panel. Dovetails formed on the ends of the top frame to engage similar cuts in the chest sides as in Fig. 2, lock the assembly together at the top. At the base, the sides are fastened even with the bottom edge of the lower frame, using screws and glue, the screw





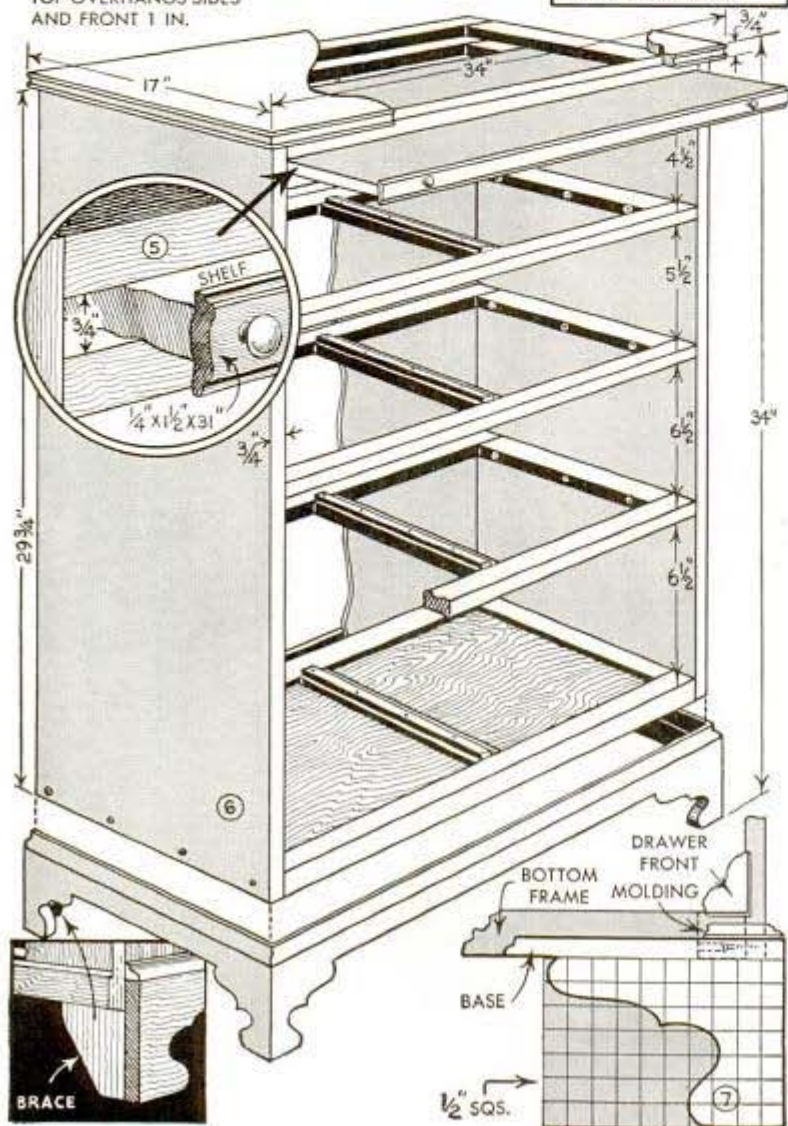
TOP OVERHANGS SIDES AND FRONT 1 IN.

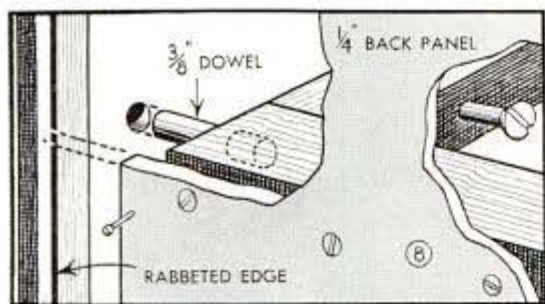
heads being concealed later by the base and its molding. All the frames, with the exception of the two top ones, include a center crossrail to which a narrow strip is nailed to register with a grooved one fastened to the underside of the drawer bottom. If you prefer, a rabbet can be cut along the rear edge of the lower frame instead of a groove as indicated. Keep the dust panel close to the top of the frame so it will not interfere in attaching the base with screws, which are driven from the inside. The screw holes



should be drilled before the frame is assembled. Use two  $\frac{1}{4}$ -in. dowels at each joint, glue and clamp flat.

As the sides of the chest are 16 in. wide, you will have to build these up in width from three or four separate pieces. Take care in planing the abutting edges straight and true and in locating the dowel holes in the edges to bring the surfaces flush. The use of dowels will assure sound construction, but a glued butt joint will be satisfactory provided the edges have been jointed properly. Fig. 6 gives the spacing of the frames. All the frames are fastened to one side of the chest first, and then to the other side. Notice from Fig. 8 that short dowels and screws are used in addition to glue to hold the frames, three screws being driven through each end from the inside as shown in Fig. 9. Before fastening the two top frames to the sides, be sure to provide holes in the top frame for the screws that hold the top in place; also bore holes in the second frame to permit insertion of a screwdriver to reach the screws. This is shown in the detail to the right of Fig. 4. Leave about a  $\frac{7}{8}$ -in. space between the top

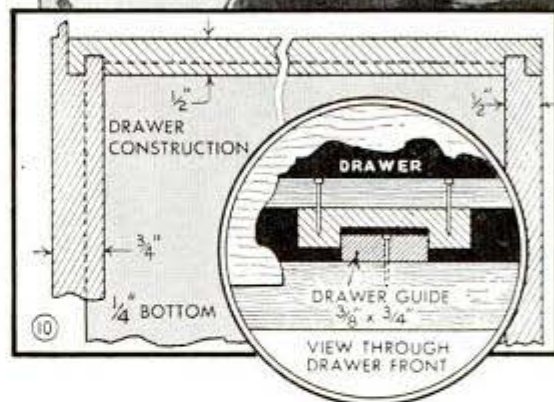




frames to allow ample clearance for the finish and for thumbtacks, which are pressed in place at each end to make the shelf slide easier. Cut the back plywood panel squarely so that when it is fitted snugly in the rabbets and screwed to each frame, it will automatically square up the assembly.

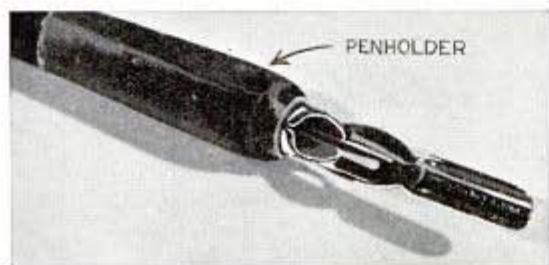
The base pieces, which are mitered to overlap the sides and front of the chest, are scrollsawed at the ends according to the pattern given in Fig. 7. The chest is set down inside the base  $\frac{3}{4}$  in., and is attached with screws from the inside through holes provided for them in the lower frame. At the back the cross grain of the leg is reinforced with a brace as indicated in the detail to the left of Fig. 7, while each front leg is fitted with a triangular corner block. Complete the base by attaching the molding to it with small finishing nails, setting the heads below the surface and filling with plastic wood.

Drawer fronts are rabbeted as shown in Fig. 10 to overlap the openings  $\frac{1}{4}$  in. If you feel capable of cutting a dovetail drawer joint, this may be used instead of rabbets as in Fig. 4. As in the case of the frames, only choice stock is used for the fronts. With this type of drawer, ample clearance can be allowed to prevent binding as the extra-loose fit of the drawer will not be seen. The bottom, which is set in grooves run in the front and sides, is left long enough to extend under the drawer back. The writing shelf is built up like a drawing



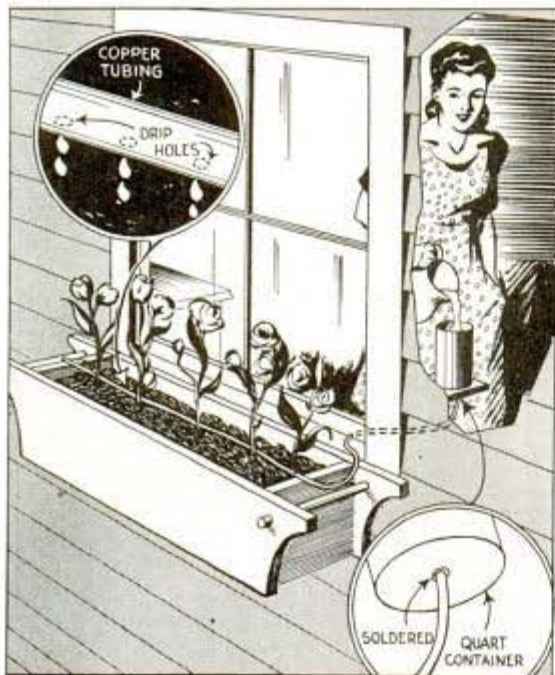
board, that is, with strips doweled across the ends to check warping. Saw kerfs cut lengthwise on the underside of the shelf about 1 in. apart and  $\frac{3}{8}$  in. deep, before the end strips are added, also will help keep it from warping. The facing strip along the front edge of the shelf is cut to overlap the opening about  $\frac{1}{4}$  in. all around as shown in Fig. 5, after which a small brass knob is fitted at each end. Metal drawer pulls of the type shown on the original chest are standard and can be obtained in either antique finish or polished brass.

## Reversing the Pen Point in Its Holder May Avoid a Serious Accident



If you are in the habit of leaving a writing pen on a desk or table top where a small child is apt to get hold of it, a serious accident may be avoided by taking the time to reverse the point in the holder when you finish using it. When placed in the holder in this position, few small children are able to remove the point and yet it is always at hand when needed.

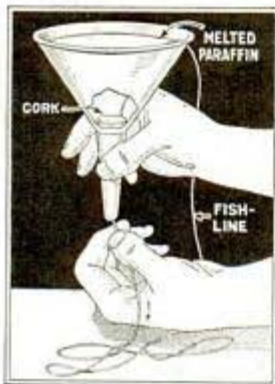
## Flowers Under a Sealed Window Watered From Inside Building



Desiring to put a window box in front of a sealed window on the second floor, one home owner overcame the problem of watering the flowers in the box by the method shown. A length of copper tubing was passed through a hole drilled in the window sash and then run across the top of the flower box, several small holes being drilled in this portion of the tubing. A quart container was soldered to the other end of the tubing inside the window. Water poured into the container inside the house passed through the tube and was distributed over the soil in the flower box.

—John E. Mason, Hamilton, Ont., Can.

## Long Fishline Waxed Quickly With Cork and Funnel



A small funnel with a cork in the neck as indicated will save you a lot of time when waxing and waterproofing a fishline. Start the line through the funnel, insert the cork and fill the funnel with melted wax or waterproofing

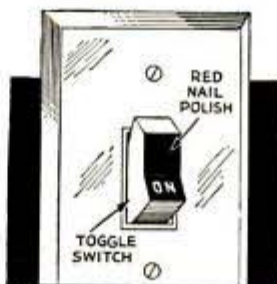
liquid. Then pull the line through the funnel. The cork retains the wax and also serves as a wringer to remove surplus wax from the line.

## Empty Shell Helps Scour Rust Off Shotgun Barrel

When removing rust from the outside surfaces of his shotgun and rifle barrels, one sportsman uses an empty shotgun shell to help speed up the job. The end of the shell is moistened with oil and then dipped into the abrasive and used as a scouring pad.



## Nail Polish Attracts Attention When Light Switch Is On



If you sometimes forget to turn off a light in your basement or other place where the light is not seen from the switch that controls it, paint the toggle of the

switch with red nail polish so that it shows only when the switch is in the "on" position.

## Water Colors Pulverized Easily In Onion Chopper

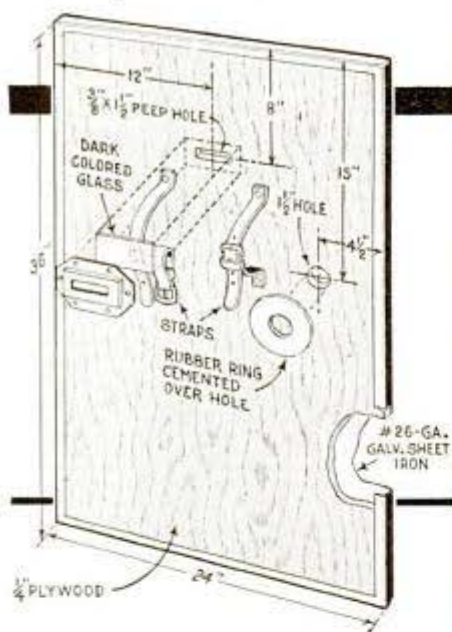
Hardened water colors can be pulverized quickly with the cutter of an ordinary onion chopper. All you need to do is remove it from the regular container and place it over any water-color jar, using the up-and-down spring motion to cut the hardened contents.



If water colors in small jars need such treatment, the chopper cutters can be either bent as indicated or ground down to suitable size.



# Body Shield Aids in the Control of Fire Bombs



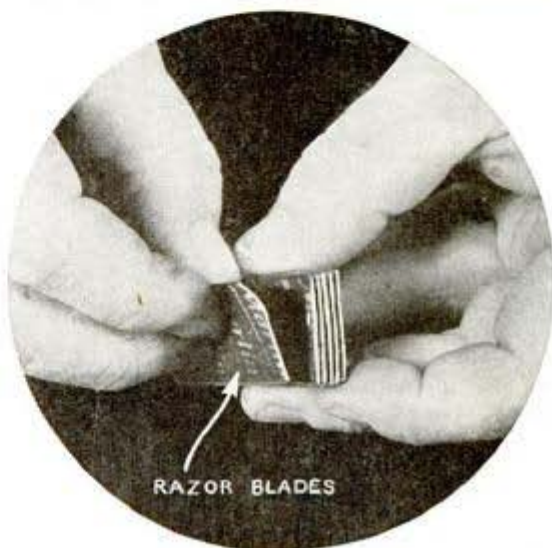
Developed by the fire department of a U. S. Marine Corps Base, this shield helps to provide safety in the control of incendiary bombs. Weighing less than 5 lbs., the shield is worn on the arm much like an ancient warrior's shield. A rubber-covered opening is provided near the right-hand side for the nozzle of a hose or fire extinguisher, and a peep hole is located near the top on the centerline of the shield, the hole being covered with dark-colored glass to permit looking at a burning bomb. Two leather or web straps attached to the shield beside the nozzle

opening are buckled over the left forearm to simplify handling it, and to leave both hands free for operating a suction pump if necessary. The shield is made from a piece of 1/4 or 3/8-in. plywood faced with 26-ga. galvanized sheet iron. The iron is bent around the edges of the plywood to extend about an inch on the back of the shield where it is tacked to hold it in place. A shield 24 in. wide and 36 in. long will afford protection for the entire body as close as 15 ft. to a burning bomb if the user crouches on one knee in the position shown in the photo.

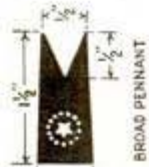
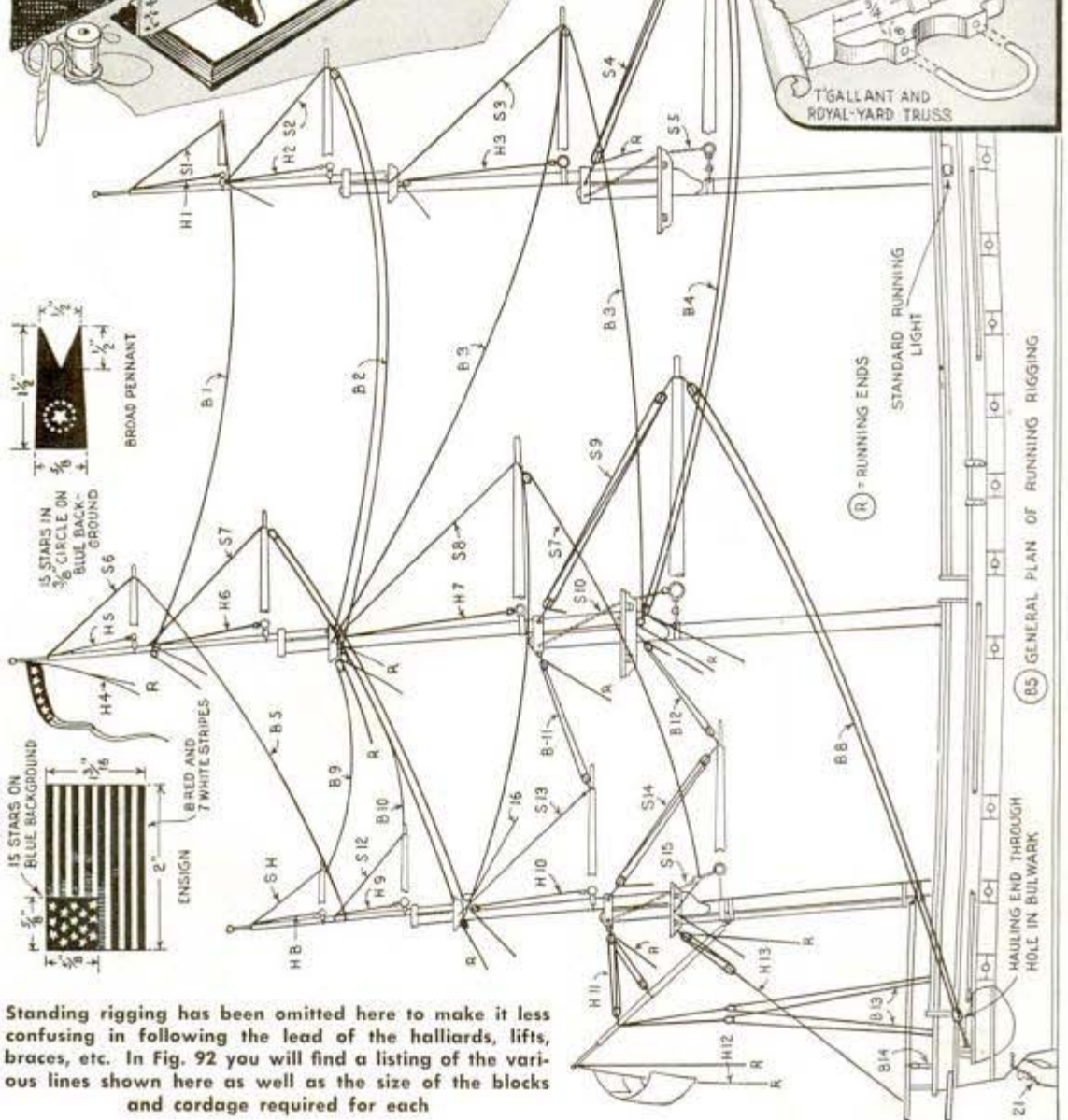
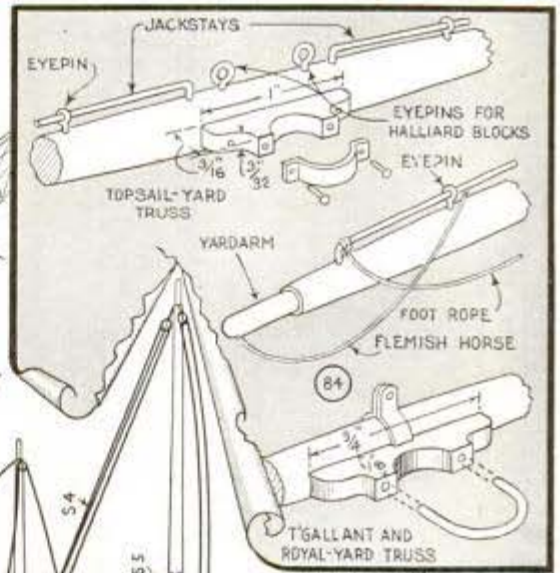
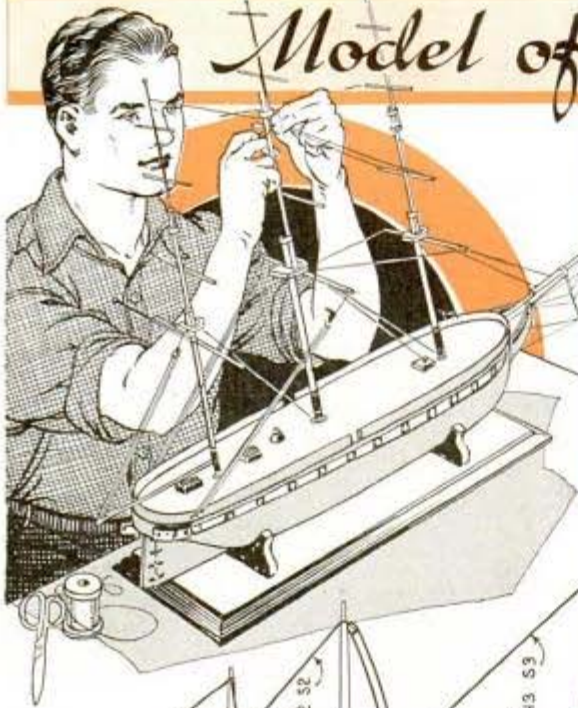
## Razor Blades Kept From Rusting by Dipping in Paraffin

New razor blades can be prevented from rusting by tying them into small bundles and then dipping these into melted paraffin. When the paraffin has cooled, the string is cut and removed, as each bundle forms a solid pack from which one blade at a time may be peeled off as needed. Such treatment is especially handy for campers who keep blades for a long period of time or others who use them in a damp climate, or near salt water.—C. E. Packer, Chicago.

☞ You cannot grow delphiniums successfully in soggy soil. If the plants are in soil of this type, cover the crowns with wood ashes before the ground freezes. If you cannot obtain wood ashes, use coal ashes.



# Model of U.S. Frigate



BROAD PENNANT

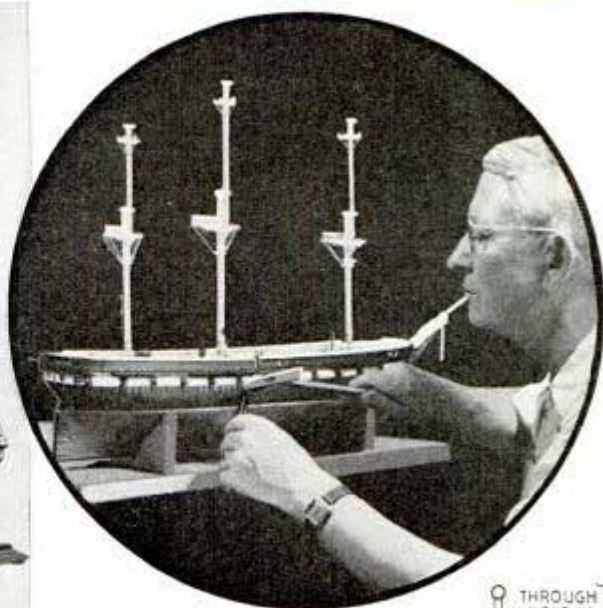
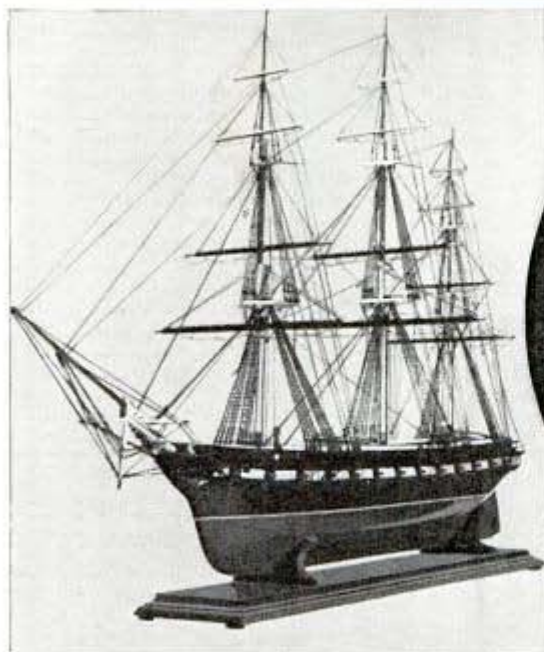
15 STARS IN  
BLUE CIRCLE ON  
BLUE BACK-  
GROUND



ENSIGN  
7 RED AND  
7 WHITE STRIPES

Standing rigging has been omitted here to make it less confusing in following the lead of the halliards, lifts, braces, etc. In Fig. 92 you will find a listing of the various lines shown here as well as the size of the blocks and cordage required for each

# "CONSTELLATION"



By H. W. Potter

## Part V—Running Rigging

WITH the standing rigging in place, all that remains to complete your model of "Constellation" is to set up the running rigging. Before the yards can be shipped to their respective masts, yard fittings such as trusses, jackstays, foot ropes, etc., must be added. The type of truss shown for supporting the lower yards in Part III, Fig. 57, can be purchased, but those used on the topsail, topgallant and royal yards must be made as detailed in Fig. 84. Jackstays on the top of the yards, to which the sails are attached, are of No. 24-gauge iron wire on the lower yards and decrease in size aloft in proportion to the size of the upper yards. The footropes on which the men stood to take in and stow the sail, are fitted on the aft side of all yards, and consist of fine enameled magnet wire with the stirrups twisted to them. A short rope, called a "Flemish horse," is provided at the outer ends of the lower and topsail yards for the sailor who had to sit astride the yardarm.

Now to begin the running rigging. Like the standing rigging, the size of cordage and the number of blocks required for each respective line can be found quickly by referring to the table given in Fig. 92. This

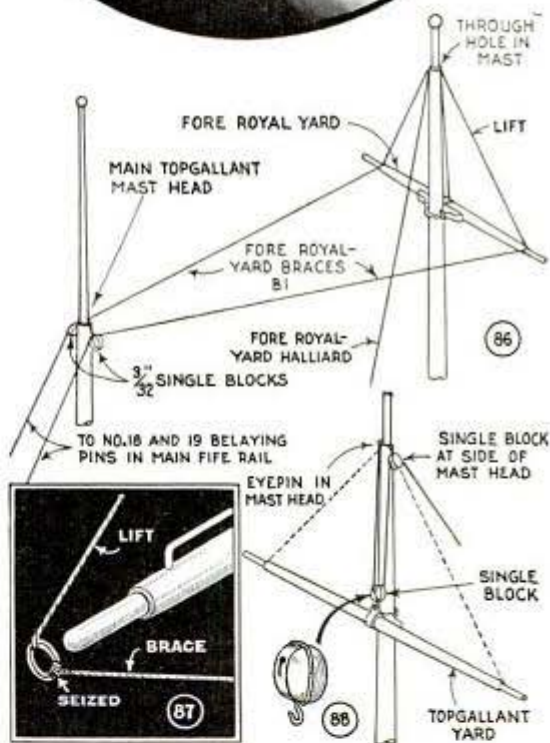
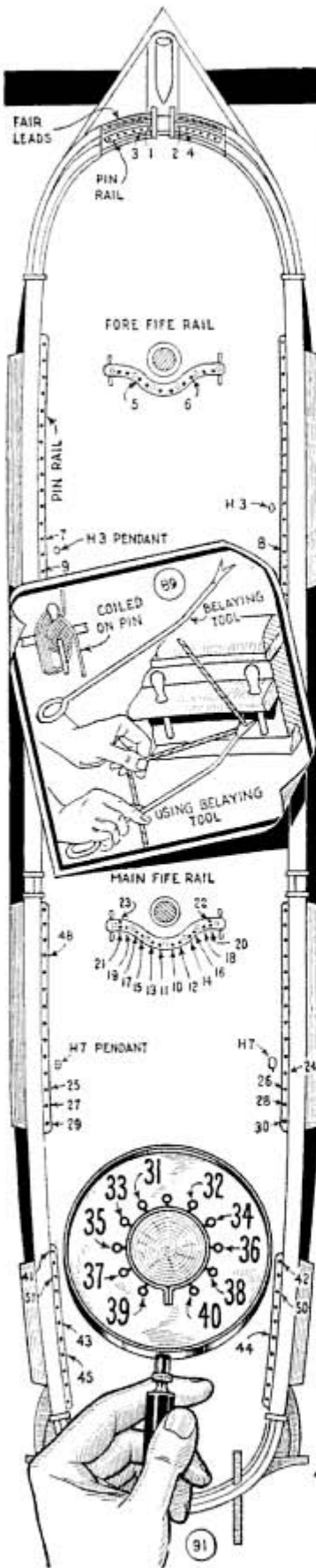


table is used in conjunction with Fig. 85, which shows each line correspondingly lettered and numbered; letters S, B and H standing for lifts, braces and halliards respectively. As the running rigging is tan, with the exception of the slings which are black, it will be necessary to dye the cord as near the color of rope as you can. Use an aniline dye dissolved in alcohol. Also, don't forget to draw each cord through a

### BELAYING-PIN KEY

1 Fore royal stay (Port).....	1	26 Mizzen topgallant-yard brace.....	B10
2 Fore flying jibstay (Starboard).....	2	27 Mizzen royal-yard brace.....	B9
3 Fore topgallant stay (Port).....	3	28 Mizzen royal-yard brace.....	B9
4 Fore outer jibstay (Starboard).....	4	29 Main topgallant-yard halliard.....	H6
5 Fore lower-yard lifts.....	S4	30 Main royal halliard.....	H5
6 Fore lower-yard lifts.....	S4	31 Mizzen lower-yard lifts.....	S14
7 Fore topsail-yard halliard.....	H3	32 Mizzen lower-yard lifts.....	S14
8 Fore topgallant-yard halliard.....	H2	33 Main topsail-yard brace.....	B7
9 Fore royal-yard halliard.....	H1	34 Main topsail-yard brace.....	B7
10 Main lower-yard lifts.....	S9	35 Main topgallant-yard brace.....	B6
11 Main lower-yard lifts.....	S9	36 Main topgallant-yard brace.....	B6
12 Fore lower-yard braces.....	B4	37 Main royal-yard brace.....	B5
13 Fore lower-yard braces.....	B4	38 Main royal-yard brace.....	B5
14 Fore topsail-yard braces.....	B3	39 Spanker-boom topping lift.....	H13
15 Fore topsail-yard braces.....	B3	40 Spanker-boom topping lift.....	H13
16 Fore topgallant-yard braces.....	B2	41 Spanker-gaff throat halliard.....	H14
17 Fore topgallant-yard braces.....	B2	42 Spanker-gaff peak halliard.....	H11
18 Fore royal brace.....	B1	43 Mizzen topsail halliard.....	H10
19 Fore royal brace.....	B1	44 Mizzen topgallant halliard.....	H9
20 Mizzen topsail-yard braces.....	B11	45 Mizzen royal halliard.....	H8
21 Mizzen topsail-yard braces.....	B11	46 Main lower-yard brace.....	B8
22 Mizzen lower-yard braces.....	B12	47 Main lower-yard brace.....	B8
23 Mizzen lower-yard braces.....	B12	48 Main pennant halliards.....	H4
24 Main topsail-yard halliard.....	H7	49 Spanker-gaff ensign halliards.....	H12
25 Mizzen topgallant-yard brace.....	B10	50 Spanker-gaff vang.....	B13



cake of paraffin or beeswax the same as you did for the standing rigging. As was true of the yard jackstays, the rigging cordage used aloft also should gradually decrease in size to keep it in proportion to the reduced size of the masts and yards.

Commencing aloft, sling the royal yards first, starting at the foremast and working aft. Referring to the table in Fig. 92, you'll find that the fore royal-yard halliard (H-1) is of .014 cordage which is the approximate diameter of No. 80 linen thread. The halliard is seized to the eye in the center of the yard, threaded through the hole in the masthead and left to hang free for the time being, after which the wire staple, or yard parrel, is inserted in the truss to hold the yard to the mast at a point approximately midway above the cap.

If the staple does not fit tightly enough to prevent the yard from being hauled aloft by the halliard when the latter is set up taut, a small pin can be pressed into the mast directly above the yard. Next, the yards are supported laterally by slings, which run from the port yardarm, up around the masthead and down to the starboard yardarm. Note from the table that No. 100 linen cordage is used for this. The slings on the topsail, topgallant and royal yards of all masts are formed from a single length of cord. Fig. 87 shows how the cord may be attached to the yardarms, the braces being seized as indicated, or simply fastened to the yard with a slip knot and coated with glue. The turns around the masthead should be adjusted to level the yard laterally with the deck and make the slings taut before finally applying a drop of glue to the turns. Royal halliards are rigged as shown in Fig. 90, the fore and mizzen ones being set up to deck eyes near the port pinrails and the main one to starboard. This is shown clearly in Fig. 94.

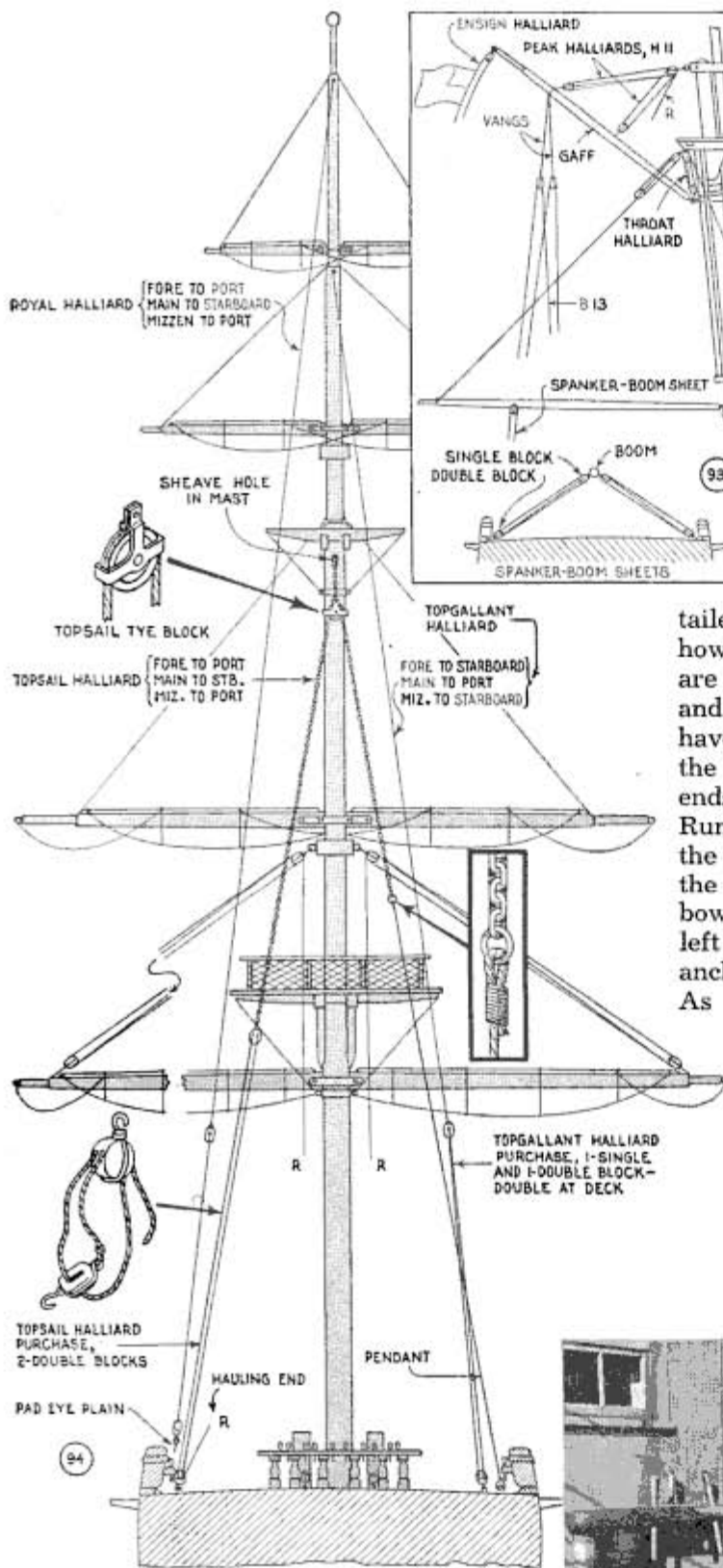
To determine the belaying point of the halliards as well

as all other running ends of the rigging, refer to the belaying-pin key shown above Fig. 90. For example, (H-1), which is the fore royal-yard halliard, is listed belayed to No. 9. Referring to Fig. 91, you'll see that position No. 9 is at the port pinrail. Thus it is a simple matter to determine exactly where the running or "hauling" end of each line is belayed. When belaying, coil the line on the belaying pin in a figure-of-eight as shown in Fig. 89. A tool such as the one shown, and used as indicated, will be found exceedingly handy for winding the line around the pin, especially in close quarters. A drop of glue applied to the pin will keep the cord in place. Belaying pins can be purchased from any ship-model supply house for a few cents a dozen. The lead of the royal braces is shown in Fig. 85, the fore royals running aft from the yardarms through blocks stropped to each side of the main topgallant masthead as in Fig. 86, and on to their proper belaying point in the main fife rail. When you have all royal braces in place, the topgallant yards may be slung to their respective masts in the manner given in Fig. 88. Notice in Fig. 85 that these yards are mounted slightly above the topmast cap, with the fore and mizzen halliards running to starboard and the main halliard to port. Alternating the halliard leads in this way distributes strain evenly on the hull. The halliard lead to the deck should follow closely the lead of the backstays. The manner of rigging the braces differs from that of the royals in that they are reeved through single blocks seized to the yardarms.

Fig. 94 shows how the fore topsail halliard looks from the aft side, the main and mizzen being rigged the same. Here chain and cord are combined. The sling, also of chain, is attached to the tye block, passed through a sheave hole in the mast and finally shackled to the yard truss. As indicated, one end of the halliard chain is fastened to a length of cord and seized to a port deck pendant; the other end is rigged with a luff tackle, which is set up to a starboard pendant and the hauling end belayed



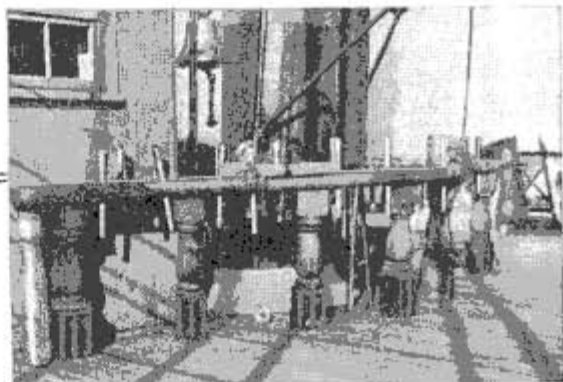
SLINGS AND LIFTS					
NO.	NAME	GORGE	NO.	PARTS	
S 1	FORE ROYAL-YARD SLINGS	100 LINEN			
S 2	" T'GALLANT "	1018.15.10.14			
S 3	" TOPSAIL "	.017			
S 4	" LOWER " LIFTS	.014	2	5/32 DOUBLE BLOCKS	PENDANT .017
S 5	" " " SLING		6W.	22-LINK CHAIN, BLACK	
S 6	MAIN ROYAL " SLINGS	100 LINEN			
S 7	" T'GALLANT "	1018.15.10.14			
S 8	" TOPSAIL "	.017			
S 9	" LOWER " LIFTS	.014	2	5/32 DOUBLE BLOCKS	PENDANTS .017
S 10	" " " SLING		6W.	22-LINK CHAIN, BLACK	
S 11	MIZZEN ROYAL " SLINGS	100 LINEN			
S 12	" T'GALLANT "	1018.15.10.14			
S 13	" TOPSAIL "	.014			
S 14	" LOWER " LIFTS		2	1/2 DOUBLE BLOCKS	1/8 SINGLE "
S 15	" " " SLING		6IN.	22-LINK CHAIN, BLACK	
HALLIARDS					
H 1	FORE ROYAL-YARD HALLIARD	.014	2	3/32 SINGLE BLOCKS	
H 2	" T'GALLANT "	.017	2	1-1/8 SINGLE BLOCK	1-1/8 DOUBLE " TACKLE, .014 CORD
H 3	" TOPSAIL "			6" 22-LINK CHAIN, 2-1/2 DOUBLE BLOCKS	10" 30 " "(TYE) TACKLE, .014 PEN. .022
H 4	BROAD PENNANT "	100 LINEN			
H 5	MAIN ROYAL "	.014	2	3/32 SINGLE BLOCKS	
H 6	" T'GALLANT "	.017	1	1/8 SINGLE BLOCK	1/8 DOUBLE " TACKLE .014 CORD
H 7	" TOPSAIL "			6" 22-LINK CHAIN, 2-1/2 DOUBLE BLOCKS	10" 30 " "(TYE) TACKLE, .014 PEN. .022
H 8	MIZZEN ROYAL "	.014	2	3/32 SINGLE BLOCKS	
H 9	" TOPGALLANT "	.014	1	3/32 SINGLE BLOCK	3/32 DOUBLE " TACKLE .70 LINEN
H 10	" TOPSAIL YARD "			6" 22-LINK CHAIN, 2-1/2 DOUBLE BLOCKS	9" 30 " "(TYE) TACKLE, .014 PEN. .022
H 11	SPANKER-GAFF PEAK "	.017	2	1/8 SINGLE BLOCKS	1/8 TRIPLE BLOCK
H 12	" " ENSIGN "	100 LINEN	1	1/16 SINGLE BLOCK	
H 13	" BOOM TOPPING LIFTS	.014	2	1/8 SINGLE BLOCKS	1/8 DOUBLE " PENDANTS .022
H 14	" GAFF THROAT HALLIARD	.014	1	1/8 SINGLE BLOCK	1/8 DOUBLE "
H 15	BOAT FALLS	.014	2	3/32 DOUBLE BLOCKS	
H 16	CAT "	.022	2	3/16 TRIPLE "	
BRACES					
B 1	FORE ROYAL-YARD BRACES	100 LINEN	2	3/32 SINGLE BLOCKS	
B 2	" T'GALLANT "	80 LINEN	4	3/32 " "	
B 3	" TOPSAIL "	30 " "	4	1/8 " "	
B 4	" LOWER "	.014	4	5/32 " "	
B 5	MAIN ROYAL "	100 LINEN	2	3/32 " "	
B 6	" T'GALLANT "	.70 " "	4	3/32 " "	1-1/2 DOUBLE
B 7	" TOPSAIL "	.014	4	1/8 " "	1-1/2 " "
B 8	" LOWER "	.017	6	3/32 " "	
B 9	MIZZEN ROYAL "	100 LINEN	2	3/32 " "	
B 10	" T'GALLANT "	.100 " "	2	3/32 " "	
B 11	" TOPSAIL "	.70 " "	2	1/8 " "	1-1/2 DOUBLE
B 12	" LOWER "	.014	2-2	1/8 SINGLE 1/8 DOUBLE	
B 13	SPANKER-GAFF VANGS	.014	2	3/32 SINGLE BLOCKS	
B 14	" BOOM SHEETS	.014	2	1/8 DOUBLE "	1/8 SINGLE "



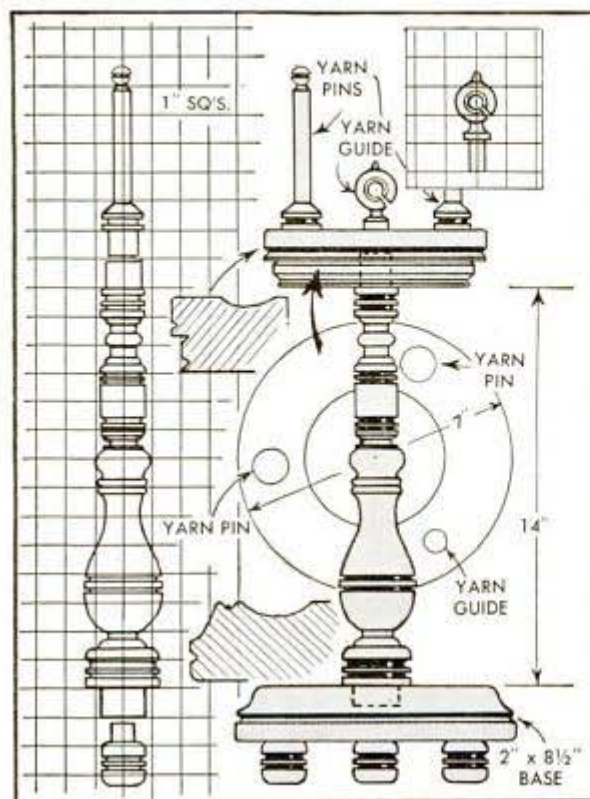
This aft view of the foremast, looking forward, is typical of how the halliards and lifts of all yards on each mast should be rigged. Note that the lower yard has no halliard, and that only the lower and topsail yards are fitted with a "Flemish horse" at the yardarms

to its pinrail. Braces are run the same as the top-gallant ones. The lower yards do not have halliards. Instead, chain slings are used between the yard truss and eyes provided in the mast-head. Lifts supporting the yard, are reeved in the manner shown in Figs. 90 and 94. The lead of all lower-yard braces can be followed easily by studying the general rigging plan which is given in Fig. 85.

This leaves the rigging of the spanker boom and gaff, which is detailed in Fig. 93. Note carefully how the peak and throat halliards are reeved. By consulting Fig. 92 and the belaying key you should have no difficulty in determining the lead of the various running ends, and the size blocks to use. Running ends of the cat falls at the cat heads are carried through the bulwark and belayed to the bow pinrail. The blocks may be left hanging free, or hooked to the anchors to indicate their purpose. As "Constellation" has been recommissioned for administrative purposes, the 48-star ensign can be used instead of the 15-star flag of her early history. Likewise, the long commission pennant can be flown from the main truck in place of the broad pennant. This completes construction of the model.



# Crocheting Yarn Held Conveniently on Stand



Women who crochet will find this handy stand a timesaver, especially when making rugs where two different colored warps are used, as it helps to prevent tangling and delivers the two strands side by side. The parts are turned from hardwood, and are finished right in the lathe. Dimensions of the feet, standard, yarn pins and guide

are determined by enlarging them on paper ruled in 1-in. squares. Profiles of the base and top are given in the sectional views in the drawing. All parts that are joined together have tenons turned on their ends, and are assembled with glue. The stand can be finished to match your furniture.—Harold Jackson, Kankakee, Ill.

*W.T.M. Concrete*

## Flagstone Steps Anchored on Hillside by Lengths of Pipe

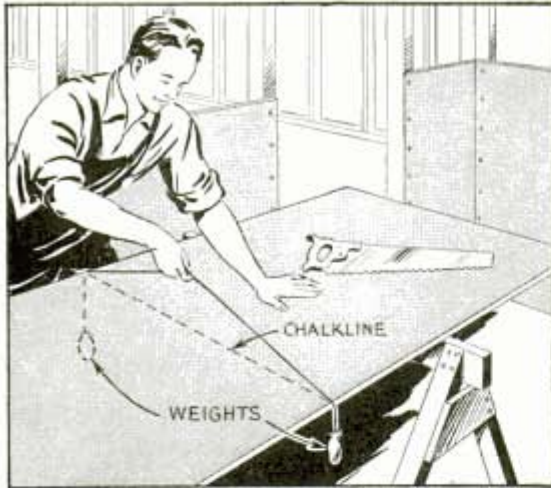
Flagstone steps will not be undermined by water running down around them if they are anchored as shown. After cutting steps to shape in the soil, concrete building blocks are placed on them and anchored by driving 3-ft. lengths of pipe through the openings of the blocks into the ground. Then the flagstones are laid on the blocks and cemented into place.

—H. E. Meredith, Rocky River, Ohio.

When using varnish to make a label waterproof, which will discolor the paper, making it practically transparent and hard to read, first apply a thin coat of mucilage and over this apply the varnish. The paper will then keep its original color.



## Plywood Panels Marked Quickly With Weighted Chalkline



When working with large plywood panels, one carpenter uses a weighted chalkline to mark them in a jiffy before sawing. Weights which hold the line in place while snapping it consist of small tobacco sacks filled with sand and tied to each end of the cord. However, small lead fishing weights could also be used for the purpose if they are more readily available.

## Cleats on Plank Prevent Slipping When Pushing Wheelbarrow

Next time you have to haul concrete or other material up an inclined plank with a wheelbarrow, nail short cleats along the edges of the plank. In addition to preventing your feet from slipping when going up and down, these cleats also serve as stops for the wheelbarrow legs, making it possible to stop and rest while on the way up with a heavy load.

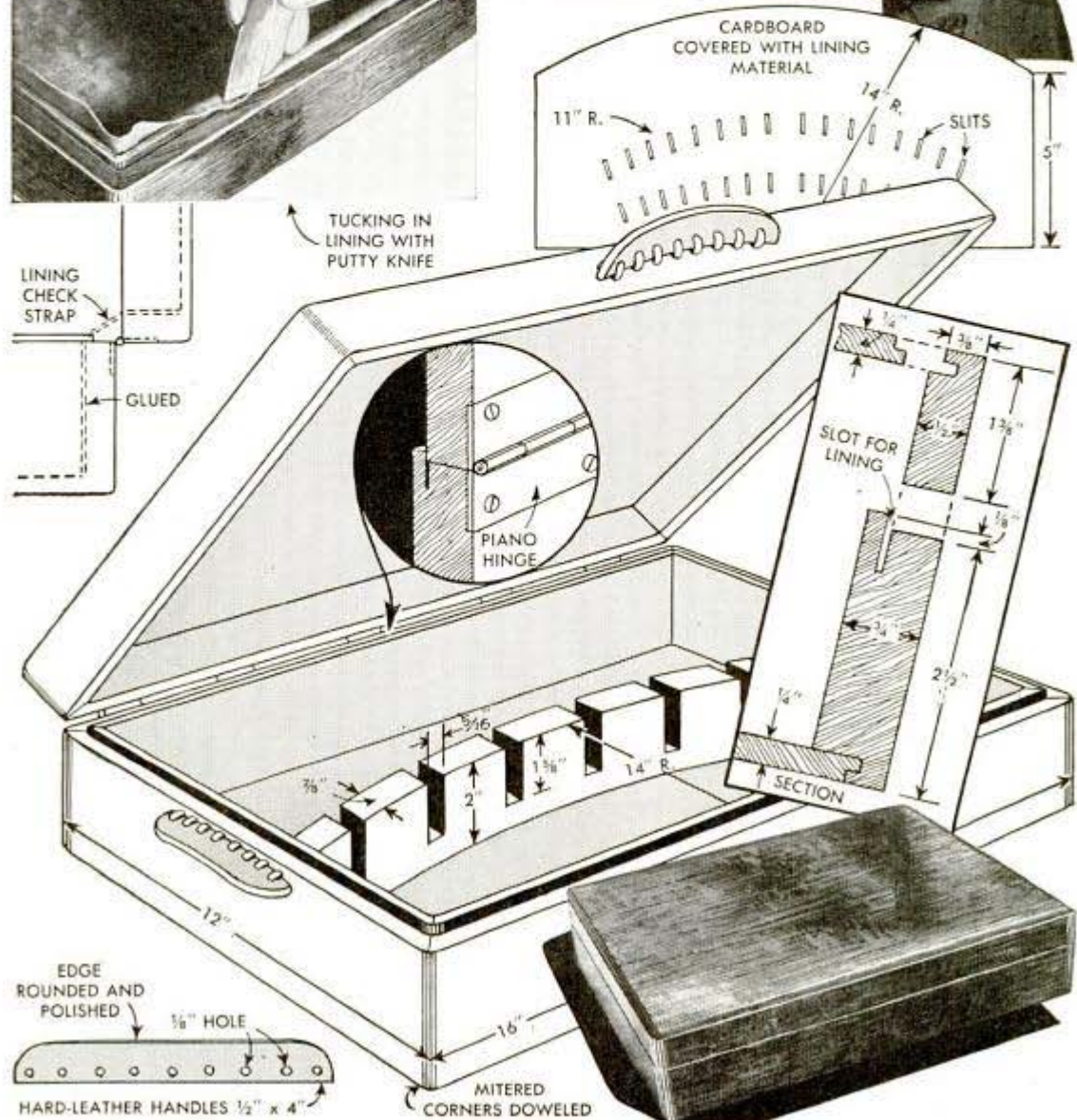
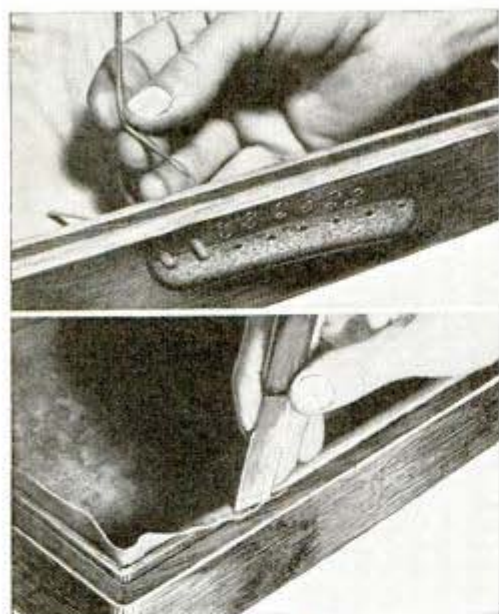


## Hand-Rubbed Silverware Chest Enhanced by Beauty of Grain

Rounded edges and corners are just enough to impart pleasing lines to this simple but beautiful silverware chest in polished walnut or other fine wood. The tight-fitting cover minimizes oxidation, which causes silver to tarnish. Solid stock is used for the ends and sides and walnut-faced plywood for the top and bottom. By ripping the pieces making up each side and end of the chest from one length of  $\frac{3}{4}$ -in. stock, the grain of the cover and bottom will match completely around the chest. From the sectional detail you can see the type of cut to be made at each joint. Run all the rabbets first, including the slot for the lining, then miter the pieces to length. It is not so important to obtain a perfect fit at the bottom rabbet, as this will not show, but at the top you should use extra care. The recess for the hinge can be cut neatly after assembly by clamping both cover and bottom together temporarily and passing it over a dado head set to bring the hinge flush, after which each end of the cut is cleaned up square with a chisel. The mitered corners of the chest are reinforced with short cross dowels. The novel handles are cut from logger's oak-tanned sole leather, drilled and polished to a hard glossy finish, after which a double row of corresponding holes are drilled in the chest in a curved line for attaching them. To make the lacing fit flush on the inside, the surface around the holes can be recessed slightly. The inside of the bottom can be lined with cloth specially treated to prevent tarnish. Along the sides and front it is tucked into the slotted edges, while at the back it is left long enough to glue inside the cover as a lid check strap. Cut the spoon-and-fork holder to a length which will permit it to be wedged in place at a curve, notch it and cover with cloth before inserting. The top half of the cover is lined with white satin, gluing it in folds, after which the knife-holder panel is cut to shape, slit as shown, covered and finally fitted with knife loops by lacing a ribbon of the same material in and out through the slits. A dab of glue on the back of the cardboard will keep the loops from shifting. If made of walnut, fill the grain, shellac and apply four coats of high-grade rubbing varnish, allowing 48 hrs. between coats.—Benj. Nielsen, Aurora, Nebr.



# You can make this SILVERWARE CHEST



## Tennis Racket Helps Art Student Proportion Work to Be Copied



TENNIS RACKET SUPPORTED WITH BOOKS

In practice work, art students and others who are studying drawing will find that a tennis racket placed in front of the object that they are sketching will be of great help in proportioning the various parts to be drawn. If the measurement squares formed by the strings in the racket are known, the student will be able to draw the object accurately to any size desired.

—Axel E. Ogren, Chicago.

## Long-Handled Shrubbery Tool Prevents Scratched Arms

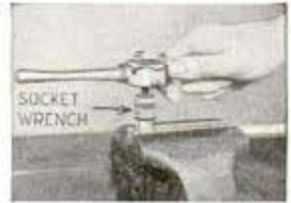
Scratches caused by thorns when thinning some kinds of shrubbery can be avoided if a long-handled tool of the type shown is used. It is made easily by filing a deep notch near the end of a discarded



spring leaf, after which both sides of the notch are ground sharp. In use, it's a simple matter to reach into a clump of bushes and cut out the undesirable growth. Such a tool has also been found handy for cutting small overhanging limbs from trees.

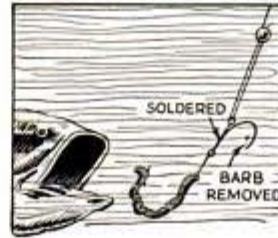
## Socket Wrench Speeds Up Work When Rethreading Nuts

On a job that required the rethreading of a number of nuts, the work was simplified by using a socket wrench to hold them. The



wrench was clamped in a bench vise as indicated so that a nut could be dropped into it and the tap run through the nut quickly. With this arrangement, it is unnecessary to loosen and tighten the vise each time a nut is threaded.

## Fish Can't Swallow This Hook

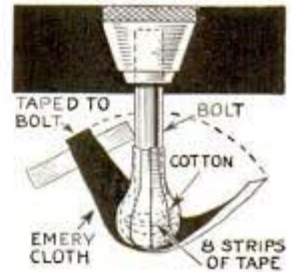


If you have experienced the annoyance of having a fish swallow a hook so that it was almost impossible to remove it, try using a hook made

like the one shown. This consists of a regular hook with a smaller one soldered onto it in a reversed position. This will serve as a stop regardless of how the bait is taken.

## Drill-Press Sander to Smooth Irregular Surfaces

Sanding inside of holes and other openings, or in concave surfaces can be done easily with this sander, which fits in the chuck of your drill press. It consists of a carriage bolt, which has the head padded with cotton taped in place as shown, and then covered with emery cloth also taped in place.



—C. R. Waddingham, Rosemead, Calif.

## Convenient Safelight Mounting

Added convenience can be given a safe-light of the type shown by fitting it with a pushbutton socket and a swivel mounting. The light is held by an angle bracket above



the sink, so the light is thrown directly on a print in the developing tray. The swivel permits the light to be adjusted as desired. If left on continuously, the light at this close range might fog the print, but by

using the switch to turn on the bulb only for short inspection periods, no harm will result.

## Plain Glass Rubbed With Soap Serves as Ground-Glass

Plain glass coated with a film of soap provides a good substitute for ground glass when you need a piece quickly and none



is at hand. Rub a cake of dry soap over the glass to leave a light deposit. Then, with a cloth or the finger tips, spread the deposited soap until the glass is completely covered with a thin, even coating.

☐ After placing prints on a ferrotype tin, cover them with several thicknesses of newspapers and squeegee off the excess water with a roller; this will absorb excess water, stick the prints firmly to the tin and help produce a high gloss.

## Audible Timer on Electric Clock Clicks Once Each Second



Especially handy when dodging prints or doing other darkroom jobs that make watching the clock difficult, this audible timer will not affect the normal operation of your electric clock. Find the shaft on the clock that turns once each second and drop a spot of solder on one side of it. Then mount a small piece of spring metal so that one end of it rests lightly on the shaft. As the shaft turns, the solder will raise the spring-metal piece once each second and it will snap against the shaft with an audible click.

—E. F. Whiteside, Wilmette, Ill.

## Rubber Crutch Tips Hold Bulbs Safely on Closet Shelf

There's less chance of photo bulbs falling off a shelf if the base of each one is pressed into a rubber crutch tip screwed to the shelf. A hole is drilled through each crutch tip and a single screw holds it in place. The ridges on the inside of the rubber tip grip the bulb base securely when it is pressed into it.

—Louis Hochman, Brooklyn, N. Y.



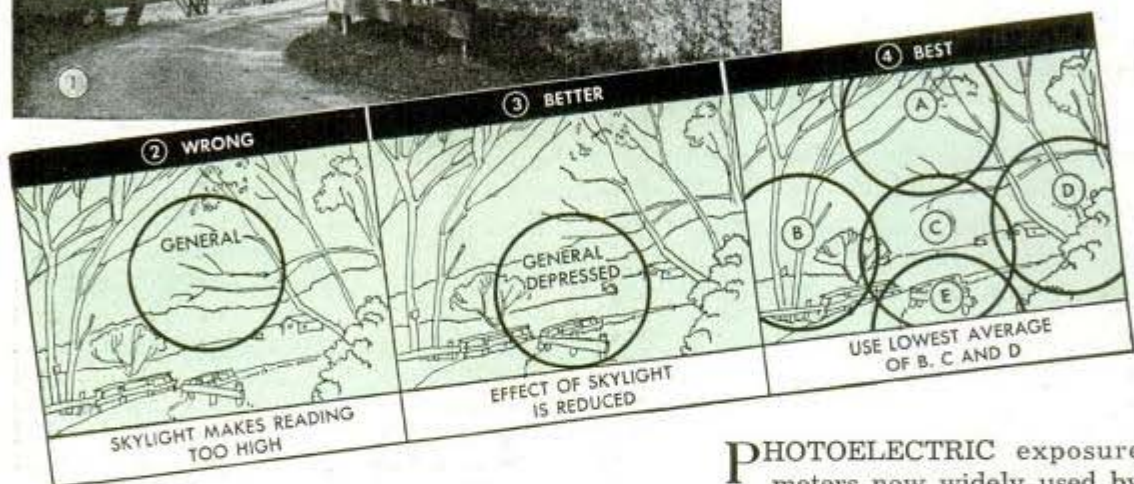


# How to Use Your

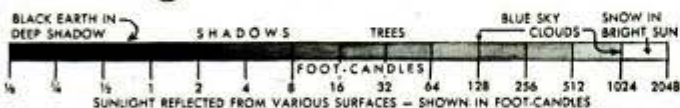
By Thomas P. Lake



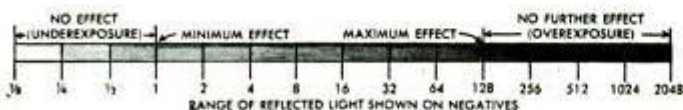
It's not enough to point your meter at a scene, take the reading and then expose the film accordingly. For the best exposures, get the average illumination from several readings—except when certain portions of a picture are to be emphasized at a sacrifice of detail in other parts



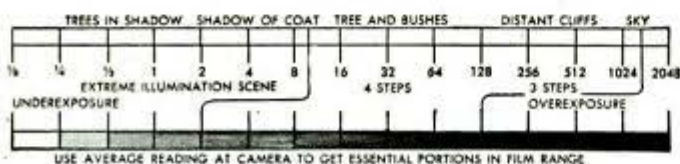
## 5 POSSIBLE RANGE IN ILLUMINATION



## 6 NEGATIVE EXPOSED TO EXTREME ILLUMINATION SHOWS:



## 7 CHOOSING EXPOSURE OF EXTREME-RANGE SCENES



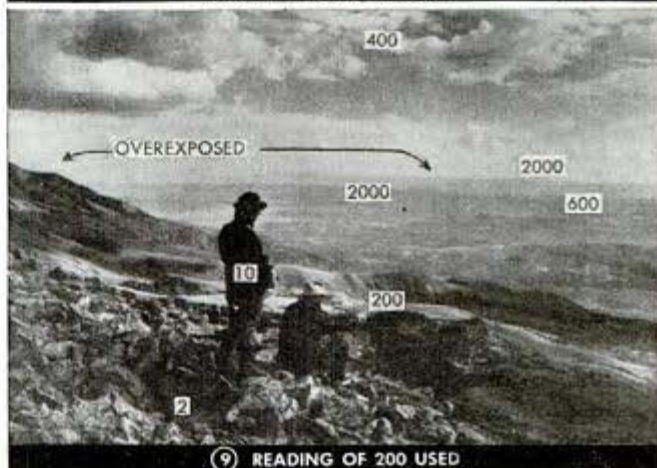
Average landscape, Fig. 1, has tone range well within that of film. For best exposure, take five meter readings as in Fig. 4, instead of one as in Figs. 2 or 3. Reading A measures sky illumination, E checks for extremes, B and D measure depth of shadows and check for extremes of range. Select average of B, C and D

PHOTOELECTRIC exposure meters now widely used by amateurs as well as professionals, have been responsible for a remarkable improvement in the average quality of negatives produced. For best results, a meter must be used accurately. Although the practice of pointing the meter at a scene, noting the reading, and then making the indicated exposure, may be occasionally correct, in the long run it leads to disappointing failures. The picture shown in Fig. 1 is typical of a normal photographic landscape scene. There are moderate shadows and highlights, and there is no extreme distance. The commonly used way of securing a light reading of such a scene is to remain at the camera position, sight across the top of the meter at the center of the scene, and note the reading shown on the light scale, as is

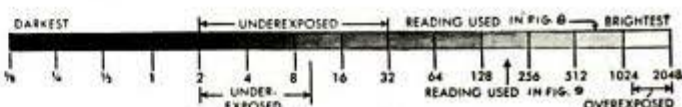
# PHOTO-ELECTRIC EXPOSURE METER

shown in Fig. 2. A second and better method, Fig. 3, is to direct the meter about 10 to 20 degrees below the horizon. This has the effect of reducing the amount of blue-sky light that enters the light-cell window. Since blue-sky light varies from about 200 to about 1,000 foot candles in power, and probably averages about 400, it is obvious that this high-intensity light probably would boost the meter reading far enough to underexpose the shadow portions of the ground. The best method of determining exposures is shown in Fig. 4. First, a reading of the sky alone is taken at A. This measures the illumination falling into shadows, since shadow illumination must come from the blue sky. Readings B, C and D are taken as the meter is swept slowly across the field of view, keeping the meter depressed sufficiently to exclude most of the sky. Then the average of these readings is used for exposure. A fifth reading in the foreground, E, is taken to make sure that it doesn't differ by more than two or three steps from the average reading obtained. If experience shows that the chosen reading is higher than might have been expected, the first, or sky reading will indicate the source of this unexpected light. If the sky reading is high, and shadow illumination is correspondingly high, the high figure chosen probably will be justified. If the sky reading is low, a further investigation usually will disclose a local area that is reflecting an unusual amount of light, such as a patch of sand, gravel or a stretch of dead grass. If this is the case, the chosen reading might be lowered about one-third, one-half or even one full step. If it is important that full detail be retained in the bright area no change need be made in the chosen reading. A little practice in this procedure will make it possible to obtain an exposure reading in about 30 seconds.

It often happens that a scene will have so great a range of tones



10 RANGE OF LIGHT VALUES IN FIGS. 8 AND 9





more than four steps below the indicated reading, and to show detail in highlights no more than three steps above the indication, a carefully taken average reading will lose least detail in both shadows and highlights, as indicated in Fig. 7.

However, it is not always possible to use the average light reading if certain types of views are to be photographed satisfactorily. Two such scenes are shown in Figs. 8 and 9. In Fig. 8 good detail of distance was desired, necessitating sacrifice of detail in the foreground as the range of tones far exceeded the recording range of the film. In Fig. 9 detail in both foreground and middle distance was desired. Although light readings were similar in both cases, Fig. 9 was

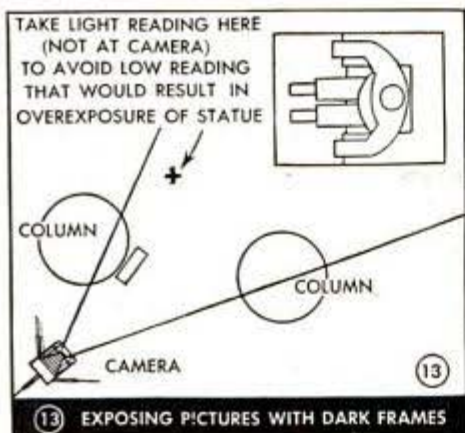


Circles at left representing area covered by the "eye" or light-cell window of the meter should not include the background, which is light in one case and dark in the other, resulting in under- and over-exposure of the face. Take the reading of the face only, holding the meter at a distance of about 8 or 10 in.

that the film is unable to reproduce all of them. This range may run from less than 1 foot candle to more than 2,000 foot candles, as indicated in Fig. 5. A film exposed to such a scene must necessarily overexpose a large portion, underexpose a large portion, or show smaller portions both underexposed and overexposed, as indicated in Fig. 6. Correct exposure for such a scene places the major portions of the scene in the normal range of the negative between the area of underexposure and the area of overexposure (underexposure, where no detail is shown in shadows; overexposure, where highlights are burned-in solid black and show no detail). As most exposure meters are designed to produce a negative showing detail in shadows down to no

exposed four times longer than Fig. 8 as indicated in Fig. 10. If a meter receives light from a wide angle, it may be unable to obtain the high readings shown for the distant horizon, as the weaker sky and middle distance will lower the reading obtained. In such a case, a 4-in. piece of mailing tube held tightly in front of the cell window will allow accurate relative measurements to be obtained. The tube lowers the readings obtained, and at the same time makes the cell highly directive. It is possible to determine the correcting factor, and to use such a tube in the field to determine accurate exposures.

In Figs. 11 and 12 are illustrated two extreme cases where a light reading taken from the camera position fails to determine



the correct exposure. Generally pictures of people are wasted effort unless faces are shown in good detail without harsh shadows. The photo shown in Fig. 11 was taken on a bright winter day when the general light reading was well over 1,000 foot candles, and would have shown the face in deep shadow if such a reading had been used, although snow texture would have been well rendered.

In Fig. 12 the absorption powers of the dark green shrubbery gave a very low general light reading, in spite of the fact that the summer sun was nearly overhead. An exposure based on such a reading would have overexposed the face (made it appear white and without detail), since under these circumstances the skin reflects much more light. In such cases, the photographer must take a light reading from within 8 or 10 in. from the face, taking care to avoid casting a shadow on it while the reading is being obtained.

Photographs showing the reflections of the sun on water are always interesting subjects, yet they require a peculiar technique to make them satisfactory pictures. If the light meter is directed at the scene to be photographed, the direct reflections of the sun will give a very high reading, possibly slightly beyond the scale. An exposure based on this reading will give a thin negative which will yield a night-effect picture. The sun's reflections will be sharp, however, since there will be little halation. However, a daylight effect may be more desirable. To secure this it would be well if a light reading could be taken of the scene without the sun's reflections. This is obviously impossible to obtain, so the next best thing must be done, which is



to take a reading on one side of the desired scene. The light reading obtained in this manner is used to determine the exposure. The somewhat longer exposure used in this method will allow reflections to lose some detail, and there may be some blurring on account of halation, yet the effect on the whole is pleasing.

Many types of subjects are more effective if they are "framed" as in a doorway, arch, a gracefully branching tree, or between a pair of columns, as in Fig. 14. As such foreground objects are often in deep shadow, a special method must be used to obtain good exposures. A light reading from the camera position, which averages the light reaching the cell window, is likely to badly overexpose the important object while obtaining a small amount of detail in the framing object. The correct method of obtaining a light reading is to approach near enough to the main object to exclude the frame from the light-receiving circle of the meter, and obtain a reading. See Fig. 13. If it is impossible to eliminate the frame from the meter reading, a substitute method is to give only one-half the indicated exposure.

Surprisingly good negatives may be obtained at first attempt from scenes that are



When a scene like the one above is too dark for taking general readings, measure the brightest spots, divide the highest meter reading by 8 and use the resulting figure to compute exposure

so dark that a general reading cannot be obtained, by a rather peculiar yet thoroughly sound use of the photoelectric meter. Such a scene is shown in Fig. 15. This picture was taken by obtaining a light reading from the brightest area to be found, in this case a patch of snow in bright

light. As the exposure meter is calculated to give a general reading four steps (equal to four lens stops) above the deepest shadow the film will record, and three steps below the brightest highlight the film will record, the light reading for the very dark scene may be assumed to be three steps lower than the reading obtained from the highlight. Usually such low figures are not shown on the calculating dials or tables of exposure meters, so the bright-area reading may be used and the lens opened three stops more than indicated, or the exposure may be given at the indicated stop but lengthened eight times (each full stop doubles or cuts in half the amount of light passed, so  $2 \times 2 \times 2 = 8$ ). After a little experience in this method of determining the correct exposure for very dark scenes, it is possible to take a well exposed picture every time.

## Dutch Windmill, Lawn Furniture, Trellises



Dutch Windmill Plan—1059

Two Cedar Chests—795, 25c  
 Gun Cabinet—991, 25c  
 Queen Anne Coffee Table—526, 25c  
 Dutch-Style Breakfast Set—822, 25c  
 Priscilla Sewing Cabinet—617, 25c  
 Corner Book Shelves—1029, 25c

### BUILD-IT-YOURSELF PLANS

Dutch Windmill—1059 (illustrated at left) 25c  
 Lawn Chair—1058, 25c  
 Jigsawed Ornaments—1051, 25c  
 Porch Chair and Table—1028, 25c  
 Two Barrow Chairs—924, 25c  
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 Artistic Dog Houses—826, 25c  
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 Trellis Suggestions—639, 25c  
 Lawn Arbor and Trellis—715, 25c  
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# SHOP NOTES

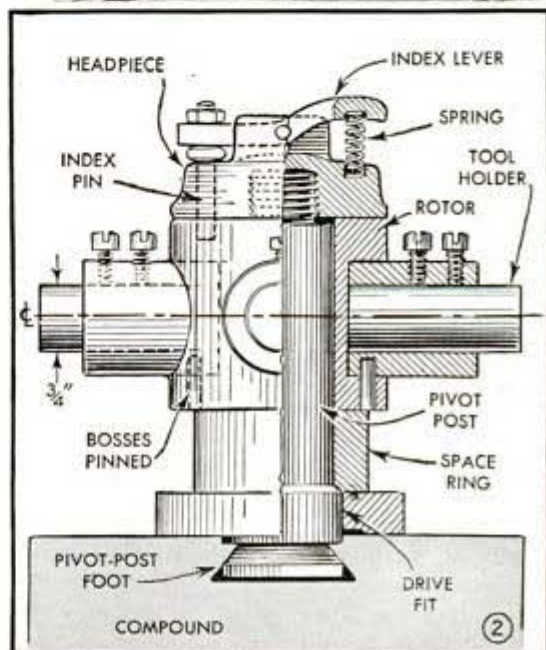
## Simple, four-way TOOL TURRET *fits 9-in. lathe*

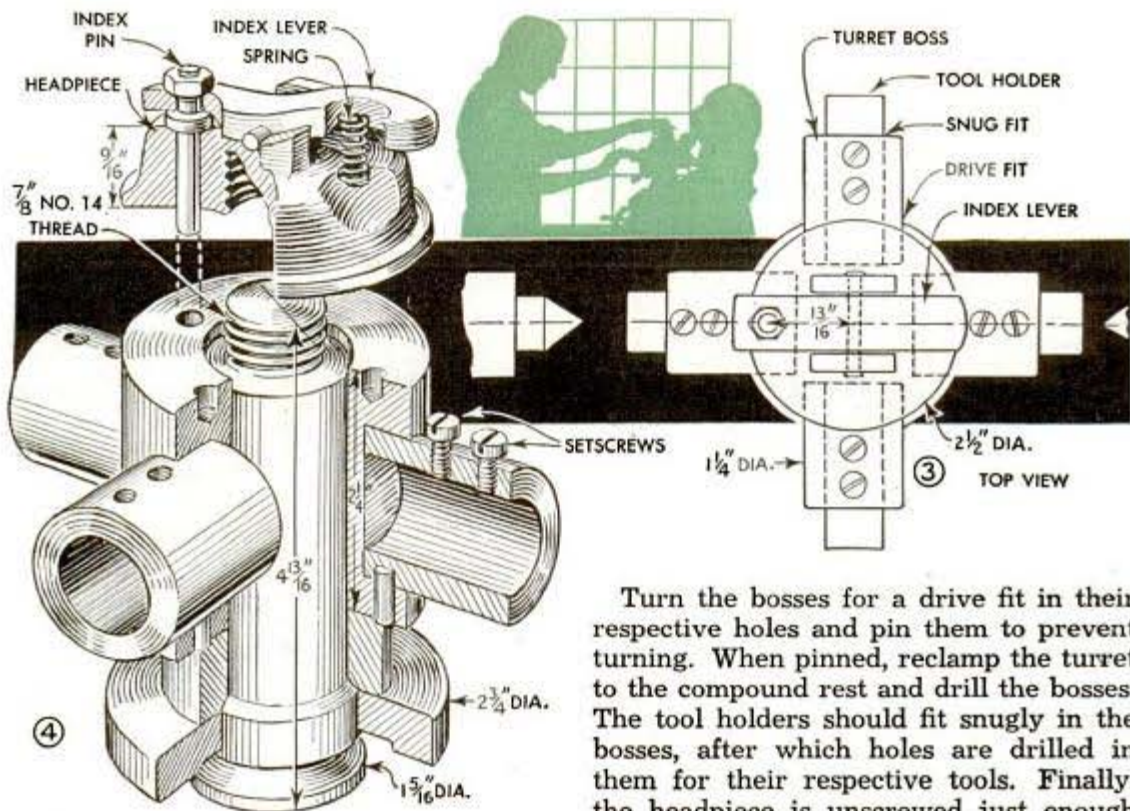
By Dana H. Bailey

**Clamps to base of compound rest in place of regular tool post. Operates easily and indexes accurately**

**B**UILT to withstand production use on a small bench lathe, this inexpensive, four-way tool turret, Fig. 1, can be machined on a lathe. Although the turret has no depth stops, marks on the various tools themselves will serve to check longitudinal travel. Cutaway views in Figs. 2 and 4 show you how its nine parts are fitted together. While the dimensions given are for a 9-in. lathe, the turret can be made for use on a larger machine by increasing its size proportionately.

Turn the pivot post first, as it will be needed to support the rotor for drilling the tool-holder sockets, and the holes for the bosses. The shoulder at the base of the post is turned to give a drive fit for the foot, which is the collar just above the dovetail. Next, you turn the space ring, rotor and headpiece, taking care to see that the rotor makes a snug sliding fit on the pivot post. In the absence of an indexing chuck or head, center lines for the four bosses in the rotor can be located 90 degrees apart in the following manner: First chuck the rotor on its side in a four-jaw chuck. Then, with a tool bit in the tool holder, advance it to bring the bit just under one of the chuck jaws. With the jaw resting on the bit, scribe a center line lightly on the work by moving the carriage.





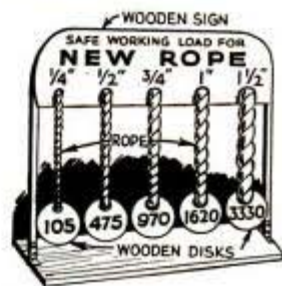
Return the bit in line with the second chuck jaw and repeat until all four are located. By aligning the four vertical center lines scribed on the rotor with the index-hole center line marked on the headpiece, and screwing the latter firmly onto the rotor, you can drill the index holes accurately, using the index hole in the headpiece as a drill guide.

With the index pin and release lever fitted in place, the complete turret assembly is clamped to the compound rest in place of the tool post for locating and center-drilling the rotor boss holes. This is done by advancing the cross-slide to bring opposite rotor center lines in alignment with the head and tailstock centers, after which the cross-slide gibs are tightened to hold the turret rigidly and the headpiece is screwed tightly against the rotor. Then, with a centering drill chucked in the headstock, advance the turret by means of the carriage long feed and center-drill, bore and finally end mill the boss holes to finish size. By engaging the index pin in the next hole, the rotor will automatically center itself 90 degrees. In case your lathe is not equipped with an end mill, the holes can be finish-bored to size by chucking the rotor in a four-jaw chuck and using the drilled holes as guides to center the work.

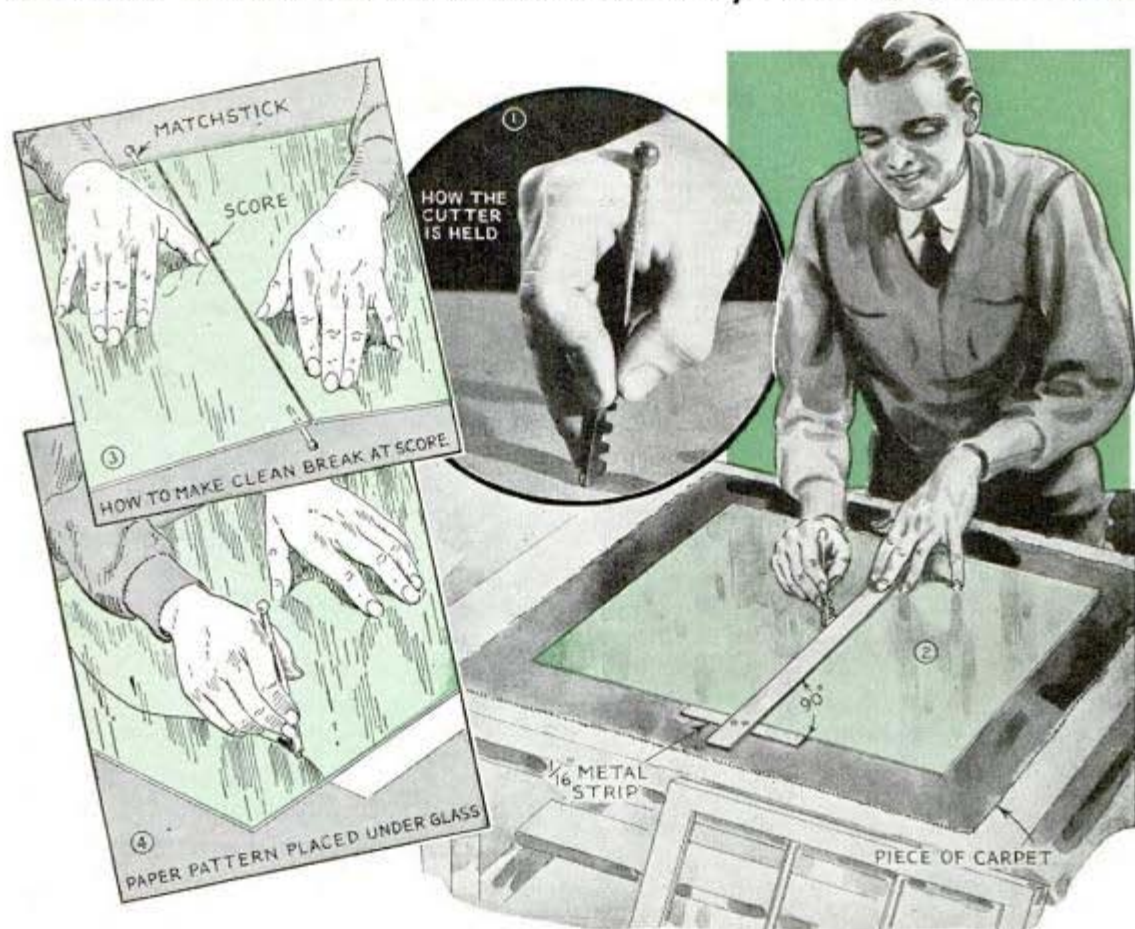
Turn the bosses for a drive fit in their respective holes and pin them to prevent turning. When pinned, reclamp the turret to the compound rest and drill the bosses. The tool holders should fit snugly in the bosses, after which holes are drilled in them for their respective tools. Finally, the headpiece is unscrewed just enough so that the rotor can be rotated easily, yet without play. Two headless setscrews, fitted in the top of the headpiece to enter the rotor, are provided to hold the two in position permanently. As shown in Fig. 3, each toolholder is held in the turret by two setscrews fitted in its boss. Then, in turn, each individual tool is clamped securely in its respective toolholder by similar setscrews.

## Counter Sign Shows Rope Sizes And Safe Working Loads

If you own a hardware store, here's a simple display that will be a big help to customers in deciding on the size rope best suited to their needs. It is made by attaching samples of the rope to a board supported by the counter as shown, after which the safe working load for each rope is painted on a wooden disk and slipped over the lower end. This makes it easy for the customer to examine the rope and tell at a glance its size and the load it is capable of handling.



# A Few Tricks That Enable Anyone to Cut Glass



Glass cutting is not as difficult a job as it seems if a few tricks of the art are kept in mind. First, the method of holding the cutter is important. Fig. 1 shows the correct way. Keep the cutter between the middle and index fingers with the tip of the latter on the flat spot on the edge of the cutter. Notice that it is held almost vertically. When cutting glass, you will need a straightedge as a guide for the cutter. A yardstick can be used, but a T-square is better. Or, you can improvise a straight-edge like the one shown in Fig. 2. Place the glass on a smooth, flat surface. If it is laid on a piece of rug or carpet, there will be less tendency of it skidding under pressure of the cutter. Start at the edge farthest from you and make the score with one sweep, pressing the cutter firmly against both the glass and the straightedge. Never go over a score a second time. You will not improve it, and you will ruin the cutter. If you make a mistake, turn over the glass and score it from the opposite side. Don't worry about the first score

having any effect when breaking the glass as it will break only at the score on the upper side. A good way to assure a clean break is to place a couple of matches under the glass close to the score as in Fig. 3, and press down on both sides of the score with the fingers held in the positions indicated. When cutting freehand, the design should be drawn on paper, which is placed under the glass as in Fig. 4 to serve as a template.

—E. J. Davy, San Diego, Calif.

## How to Determine the Board Feet In Pile of Small Pieces

In many woodworking concerns where scrap wood is sold by the board foot, time can be saved by selling the scrap by weight. A board foot is made up, using average pieces from the pile of scrap material, after which it is weighed. Then, by weighing the rest of the pile, and dividing the sum by the weight of the sample board foot, you can tell how many board feet are on hand.

## Chicks Herded Into Colony House With Scoop-Shaped Board

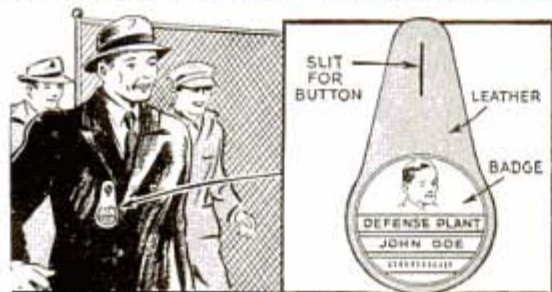


Have you ever had trouble chasing a flock of baby chicks into a coop or colony house before a rainstorm? If so, here's a scoop-shaped board that will be helpful in cornering them at the entrance. It is made by assembling a wooden framework and attaching this to a handle, after which a piece of heavy cardboard is tacked to the curved frame member as shown. In cases where it is possible for two or more of these boards to be used, the job can be done quickly by keeping the ends together to form a pen outside the door.

—Fred W. Schneider, Towaco, N. J.

## Simple Leather Attaching Holder For Identification Badge

At the plant where I worked recently, it was necessary to display an identification badge at all times. When changing the badge from work clothes to street clothes, one workman soon found that the pin holes were becoming noticeable on his coat lapel. To overcome this, he cut a piece of scrap leather to the shape indicated and pinned



the badge to the circular bottom. A slit was then cut near the top, making it possible to slip the holder over a coat button. The holder can be changed quickly and there is no danger of the pin wearing the clothing.—H. R. Wallin, Falls Church, Va.

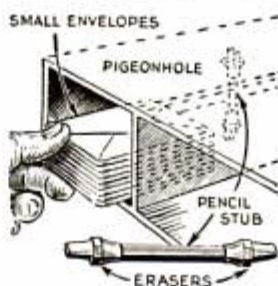
## Vegetable Crates Fitted With Feet Are Easy to Stack

Vegetable crates that are made with the corner members projecting about  $1\frac{1}{2}$  in. above the top edges can be stacked in tiers several crates high without any possibility of damaging the contents,



and the resulting space between the crates allows ample room for circulation of air. If filled crates are stacked in a building, they should be spaced at least 20 in. from the walls to allow proper air movement.

## Pigeonhole Shortened by Stop To Hold Small Envelopes



To provide a stop in a deep pigeonhole so that short envelopes could not slip back out of easy reach, one clerk provided a stop as shown. It consisted of a short piece of lead

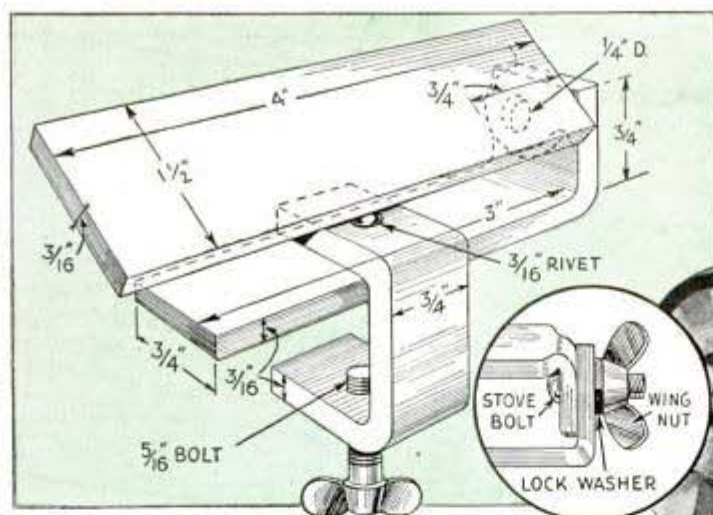
pencil having slip-on erasers at the ends. The over-all length should be slightly more than the height of the pigeonhole so that the pencil can be wedged in place.

## Circle Stamp From Vacuum Cup

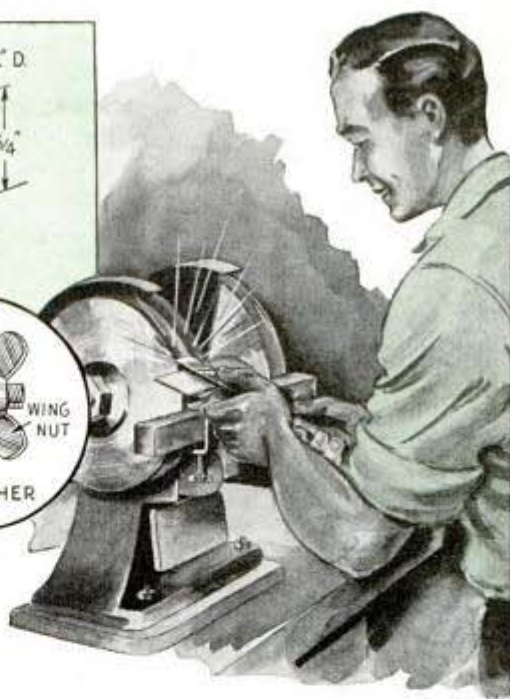
Shipping clerks and others who require a stamp to make circles calling attention to certain marks on shipping containers, will find a rubber vacuum cup handy for this purpose. The cup is used just like a regular rubber stamp.



## Adjustable Rest to Grind Bevel-Edged Tools



This tool rest for a grinder can be adjusted instantly to support work such as chisels, plane irons, spokeshaves and similar tools at the correct angles for sharpening them conveniently. The rest is made of iron or steel and the adjustable part is locked in the desired position by a stove bolt and wing nut as shown in the detail



## Counter Turntable for Autographic Register Saves Time

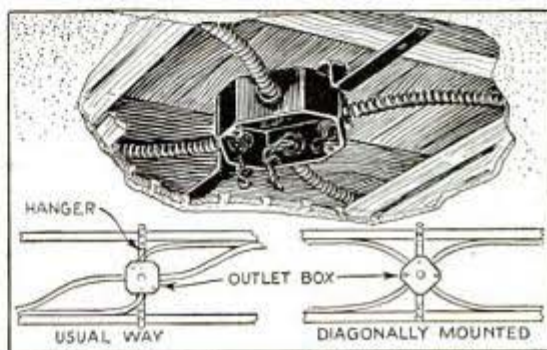


Clerks of a California basket company appreciate this turntable which makes it easy to turn an autographic register for the customer's signature without lifting it from the counter. The top of the register and turntable are flush with the counter surface. Consisting of two large wooden disks spaced the thickness of the register, the turntable is supported on a wooden platform, which is suspended from the counter and is fitted with a pivot, the latter passing through the center of the lower disk. This disk rotates on three evenly spaced casters which are inverted with their shanks set in the platform.

## Diagonal Mounting of Electrical Outlet Boxes Eases Strain on Cables

When using armored cable in electrical wiring where octagon-shaped outlet boxes are mounted on hangers between ceiling joists, mount the boxes with their sides running diagonally to the joists instead of parallel with them which usually is done. With this method, there is less strain on the cables and it is easier to connect them to the boxes because it is unnecessary to bend them sharply, especially when the cables are run along the joists to the boxes.

—W. Dittman, West Bishop, Calif.



## When **STORING**



How to protect the paint finish, chrome, upholstery, tires and other rubber parts, when putting your car in dead storage for the duration; also, methods of safeguarding the motor and mechanical parts against corrosion, keeping up the battery and other important details

A good moth-proofing solution applied with a spray gun to assure uniform coverage helps preserve the upholstery, floor carpets and the seat padding

By James R. Ward

**STORING** your car for the duration is not just a matter of putting it in a garage and locking the doors—not if you expect it to be in a usable condition later. It should be put in a clean, dry building that is free from water leaks and lime from whitewash, and as dark as possible. Remember that a car is made up mainly of metal and rubber which deteriorate rapidly in storage unless steps are taken to protect the finish, motor, upholstery, battery and tires.

Prepare for storage by washing the car thoroughly, taking care to remove all dirt and grime under the fenders and from the chassis. Then clean and wax the body. Do a good job here, even better than you would normally, because the wax will seal any pores in the paint film and help prevent moisture from reaching the metal underneath. If the paint under the fenders and on the chassis is damaged, go over the parts lightly with fine steel wool to remove the flaked paint and rust, and then spray the parts with light oil. You must protect the chrome parts too. Clean them carefully and coat them with light oil, vaseline or cup grease. This is best done with a small paint brush, being careful not to get oil or grease on the rubber gaskets around the windshield, lamps and other parts, as oil left on rubber will soften it and cause it to deteriorate rapidly.

Now you are ready for the motor. Drain



Lard oil injected through the spark-plug holes prevents rusting of pistons, rings and cylinder walls. When draining the cooling system, don't forget to open the cock or plug in the cylinder block

# YOUR CAR



Spread over the entire car to reach the floor, a tarpaulin or paper cover helps exclude light and dust

and flush the crankcase. Use plenty of flushing oil, draining and refilling a couple of times if necessary, because it is important to have the interior of the motor free from old oil, which may contain acids that will be extremely harmful to the motor. Refill the crankcase with light, clean oil. This will do for the first 500 miles of driving when you again put the car into service. Drain the gasoline from the tank, and run the motor until the carburetor and



Wipe oil and grease from all insulated cables and wires to prevent rotting the rubber coverings. Waxing the car protects the finish as it seals the pores in the paint film and keeps moisture from penetrating to the metal under the paint



fuel pump are empty, working the throttle up and down to facilitate draining the parts. Remove all of the gasoline. If any remains in the carburetor, it will evaporate and leave a gum deposit that will clog the tiny openings.

Other parts of the motor that need attention are the rings, cylinder walls, valves, etc. Lard oil, because of its nonevaporating qualities and tendency to stick to



Vaseline, light oil or cup grease brushed on chromium trim provides a coating that will afford protection almost indefinitely. The clutch should be propped in the released position by depressing the pedal and placing a wood block between it and the lower part of the front seat



It's best to remove tires from the wheels, replace the tubes, inflate them slightly and then stack the tires horizontally in a dark, cool place

metal, is ideal for protecting these parts. Remove the valve cover and apply the oil plentifully to the valve stems. Have the oil warm so it will flow freely and penetrate into tight places. Then remove all spark plugs and inject the oil into the cylinders, turning the motor over several times to work the oil over the cylinder walls, pistons, rings, etc. If desired, you can purchase oils made especially for this

purpose. They are noncorrosive and have the necessary oiliness to maintain a film on the metal parts. When these are used, the lard oil and the cylinder oil in the crankcase are unnecessary. The oil is put into the drained crankcase and the motor is run for some time to circulate the oil throughout the system. It is a good idea to tie paper bags over the carburetor air cleaner, and the crankcase-ventilator inlet and outlet to keep out dust.

Next comes the cooling system, which should be drained thoroughly, opening the cocks at the bottom of the radiator and at the side of the motor block. Be sure that all liquid drains, to prevent rusting and freezing. To preserve the battery, it is best to remove it and put it in the hands of a reliable service station for proper care. If you keep it yourself, the specific gravity should be checked at regular intervals of six weeks, except during extremely hot weather when inspection should be made at three-week intervals. Recharge the battery slowly every six weeks to bring the gravity reading to 1.280 or above. In no case should the gravity be allowed to fall below 1.220. The specific gravities given here are correct at 60 degrees Fahr. Check and correct the water level in the cells at each inspection prior to recharging.

Differential and transmission can be left as they are, but the hand brake should be released fully, and the clutch should be





Dust cannot enter the carburetor air cleaner and the crankcase-ventilator inlet and outlet openings if paper bags are tied over them. Rubber gaskets should be protected by coating them with special paint



propped in the disengaged position. This can be done by placing a wood block between the pedal and the front seat. A piece of 2 by 4-in. stock is ideal for this purpose. All rubber weatherstrips, such as are used around doors, deck or trunk openings and window ventilators, as well as rubber gaskets with exposed edges around taillights, cowl ventilator, etc., should be covered with special paint for rubber parts. The floor mats should be left in their normal positions.

Care of the upholstery is important. It should be protected with a good moth-proofing solution, using a spray gun to get uniform coverage. The seat cushions should be lifted and sprayed, making sure that every part of cloth and padding is covered thoroughly. Before doing this, however, be sure that the upholstery is clean so that the solution will not set the dust

or cause discolored spots. The floor carpets should be treated in the same way.

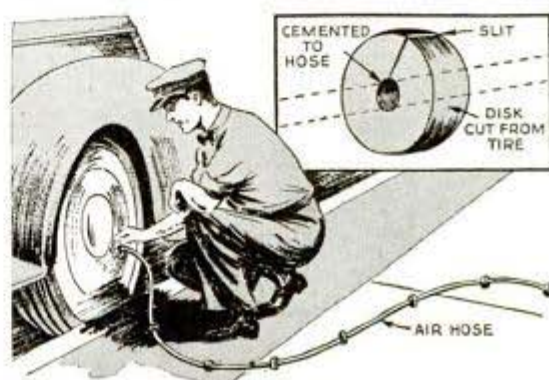
After this, you are ready to put the car up on blocks. Any method of blocking desired can be used, but be sure that it is substantial so that the car will not fall. It is best to remove the tires from the wheels and store them in a cool, dark place. Light, particularly sunlight, heat and dry air are injurious to rubber. After removing the tires, replace the tubes and inflate them slightly, stacking the tires horizontally instead of vertically. If it is impractical to remove the tires, they should be kept inflated to a pressure of 4 or 5 lbs.

As a last precaution, cover the entire car with a tarpaulin, or even paper. If a tarpaulin or paper cover is unavailable, you can make one by pasting or taping old newspapers or sheets of kraft paper together to form one of suitable size.

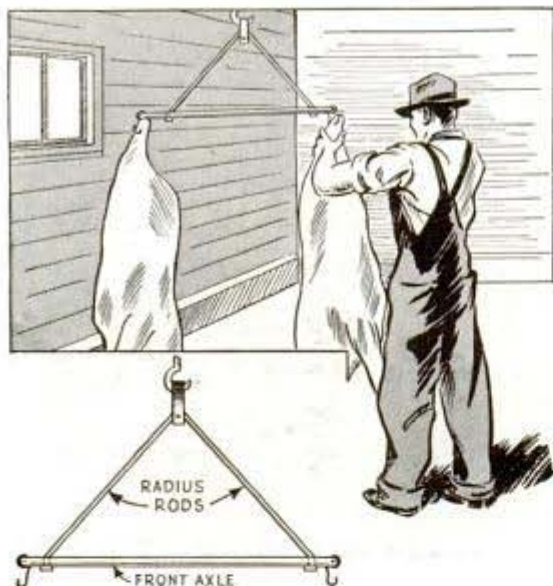
## Rubber Disks Protect Air Hose on Concrete Driveways

Life of an air hose at filling stations and garages can be increased considerably by fitting small rubber disks over it. The disks are cut from an auto casing after which they are slipped on the hose and cemented in place at regular intervals. In this way, the hose is not damaged by continually dragging it across the concrete driveway.

Drills and other polished tools are less likely to rust, if several cakes of chalk are placed on the shelves near them.



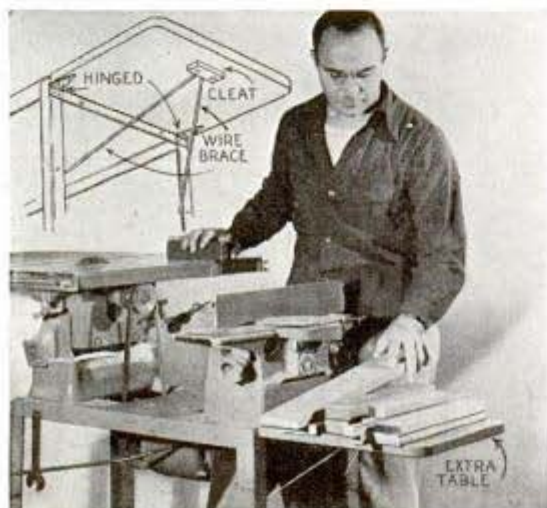
## Beef Hung With Model-T Axle While Butchering



Hanging a beef while butchering is not a difficult job for one farmer who uses an old model-T front axle and radius rods for the purpose. Both steering knuckles and spindles are removed after which improvised hooks are fitted on the spindle bolts. A clevis placed at the ball-and-socket end of the radius rods makes it an easy matter to attach a block and tackle to the assembly and raise the beef.

## Drop Leaf on Circular Saw Holds Small Work

Metal stands for circular saws and jointers of the type shown can be equipped easily with a drop leaf to hold stock from which a number of pieces are to be cut to



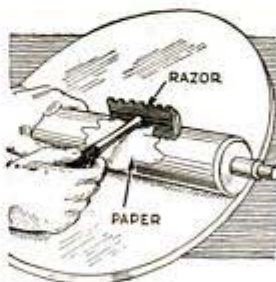
size. Using the saw table to hold work to be cut is inconvenient at times and is very dangerous. The leaf is cut from  $\frac{3}{4}$ -in. plywood of any suitable size and hinged to the stand. Three-sixteenths-inch wire rod is bent V shape for a brace and the two ends bent to fit into two metal straps. The straps act as hinges and are bolted to the stand legs. A metal bracket or stop is fastened underneath the leaf.

## Finger Rest for Showcard Writer From Sewing Thimble

To provide an easy gliding rest for his hand when lettering showcards, one artist uses a sewing thimble. It is worn on the third finger and does not interfere with the use of his hand.



## Comb Guard of Safety Razor Cleans Printing Rollers

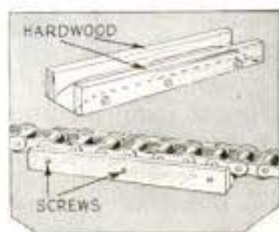


One printer employs a bladeless safety razor, as indicated, to remove torn bits of paper from the rollers of a printing press, without damaging the composition of the roller. The

comb of the razor scrapes off the paper but does not dig into the roller.

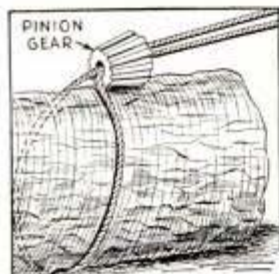
## Flapping of Roller-Chain Drives Avoided With Wood Raceways

Where long runs of roller or pintle chain drives carry the load on the top side, the lower or idling side can be prevented from vibrating or flapping by using a wooden raceway as indicated. This is fitted with sides and is slightly wider than the width of the chain. This type of raceway is particularly effec-



tive where the drive operates with the sprocket at an angle from the vertical, as it not only prevents vibration but keeps the loose side of the chain from sagging.

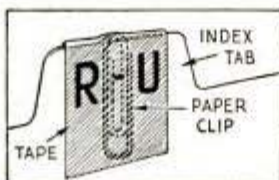
### Pinion Gear Prevents Slipping Of Wire Cable on Logs



To permit quick attachment and removal of a wire cable on logs to be pulled and also avoid the possibility of it slipping off and causing an accident, slip a pinion gear over the looped end of the cable. With the loop tightened and the gear resting against the log, pulling causes it to bite into the wood.

### Tabs on File Dividers Reinforced With Ordinary Paper Clips

Alphabetical index tabs on file dividers will last much longer if they are reinforced with paper clips. These are held in place securely without covering the letters by applying strips of transparent cellulose tape over them. In cases where the tabs have been bent and cracked, this method will also serve as a quick repair.

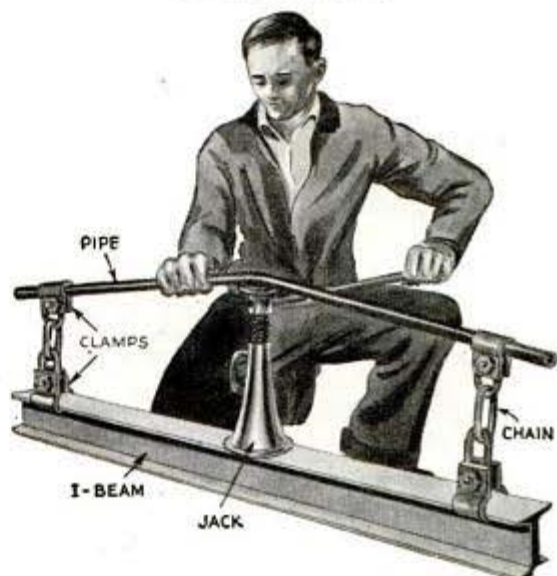


### Water Glass Spreads Uniformly If Wetting Agent Is Used



Sodium silicate (water glass), which is commonly used as a protective coating over labels, can be made to spread uniformly instead of forming into small droplets by using a minute quantity of a wetting agent such as used in photographic solutions. A smaller quantity of water glass is required and the appearance of the work is much better.

### Pipe Bender Is Made From Jack And I-Beam

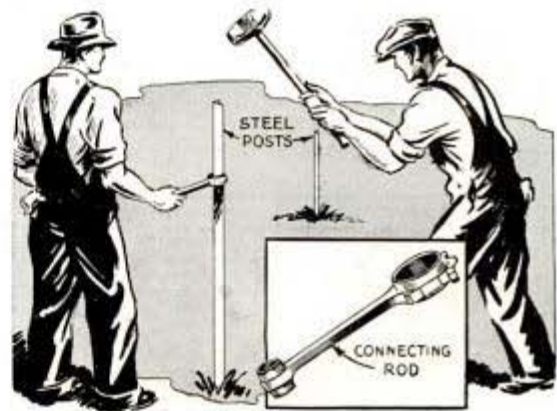


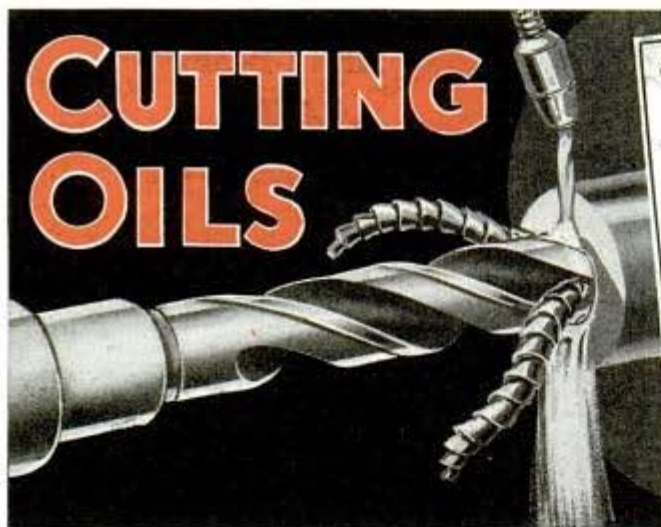
In fabricating pipe work where regular bending equipment is not available, a tool to do the job can be made quickly by using a strong jack and a short length of I-beam as indicated. The jack is set in the center of the beam and chain clamps slip over the pipe and the edges of the beam to hold it. Running the jack up will then bend the pipe at any desired angle.

—Geo. Holman, Marissa, Ill.

### Steel Fence Posts Held Safely While Driving With Maul

When driving steel fence posts with a maul or sledge, one farmer and his helper do the job safely by using a discarded auto connecting rod to steady each post. The connecting rod is slipped over the post and held with a downward pressure which causes it to grip the post and steady it for the workman swinging the maul.





## War Speedup!

Faster and better work! Every metal-working machine must answer this demand now. Correct use of the right coolant on a cutting or chip-producing machine is just as important as proper grinding and correct set-up of the tools. Without the right cutting fluid, tools wear out quickly and rate of replacement is high; also, production of work is of inferior quality. Therefore, every machine operator who wants maximum results, should know about cutting oils and how to use them

By C. A. Crowley

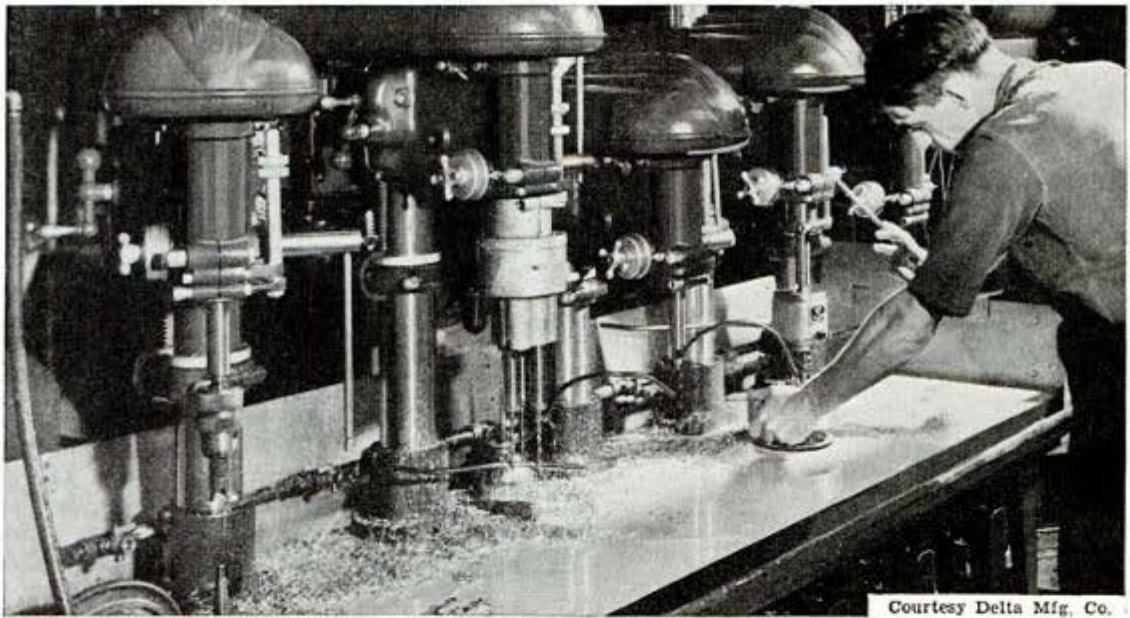
**C**UTTING fluids are compounds applied to tool points to facilitate metal-cutting operations. There are two general classes: straight-oil cutting fluids and emulsion cutting fluids or the so-called water-soluble oils. The straight oils are usually viscous, dark-colored, chemically treated mineral oils containing sulphur or chlorine or both, and proportions of animal or vegetable oils. Water-soluble or emulsifying oils also consist of a mixture of mineral oil and animal or vegetable oil chemically treated with sulphur or chlorine. These chemically treated animal or vegetable oils are commonly sulphated, sulphated or chlorinated oils according to the process of chemical treatment which they have undergone. Soluble oils also contain an emulsifying agent, that is a substance which has the property of causing the oil to form a milky solution or emulsion when stirred into water. Many compounds such as certain soaps and alkaline compounds are used as emulsifying agents. For use, soluble oils are mixed with water in varying percentages from 5 to 95 percent, according to recommendations of the manufacturer.

**Purpose of cutting fluids:** Intense heat produced in a metal-cutting operation will

soon remove the temper from a tool point, resulting in short tool life and the production of improperly finished work. Therefore, the first requirement of a cutting fluid is cooling. Excessive friction, which is evidenced by increased heat and noticeable increase in power consumption, can be minimized by using a cutting fluid of good lubricating quality. A cutting fluid should aid also in producing a good finish, as well as inhibiting rust and corrosion. In deep borings, a washing action must be maintained to remove excess chips.

The best type of cutting fluid with respect to cooling is an emulsion or one that contains a large percentage of water. Water seldom is used alone because it is a poor lubricant and rusts the tool rapidly, but these effects can be minimized by adding a soluble oil to the water. By increasing the amount of oil added, the solution will increase proportionately in lubricating ability. It is obvious then, that a cutting fluid will have the greatest lubricating ability when it is 100 percent oil, which is termed a straight-oil cutting fluid. A light



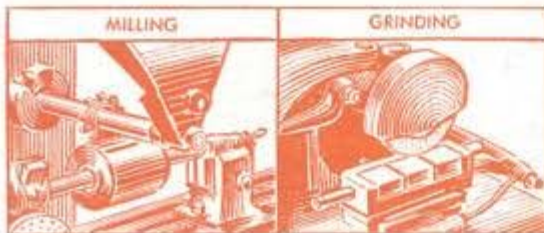
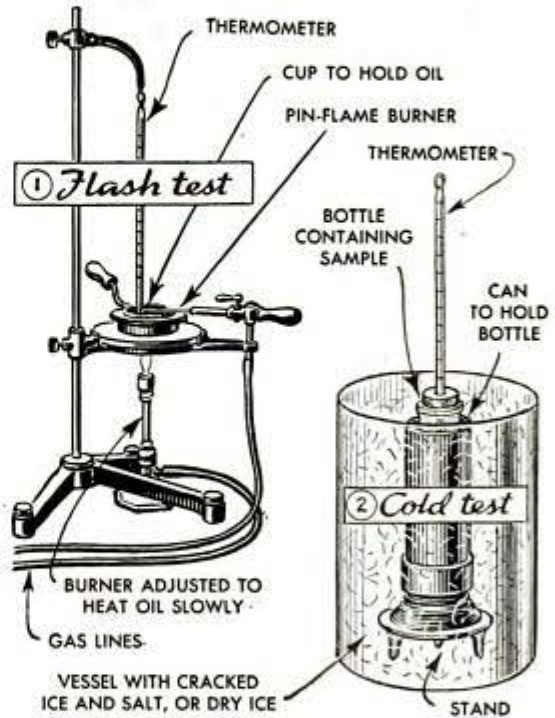


Courtesy Delta Mfg. Co.

mineral oil alone has little lubricating ability; so a pure or chemically treated fatty oil, (animal or vegetable oil) generally is added to increase its lubricating properties or "oiliness." When the requirements of cooling and lubricating are satisfied by a cutting fluid, the work being machined will receive a good finish.

**Selecting best cutting fluid for the job:**

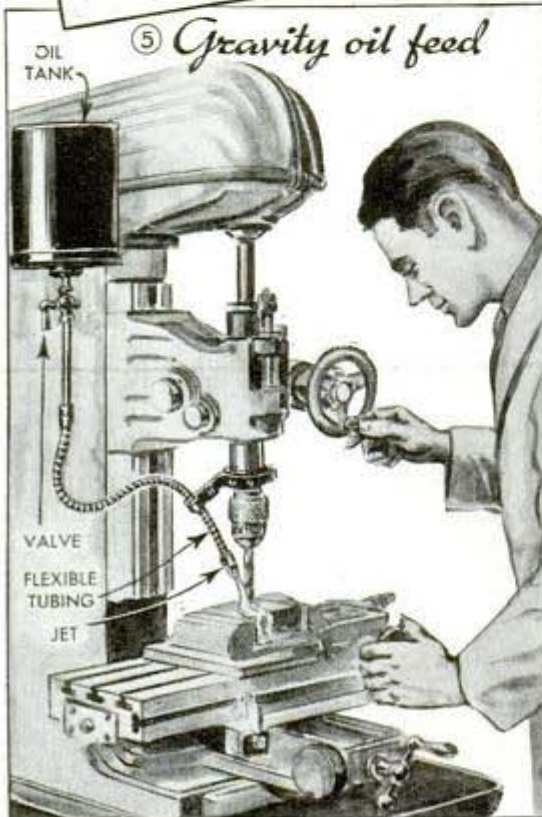
When performing a cutting operation, such as threading, tapping, milling, etc., the following points should be kept in mind: First, the kind of metal being machined, that is, steel, copper, cast iron, etc., and secondly, the actual machine operating conditions, such as speed, and depth of cut. Metals such as brass, cast phosphor bronze, gunmetal, and gray cast iron, which break up easily to form short chips, and aluminum and magnesium alloys, which are of low tensile strength, usually are machined without any cooling or lubricating fluid unless the speed of the operation produces an excessive amount of heat requiring a coolant such as a soluble oil emulsion with a high percentage of water. Tough metals such as steel, monel metal, and certain copper alloys, which form a continuous chip that presses heavily upon the face of the





④ CUTTING FLUIDS FOR VARIOUS METALS

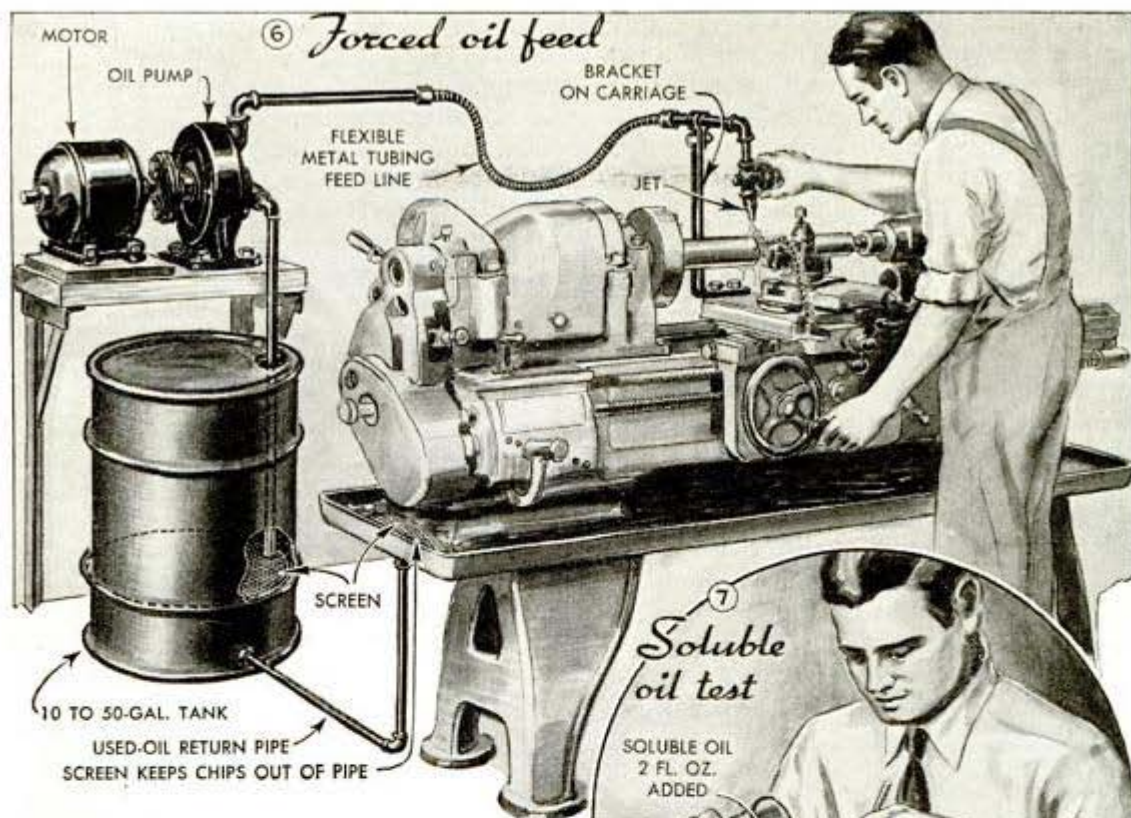
Metal	Cutting Fluid to Use
Aluminum	Kerosene, lard oil or Soluble cutting oils
Soft alloys	Soluble oil and water
Brass	Paraffin oil
Cast iron	None
Malleable iron	Soda water
Wrought iron	Soda water or lard oil
Hard steel	Soluble oil and water
Magnesium alloys	None



tool, require a lubricant as well as a coolant. A shallow cut at a low speed generally requires little coolant or lubricant; a low speed and heavy cut, particularly on a tough metal, demands a good lubricant; high speed and shallow cut demands a coolant; high speed and heavy cut requires a cutting fluid of great lubricating as well as cooling quality. When long tool life is desired, a cutting fluid of good lubricating ability is required to reduce wear. The table in Fig. 4 gives the types of fluids preferable for common metals.

**Judging quality of cutting fluids:** In selecting the proper cutting fluid, the composition and character of the oil is of utmost importance. Besides doing an efficient job of cooling and lubricating, the cutting fluid should not rust or corrode either the tool or the work. Corrosion is caused by plain water, excess acid or alkali, and chemical constituents that may react with the metal being worked. The cutting fluid must not decompose on standing or under operating conditions. If this does occur, impurities will form, which will cause gumming, clogging, and possibly offensive odors. Straight mineral oils are very stable, but to improve their oiliness, fatty oils, which are not as stable and soon become rancid, must be added. Other physical characteristics to be noted are flash-point and cold test. The flash-point, illustrated in Fig. 1, is the temperature at which oil first flashes but does not continue to burn. This should be well above any temperature at which the oil is to be used. The cold test, Fig. 2, indicates the temperature at which the fluid ceases to flow. Let the oil cool slowly, remove and invert the bottle at a drop of every few degrees in temperature. The pour-point temperature is reached when the oil will barely flow. The cutting fluid should be as clear as possible and free from cloudiness and suspended matter when held up to the light as in Fig. 3. The color is not important. Clearness of the oil enables the operator to watch the actual cutting operation at the tip of the tool.

**Application of oil:** The method of application of a cutting fluid depends on the type of operation. Where a profuse amount of cutting fluid is not necessary, it can be applied with a common oil can or a gravity drop-feed system as shown in Fig. 5, but where a large amount of fluid is to be used, an automatic system such as is built into



many machines or can be arranged as shown in Fig. 6, should be used.

**Problems in using cutting fluids:** If the balance between the oil and water in an emulsion cutting fluid is disturbed, cutting troubles usually follow because of the separation of the constituents. Careless mixing and the use of impure water are among the chief causes of failure. The manufacturer's directions for compounding should be followed explicitly. Soluble oil should mix well in water between temperatures ranging from 70 to 120 degrees Fahr. See Fig. 7. An inadequate flow of cutting fluid over a hot tool point will shorten the active life of the emulsion. For this reason a generous flow is advisable. Many soluble oils break down when machining cast iron or brass with high lead or zinc content. In such cases it is best to use a specially compounded soluble oil. The cutting fluid may become excessively acid when machining acid-pickled metals. The addition of a little soda (soda ash) to neutralize the acid, which is determined by using red litmus paper as in Fig. 9, will solve the problem. Discoloring of emulsions may be caused by the collection of rust or reaction products between the metal being worked and certain constituents of the cutting fluid. Rust may be caused by improper mixing or the

The emulsion of a soluble cutting oil in water should be uniform; no oil or grease should float on the surface of the solution after the oil has been stirred in

use of impure water. Gummy deposits may be the result of a large amount of rosin present in some cutting fluids. If a good soluble oil is used properly, little or no trouble should be encountered with bearing trouble or the sticking of slides or guides on machine tools.

Machining troubles with straight oils are usually made evident by smoking, which is the result of exceptional surface speeds, heavy cuts on tough materials, or inadequate flow of cutting fluid. Sulphurized oils tarnish copper-rich alloys, because of a reaction that takes place in the presence of moisture. For this reason the oil should not be stored in a damp place in an open container.

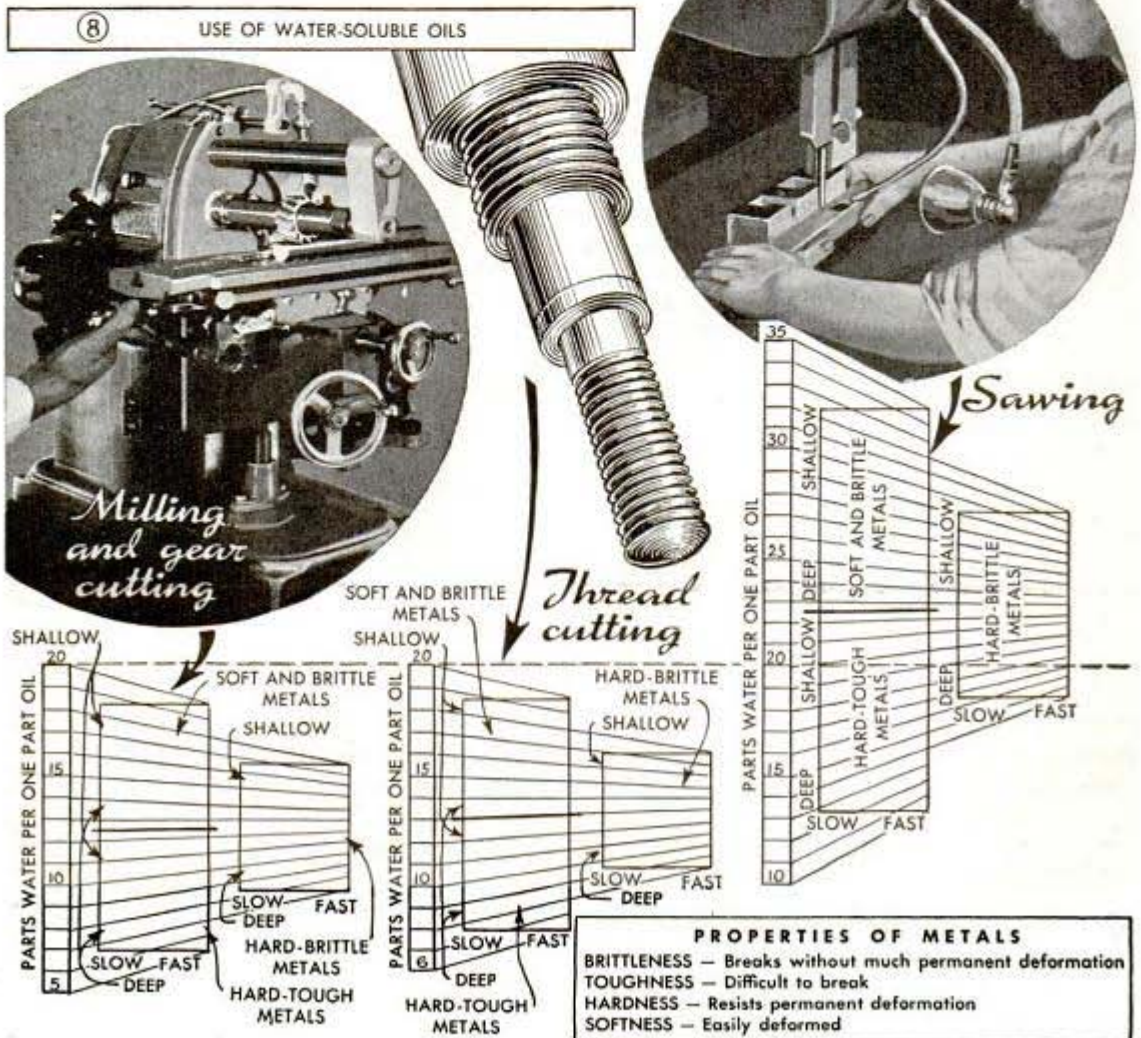
**Grinding:** Grinding operations produce heat resulting in an uneven temperature

in the work, which causes distortion and a consequent inaccuracy. The flow of a cutting fluid serves to prevent this and serves also to keep the wheel clean and free cutting which makes for greater production. Here again clear water will rust the machine and work. The addition of a water-soluble oil will inhibit the corrosive action, but it must be remembered that too small an addition will not afford the proper protection.

**Drawing, extruding and pressing:** Drawing, extruding, and pressing operations are accomplished generally by using relatively high pressure which results in high temperature and great friction. The proper cutting fluid should provide sufficient lubrication and cooling qualities and yet not break down, decompose, or char under the severe operating conditions. It should also be easy to remove and not interfere with subsequent operations, such as welding, plating, and painting. Dry drawing is usu-

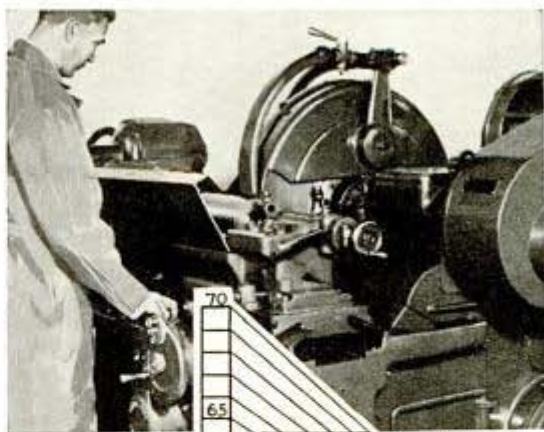
ally done with a very dry sodium soap powder free from oil, fat and glycerin. Wet drawing baths are merely a water solution of the sodium soap called an emulsion. Sulphonated fatty acids, that is, the acids from natural fats which have been chemically reacted with acid under proper conditions, produce stable emulsions of fine particle size for this purpose. Graphite has been used in drawing and pressing operations, but as it causes excessive charring, which is almost impossible to remove, its use has been restricted.

**Using soluble cutting oils:** The chart given in Fig. 8 has been prepared to serve as a guide in the use of the most common cutting fluid or water-soluble cutting oils. This chart makes it possible to determine quickly and accurately the proper amount

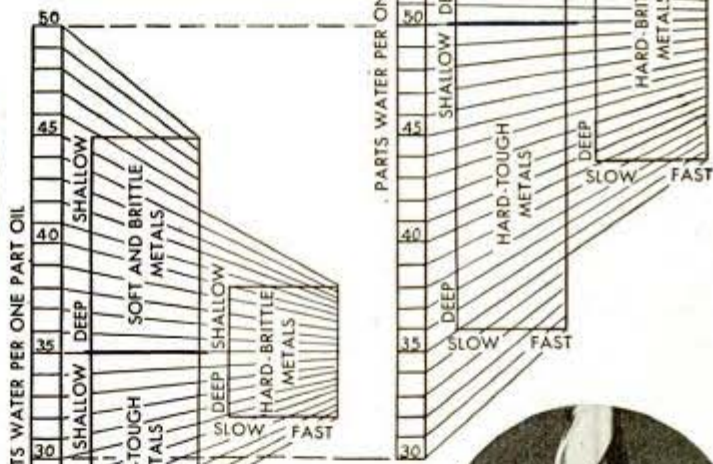
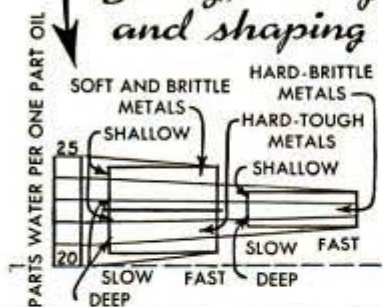




of water to add. To aid in using the chart, a shop operation will be followed through. We will assume that a certain metal rod is to be threaded, although we are not certain what type of metal it is. The chart gives two common methods for determining the type of metal, that is, whether it is hard, brittle, etc. After performing a test grinding, noting the sparks, a confirmatory test can be made with a cold chisel. In our example we will assume that these tests show that the metal is hard and tough, that is, the large white sparks are relatively few in number and continuous chips are formed with difficulty by a chisel. Next, we must determine the speed of the operation and the depth of cut. Here again we will make an assumption that a heavy thread is to be cut, which means a deep cut, and that the operation is to be carried out as fast as possible. In any case, before the selection of the amount of water to be added to the soluble oil can be made, four things must be known:



*Boring, turning and shaping*

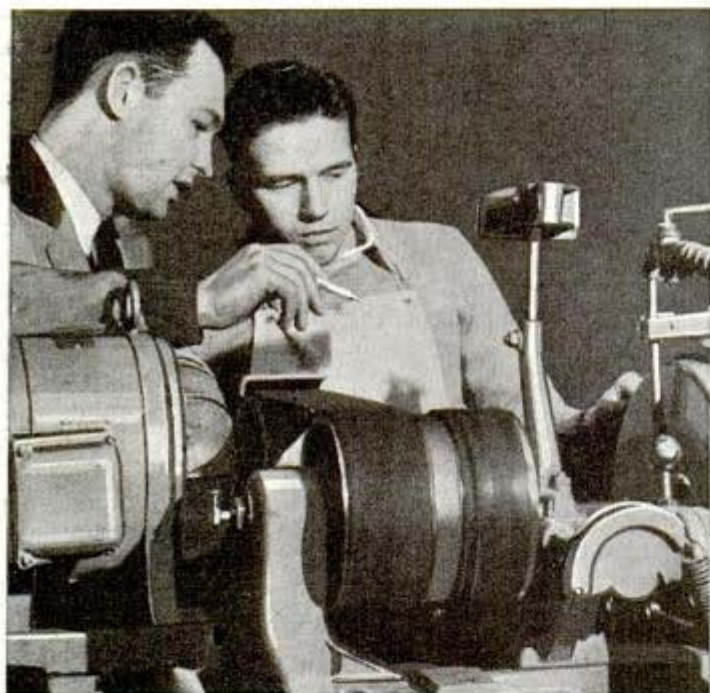


*Drilling*



**TESTS TO DETERMINE TYPE OF METAL**

METHOD OF DETERMINATION	TYPE OF METAL					
	SOFT	BRITTLE	HARD	TOUGH	HARD-BRITTLE	HARD-TOUGH
COLD CHISEL TEST	Easily cut	Chips break in-to small pieces and tend to powder	Difficult to chip	Chips long with little tendency to break under chisel	Hard cutting accompanied by chips that break into small pieces	Hard cutting accompanied by a long chip
GRINDING TEST	Few or no sparks with tendency of metal to adhere to stone	Small yellow sparks	Small white sparks	Large forked white sparks	Many very fine white sparks	Few large white sparks



Red litmus paper immersed in soluble cutting oil should turn blue. If this does not happen, add soda ash to the oil, a little at a time, and stir in, testing with fresh red litmus paper between additions

(1) Type of metal to be worked, as a hard-tough metal, etc. (2) Operation to be performed, as threading, etc. (3) Speed of operation (4) Depth of cut. With this information, the next step is to determine the parts of water that are to be added to one part of oil. To do this, first select the portion of the chart treating with the desired operation, which in our case is thread cutting. This is found on the graph as the second scale from the left. This scale, as in the case of the other five, is divided into three main parts by rectangular areas labeled; (1) Hard-tough metals, (2) Hard-brittle metals, and (3) Soft and brittle metals. If the metal is a hard-tough metal, as in our example, the rectangular area treating hard-tough metals is referred to. If the metal is soft, or if it is brittle, the rectangular area treating soft or brittle metals is referred to. The same method is applied to hard-brittle metals. Following our example again, we see that we must refer to the rectangular section marked hard-tough metals under thread cutting. This rectangular section, is crossed by lines that lead to the scale at the left marked "parts water per one part oil." As one moves to the bottom of the rectangular area, this corresponds to an increase in the depth of cut. As one moves along the bottom from left to right, this corresponds to an increase in operational speed. In our example, the depth of cut is to be deep and the speed of operation fast. Therefore, this places us in

the lower right-hand corner of the rectangle marked hard-tough metals under thread cutting. All that is now necessary is to follow down the nearest line that leads to the scale marked "parts water per one part oil." In our case we find that six parts of water are to be used with one part of oil. The same procedure is followed through for all other types of shop operations. For the specific shop operations that are not actually listed on the graph, select the most similar operation listed and consult it for the selection of the proper cutting oil.

(Next month—How to Read Machine Shop Blueprints)

## Scratch Brush Reversed Weekly To Make It Last Longer

For several years, I have devoted an hour or so each Saturday night to cleaning up the shop preparatory to the next week's work, and one of the points of procedure during this clean-up is to remove the wire scratch brush from the motor shaft and turn it around. By this means the brush is rotated in the opposite direction and any tendency for the bristles to become bent backward from hard use one week is automatically corrected the following week. A brush periodically turned in this manner will give satisfactory service much longer than one which is installed and never moved until it wears out.

—W. C. Wilhite, Carlinville, Ill.

## Re-Inking Typewriter Ribbons

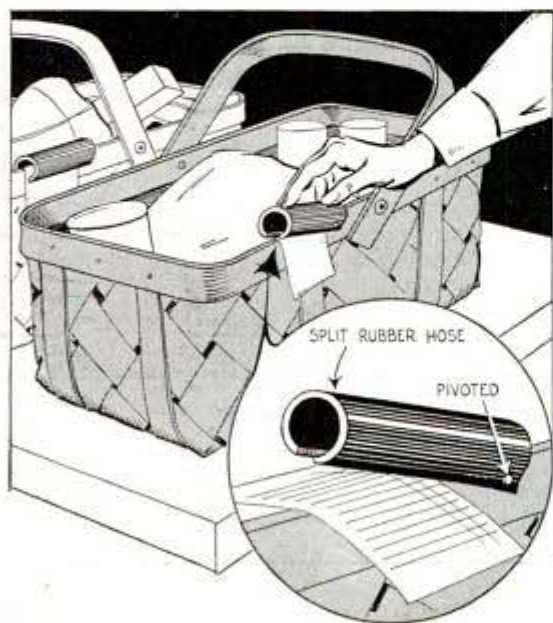
Regular stamping ink can be used to re-new a typewriter ribbon. Just remove one side from the ribbon reel and apply the ink to the edges of the rolled ribbon. Then



wind the ribbon onto another spool and re-wind it onto the first spool again, twisting the ribbon so that the edges of the ribbon not previously inked are exposed

to the side of the reel that has been removed. The re-winding is best done on a typewriter. Now ink this side and let the ribbon stand for a day or two so that the ink works evenly throughout the entire surface. Then re-assemble the spool.

## Split Hose on Delivery Basket Retains Order Slips



To keep delivery slips on baskets of groceries, one merchant fits each basket with a short piece of rubber hose, which is slit on one side to fit over the edge. A tack through one end prevents loss of the improvised clip, which is merely lifted to clamp down over the delivery slip.

When repairing V-belts by beveling the ends and gluing them together, additional strength can be provided by inserting two catgut strings through the joint.

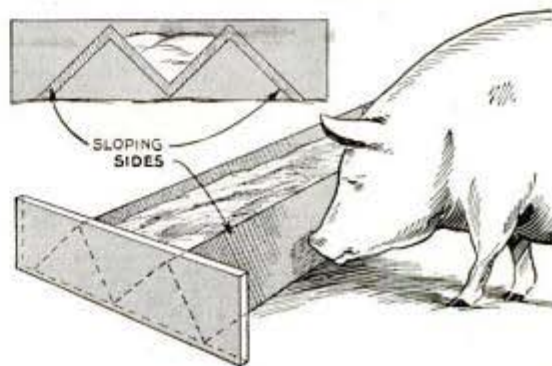
## Quarter-Notched Hitching Post Holds Halter Rope Easily



A Wisconsin veterinarian who often treats or examines horses in the yard of his office, has a special hitching post for the purpose. The top is quarter-slotted as shown, the slots running to a depth of about 6 in. from the upper end. The halter rope or strap can be drawn through these slots quickly and pulled to hold the animal with a long or short hitch as required. No tying or knotting of the rope is necessary as the double looping through the slots holds it securely in place.

## Sloping Sides on Wooden Trough Prevent Hogs Rooting It

The nuisance of having hogs root their feed trough around the floor, sometimes spilling the contents, can be eliminated by adding sloping sides to the trough. These are additional boards the same length as the trough and they are set at an angle and fastened by nailing through the ends and sides of the trough. In this position the extra sloping sides make it impossible for the hogs to work their snouts under the trough or to gain leverage against the sides to push it on the feeding floor.



## Form on Which to Oil Harness Made From Barrel

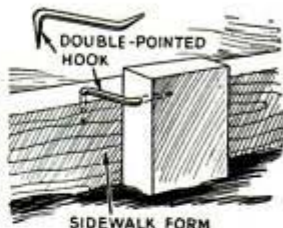


Set on a sawbuck or other suitable support, a barrel provides a good form on

which to place a harness while oiling it. In this way, the job is not only simplified, but the various parts are more easily available for adjustments that may be necessary.

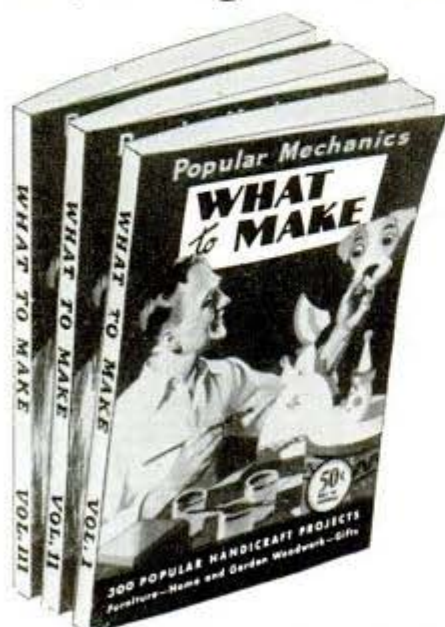
## Double Hooks Replace Tie Wires On Sidewalk Form Boards

To avoid wasting time handling tie wires on concrete forms for sidewalks, one contractor uses double-pointed hooks which are made from medium gauge wire. In use, one end of the hook is driven into the form which leaves the other hook at an angle to be swung and driven into the stake that supports the form.



The rapidity with which the fasteners can be attached or removed makes the time necessary to construct them worthwhile.

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# Radio

## First Aid Suggestions for Your Radio Sets

### PART IV

**DO NOT** mistreat your radio set or any electrical appliance by yanking the cord out of the wall socket. Bad connections and broken power cords are the result of such treatment and it is easier to grasp the plug and remove it, as shown in the insert photo. Many midget and table model receivers employ a line cord that has a built-in voltage-dropping resistor that will withstand just a few such jerks, then the set will develop crackling noises or refuse to work. The only remedy in such cases is a major operation on the line cord or a new cord. Even where there is no resistor in the line cord, the plug is easily damaged and rubber-covered plugs are not plentiful.



Although there is no serious shortage in receiving tubes at the present time, production will be discontinued on many of the obsolete and seldom used old

types, as well as many others that are duplications in all but minor details. However it is claimed that there will be several years supply of these discontinued types on hand after production ceases.

The RCA interchangeable tube chart No. 1 shows tubes interchangeable with their preference types. The tubes listed are ordinarily interchangeable but occasional exceptions will be found. Such exceptions will generally be caused by size difference of tube types or unusual circuit conditions. In receivers designed for glass-octal tube types, the No. 1 terminal of sockets is often used as a tie-point support for circuit parts. In such sets, the interchange of a metal-type tube may not be advisable because the No. 1 socket terminal connection may put a high voltage on the shell of the metal tube. Tube chart No. 2 will list Raytheon types. Reference to these and charts issued by other tube manufacturers will solve tube renewal problems.

(To be continued)

### INTERCHANGEABLE TUBE CHART

RENEWAL TYPE	INTERCHANGEABLE TYPE(S)	RENEWAL TYPE	INTERCHANGEABLE TYPE(S)
OZ4	OZ4-G	12A8-GT	12A8-G
1A5-GT	1A5-G	12K7-GT	12K7-G
1A7-GT	1A7-G	12Q7-GT	12Q7-G
1C5-GT	1C5-G	12SA7-G, 12SA7-GT	12SA7-G, 12SA7-GT
1H5-GT	1H5-G	12SK7	12SK7-GT
1N5-GT	1N5-G	12SQ7	12SQ7-GT
2A3	2A3-H	24-A	
2A5		25L6-GT	25L6, 25L6-G
3Q5-GT		25Z5	
5Y3-G	5W4, 5Z4	25Z6-GT	25Z6, 25Z6-G
5Y4-G		26	
5Z3	83-V	27	
6A7		30	
6A8	6A8-G, 6A8-GT	35	
6C6	77	35L6-GT	35L6-G
6D6	78	35Z5-GT	35Z5-G
6F5	6F5-G, 6F5-GT	39/44	
6F6	6F6-G	41	
6H6	6H6-G, 6H6-GT	42	
6J5	6C5, 6C5-G, 6C5-GT, 6J5-G, 6J5-GT	43	
6J7	6J7-G, 6J7-GT	45	
6K6-GT	6K6-G	50L6-GT	
6K7	6K7-G, 6K7-GT	56	
6L6	6L6-G	57	
6Q7	6Q7-G, 6Q7-GT	58	
6SA7	6SA7-G, 6SA7-GT	75	
6SJ7	6SJ7-GT	76	37
6SK7	6SK7-G, 6SK7-GT	77	6C6
6SQ7	6SQ7-G, 6SQ7-GT	78	6D6
6U5/6G5		80	
6U7-G		83	
6V6-GT	6V6, 6V6-G	84/6Z4	
6X5-GT	6X5, 6X5-G		

CHART NO. 1

The short length of the "GT" type ordinarily permits it to be interchanged with either "G" or metal type

# EXPERIMENTERS' "SPECIAL" 5-BAND

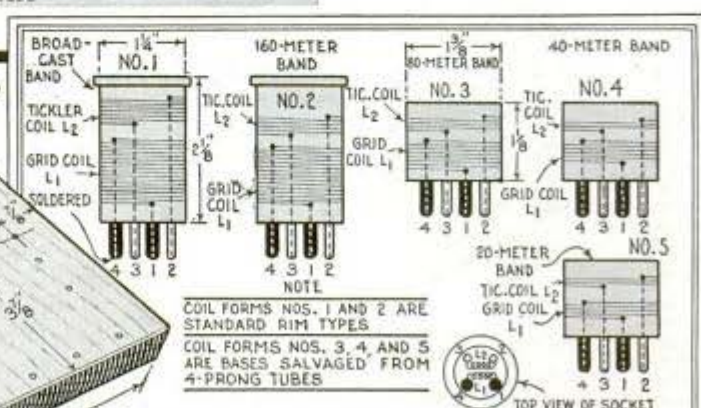
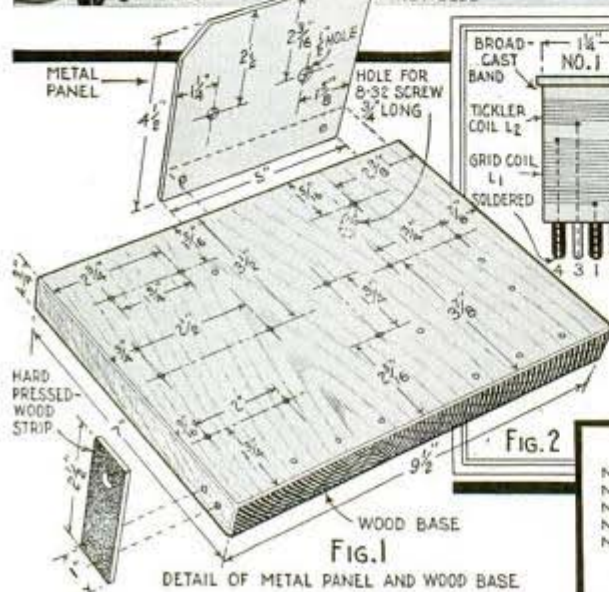
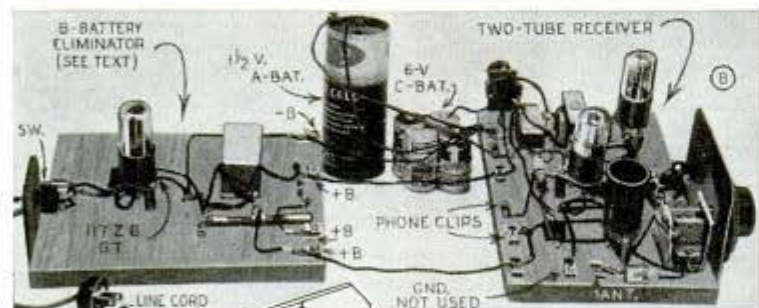
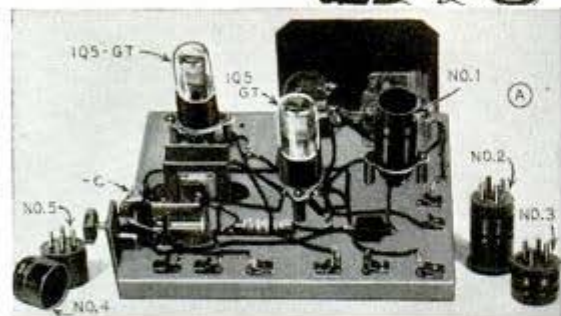
By Stanley Johnson



THIS is No. 2 "Special" in the series of "V" sets for students and experimenters. No. 1 appeared in the July issue and, although this two-tube receiver utilizes all of the same parts that were used in the 1-tube, it is a complete and entirely different set. Like the previous set this one uses a 1Q5-GT as a detector, and a second 1Q5-GT serves as an audio-amplifier stage, boosting the output to loud-speaker volume on local broadcast stations and gives excellent headphone volume on weak distant short-wave stations.

If you have built the one-tube set, it will not be necessary to dismount the volume control, tube socket or the Fahnestock clips. Resistor (R<sub>1</sub>) and fixed condenser (C<sub>2</sub>) also can be left in position, however all other parts and wiring should be removed before starting construction on this two-tube receiver. Frame and shaft of variable condenser (C<sub>1</sub>) must not touch metal panel.

Five-band operation is obtained by the use of five hand-wound plug-in coils, and a simple switching arrangement, switch No. 2, which permits the use of all of the capacity in the .000365 mfd. variable condenser (C<sub>1</sub>) on the broadcast band, and to reduce



**COIL CHART**

No. 1—(BROADCAST BAND)—GRID 90 TURNS—TICKLER 25 TURNS
No. 2—(160 METERS)—GRID 43 TURNS—TICKLER 16 TURNS
No. 3—(80 METERS)—GRID 22 TURNS—TICKLER 9 TURNS
No. 4—(40 METERS)—GRID 12 TURNS—TICKLER 6 TURNS
No. 5—(20 METERS)—GRID 5 TURNS—TICKLER 5 TURNS

NOTE—ALL COILS ARE CLOSE WOUND IN THE SAME DIRECTION WITH No. 30 ENAMELED WIRE

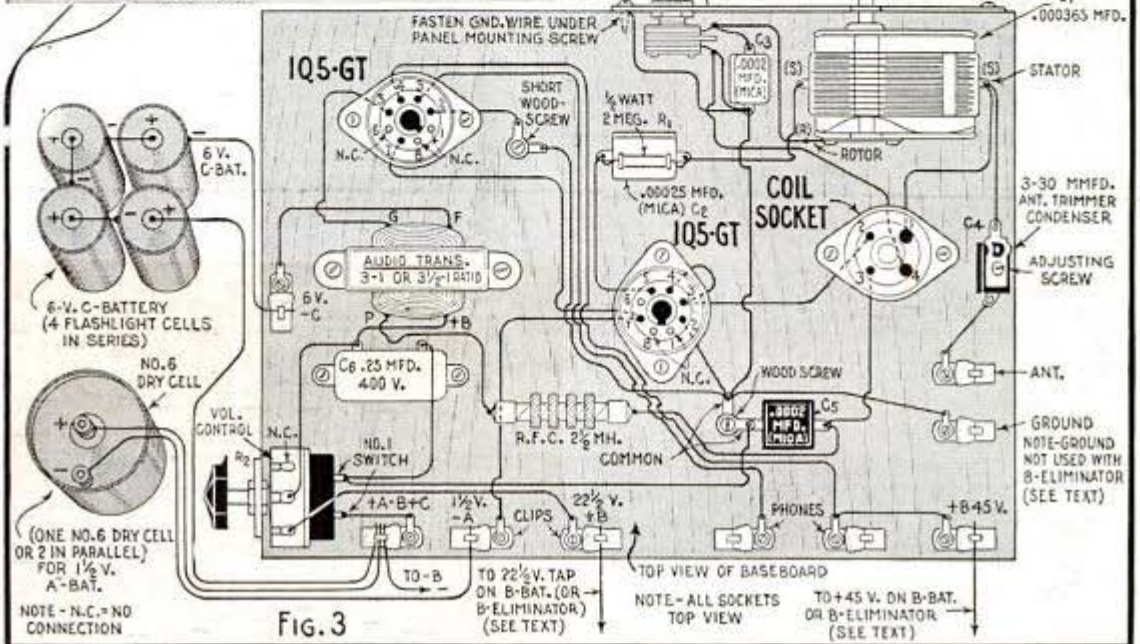
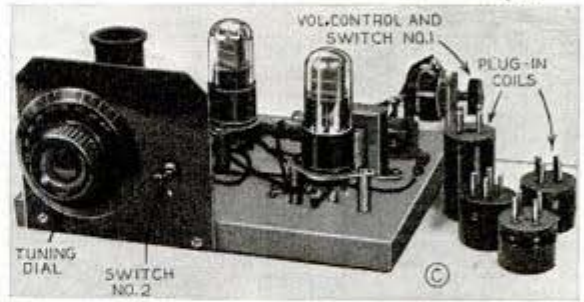
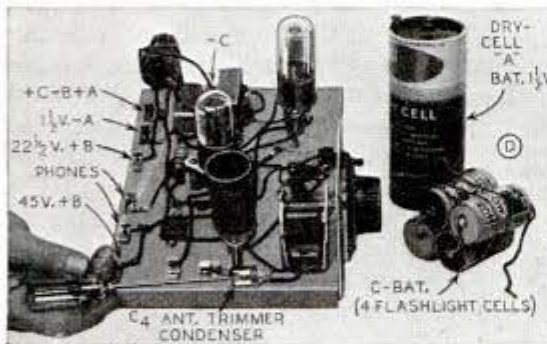
# BEAM-POWER "TWIN" TWO-TUBER

JUNK-BOX PARTS ADDED TO THE JULY BEGINNER'S "SPECIAL" ONE TUBER

the capacity of condenser ( $C_1$ ) by switching in a .0002 mfd. fixed condenser ( $C_3$ ) in series with it, so that the short-wave bands may be tuned with the customary four plug-in coils.

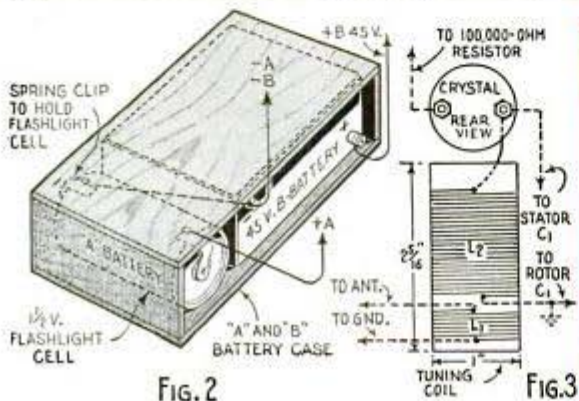
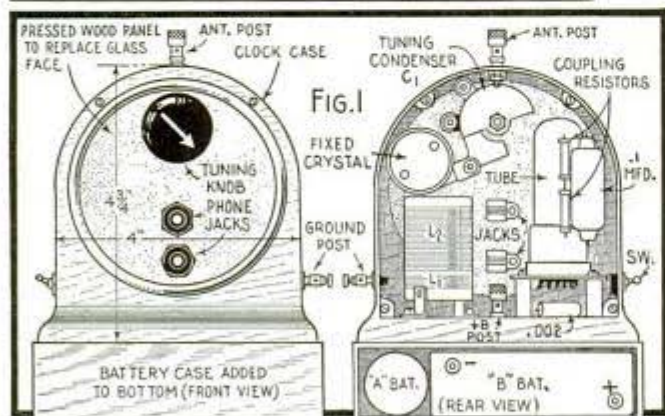
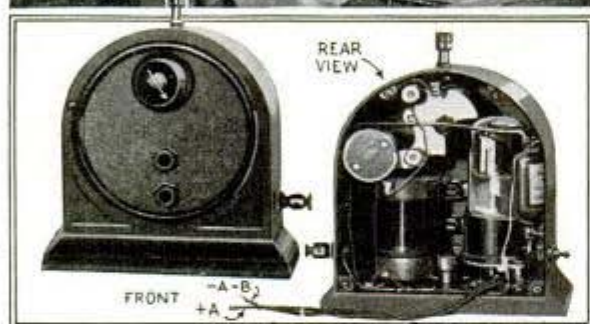
Complete baseboard and panel details for this set are given in Fig. 1, and the coil-winding data appears in Fig. 2. All parts are clearly shown in the simplified wiring diagram Fig. 3, schematic circuit diagram Fig. 4 and photos A, B, C, D and E. It will be noted that both octal tube sockets and the 4-prong coil socket are mounted on 1-in. bushings cut from any kind of metal tubing available. The audio transformer and other parts, indicated in Fig. 2 are commonly found in any radio experi-

(Continued to page 172)



# Crystal-Tube Receiver From Junk-Box Parts

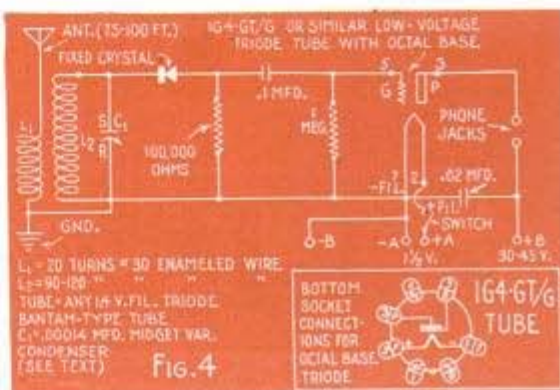
By L. B. Robbins



HERE is a crystal receiver that really "goes to town" because it combines a fixed crystal with one stage of resistance-coupled audio amplification. If a long, high antenna and a cold water pipe ground are used, local stations come in clear and quite loud, while many distant stations have been logged by the writer, especially at night when signals are best.

Any triode tube of the 1.4 volt filament type such as the 1G4-GT/G, HY-113 or similar variety may be employed. The entire receiver was assembled in the case of a small defunct electric clock and then mounted on a suitable cigar-box wood base to hold the batteries for the amplifier stage, as detailed in Figs. 1 and 2. The completed set is about 6 in. high, 2½ in. thick and 4½ in. wide. If an old clock case is not available, any wood box of similar dimensions may be used and extended to include the batteries.

The circuit diagram and coil winding details are given in Figs. 3 and 4. Coil L<sub>2</sub> is close-wound on the form; then wrap a piece of paper or Scotch tape over the lower end, and over that wind the 20-turn coil L<sub>1</sub> in the same direction. If you have an old r.f. coil from a broadcast receiver it may be adapted for use; the resistors are ¼ watt. In case the band is not completely covered, add to or remove turns from L<sub>2</sub> or use a larger capacity for condenser C<sub>1</sub>. Try reversing the crystal terminals for best sensitivity. A 150 mmfd. fixed condenser in parallel with C<sub>1</sub> aids in covering the lower half of the broadcast band.



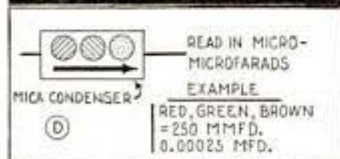
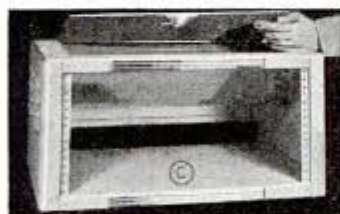
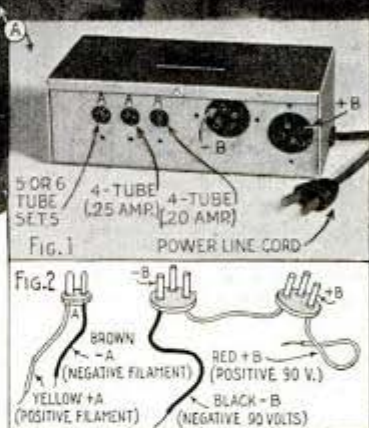


# Helpful RADIO HINTS

(A) When battery packs for portable receivers are difficult to obtain, you can operate such sets by means of a compact A and B power unit that works from the 115-volt 60-cycle house line. Plug-in sockets provide 1.4 volts "A" and 90 volts of hum-free "B"-power for any 4, 5 or 6-tube battery receiver. A simple cable harness is supplied to fit all standard sets as shown in Figs. 1 and 2

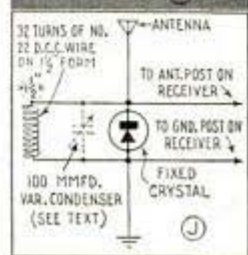
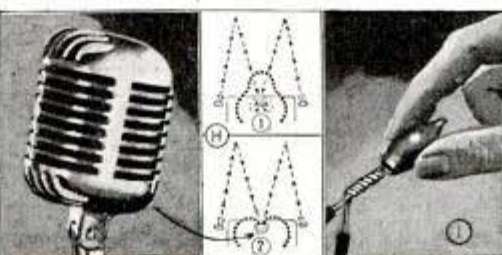
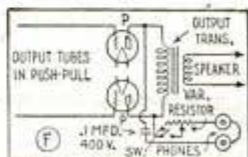


(B) Screwdriver designed to fit all Reed & Prince and similar recessed head cross slot screws from the smallest size to the largest, as indicated in the sketch. (C) Rough coat air-drying wrinkle-finish varnish brushed or sprayed on metal cabinets provides a durable, attractive finish; it is available in the silver-gray shown, also in black, brown, green, red and blue. (D) Condenser color code is based on standard RMA resistor color code

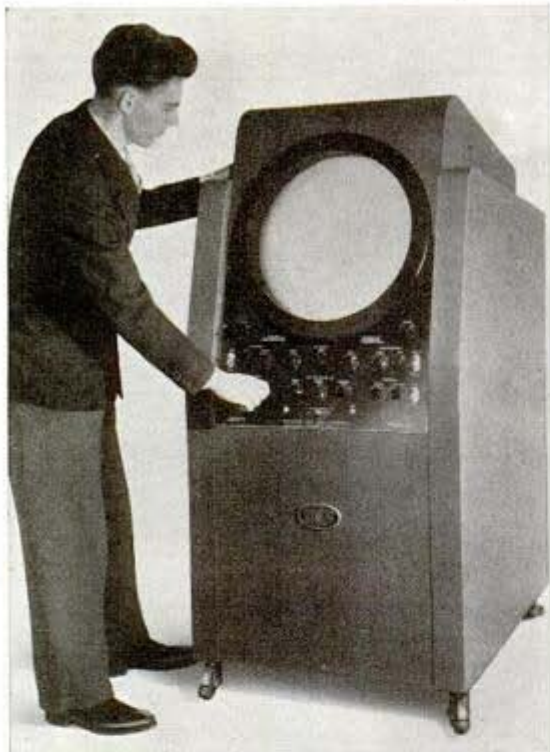


(E) Call letters drawn on scrap plastic and cut out with a fret-saw, for mounting on your car. The same idea can be used for house numbers, weather vanes and similar applications. The light shades may be illuminated. Draw the design on typewriter paper with pen and ink; each figure or letter is tied in as shown. Transfer the design with a hard pencil and provide a V-block on the bench for sawing and filing. (F) 5-megohm universal "Clarostat" or similar variable resistor, with switch and fixed condenser permits use of headphones with any receiver

(G) Polarized pilot-light assembly provides regulation of light intensity. (H) "Cardioid" type microphone is unidirectional, receiving front sounds and rejecting rear sounds yet has wide angle front pick-up. Diagram No. 1 shows how an ordinary microphone is subject to feedback, No. 2 is not. (I) Soldering unit for emergency connections; match applied to shell flows solder into splice. (J) Experimental short-wave adapter for a broadcast receiver; variable condenser permits flexible tuning over the police bands



## Giant-Screen Oscillograph



Designed for lecture-room demonstration and for more critical laboratory studies, this giant oscillograph employs a 20-inch intensifier-type cathode-ray tube with a medium-persistence green screen. The final accelerating potential of 6,000 volts provides a high-intensity spot so that a highly detailed trace may be observed even in lighted rooms by a large group.

## Illumination Blackout Control



This compact blackout control unit permits illuminated billboards, store-window displays and other time-switch-controlled illumination to remain in operation in districts where blackout regulations are in effect.

Its photo-electric optical system is focused on the nearest street lamp; when this street lamp is turned out, the blackout control unit immediately turns off the illumination which it is controlling. It is claimed to be relatively insensitive to light from any source other than the street lamp which it is observing. A special feature is a time delay circuit that makes it independent of momentary fluctuations and flickering of the street lamp.

## Ultra-Short-Wave Transceiver

This combination 2½ meter radiotelephone and receiver has been developed for authorized fixed station operation or as a mobile unit in an automobile, truck, boat or plane or anywhere a 6-volt battery or 110 volts 60 cycle a.c. is available. It incorporates a separate receiver using an HY-615 tube as a super-regenerative de-



tector and a separate transmitter utilizing an HY-75 as an ultra-high-frequency oscillator. The input is rated at 20 watts. A 5-inch speaker is self-contained and good volume was obtained from most stations during field tests.

Blueprints covering simplified radio construction articles in this and past issues are available for 25c each. Many popular tested circuits for beginners, students and experimenters may be built with used parts. Detailed material lists can be obtained from Popular Mechanics Radio Department upon receipt of postage.

**NEXT MONTH—Experimenter's All-Wave "Special" Three-Tube Junk-Box Super. No. 3 set in the Special "V" series; each unit in this series is a complete receiver of progressive type employing the same parts with minor additions. Also A Home-made Tungar Battery Charger and First Aid for Home Sets, Part 5.**

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**Band Saw & Scroll Saw**—Ripping and Resawing; Use of Standard Fence; The Ripping Blade; Ripping Curves; Tilt Table Operations; Cutting off with Fence and Gage; Use of Stop Rod; Cutoff Block; Using Clamp attachment; Crosscutting Wide Stock—Cutting Circles; Jig Construction; Cutting Glue Blocks; Round Corners; Circular Rails; Sanding; Compound Band Sawing; the Cabriole Leg; Compound-Sawed Turnings; Ornamental Work; Sawing in Multiple; Ripping Thick Stock; Split Dowels; Tapering Jigs;

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## Let's Keep 'Em Healthy

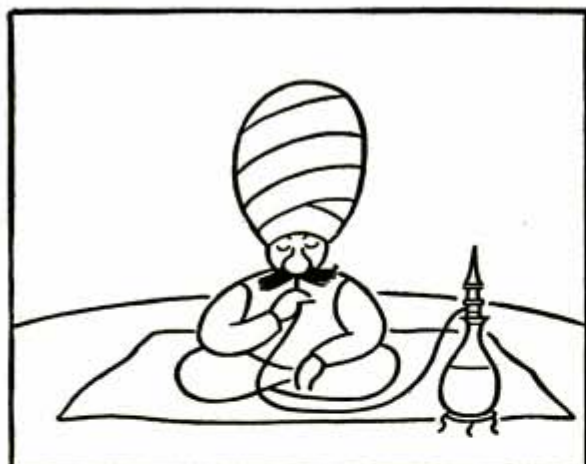
(Continued from page 85)

accidents of this type. The wax tester was built like a midget bobsled, with three little leather runners supporting an eight-inch wood base. When a 100-pound weight was placed on the sled the load was carried by the runners much as the weight of an average person is distributed over the soles of his shoes. When pulled by a spring balance across a waxed surface, the sled measured the amount of pressure required both to start it and to keep it moving, thus determining how easily a person might slip on the wax and how far the slip would carry him. Numerous tests with the robot uncovered one wax on which a pull of more than 100 pounds was necessary to start the sled and almost as much to keep it sliding.

Of all occupational diseases, skin irritations are dominant. Even if a worker has a mild skin disease, he may have to be transferred to another department to prevent aggravation of the ailment by dirt, dust or grease. This costs time. Unless safeguards are provided, skin irritations may be caused by a number of the countless new materials, such as solvents, resins, waxes and cleaners that are being used in industry today. One large company alone used some 4,200 different materials in its manufacturing processes and something about the toxicity of all must be known. Precautionary instructions may be necessary in handling a material. For example, a new paint-spraying operation may require the use of a special hood or ventilating system; the vapor from a new lacquer may be injurious to the hands or lungs and instructions must be given for wearing a respirator or gloves.

The importance of keeping the worker on the job was pointed out not long ago by Dr. Thomas Parran, Surgeon General of the U. S. Public Health Service. Here is the way he puts it: "Based on data from the Bureau of Labor Statistics showing the man-hours required to produce various kinds of war material, I have calculated that a 10 percent reduction in industrial manpower losses from disability would build twelve cantonments of average size, or five battleships or 16,407 tanks."

So the great battle goes on, for victory over industrial hazards means victory elsewhere.



## The Last Round-Up

(Continued from page 76)

museum. Another was the artist who made the painting or field study for the background. The third man was the artist-technician who collected grass, sage, trees, soil, rocks, and also photographed in black and white and in color the grass, sage and trees as well as the sky, distant hills and the horizon.

For the most commonplace article of all, the buffalo grass, transportation was a tremendous problem because the thin stalks were so easily broken. As in the case of the small sage brush, the grass was shipped by express suspended inside of specially made boxes so that the stalks might wave without cracking. Speed was necessary so that the uprooted grass would not fade and wither.

As soon as the grass reached the museum it was treated with an arsenic solution to kill all bacterial life, given a soaking in alcohol and treated with glycerin. Similar preservative methods were applied to the sage and other bushes.

In the case of a tree, however, the trunk is not usually shipped, but is measured and photographed, after which the bark is removed, along with the branches which will be used. Back in the huge preparatory rooms of the museum, a tree is constructed to measure for the bark with a foundation of bolted wood, a covering of wire mesh, burlap, plaster of Paris and papier-mache. After an adhesive has been applied to this, the bark is cemented on and the branches are attached in the correct places. This is not just any tree, but a replica of a real tree which actually grew many miles away from the glass cage of the museum.

Meanwhile, in the case of the bison, the hides are tanned while artists prepare a body to receive them. From photographs and measurements, the sculptor produces a replica of the original animal's shape. This sculpture is used to make a mold from which the final body is cast. An adhesive is applied and the skin is put on.

New methods together with new products have made possible the lifelike character of the exhibits, never before achieved by a museum on such a scale. Paints with casein bases and light lacquers have made it possible to color flowers and large areas

(Continued to page 164)



**"Sani-Flush saved my car's life.  
Cleaned out the radiator,  
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of delicate grass which would soon bend and collapse under the weight of the lead in old-fashioned paint. Lakes and streams, for which glass never was practical because it continued to look like glass regardless of what was done to it, are now created by the use of Plexiglas or Lucite or some similar plastic which renders molding and shaping easy. Paint is sprayed on lightly, in contrast to the heavy brush in exhibits a generation or so ago. Fluorescent lights soften natural effects. Color photography brings the correct hues back

to the museum for duplication. New adhesives are more lasting. And Cellophane raincoats protect animals while exhibits are being built.

Thus science, which specializes in artificial reproduction of nature's wonders, is working to make more natural the reproduction of wildlife so that the future generations—if the time should come when any of our American mammals are extinct—may find in the museums what we can still see today in zoos and reservations, or in the woods.

## New Crops for America

(Continued from page 95)

first thing the American farmer would need do is to strive for a worthwhile yield per acre.

Other condiment crops include anise, which might be grown on the Pacific coast and in the north-central states; cayenne, suitable for cultivation in the cotton producing states; cumin, adapted to gulf coastal and Pacific coast states; dill (used in making dill pickles), which may be grown in the north-central states; fennel, adaptable to northern states; ginger, which has possibilities in subtropical parts of southern Florida; marjoram, requiring a mild climate; paprika, (\$740,000 worth imported each year), which might be produced in the southern states, east and Pacific coast states and in irrigated valleys; sesame (imports totaled \$3,120,000 in 1936), which can be grown in warmer parts of the country, chiefly where cotton grows best; sage, adaptable to the central and eastern states, and thyme, a small crop that can be produced in mild sections of northern states or local regions on the west coast. The farmer faces many difficulties in cultivating and harvesting these crops, however.

Few people can imagine that this country imports approximately \$700,000 worth of sunflower seed and oil from the seed each year. Surely, thinks the average farmer, nobody should be paying good money to "foreigners" when sunflowers can be grown so easily in this country. One drawback has been that the yield has not been sufficient for the crop to compete with others that could be grown in the same region at a greater profit. Too, cultivation has not been on a scientific scale, with the result that the oil yield from seed

is only 32 percent. Experimentation might raise this yield to 50 percent, making this crop more profitable. Factors influencing the yield of oil are soil, irrigation, fertilization, climatic conditions, planting methods, and quality and variety of seed. Oil from sunflower seed is used in making edible oil, soaps, illuminants, glues, paper, plastics and drying oils for paint.

Some other crops which the farmer might be wise to plant experimentally, with the idea of eventually adopting them as profitable sidelines, are listed by the chemurgic council, with the annual value of imports, as follows:

Arrowroot, \$189,000; bergamot oil, \$225,000; blueberries, \$558,000; canary seed, \$519,000; castor beans, \$2,794,000; garlic, \$208,000; hops, \$1,671,000; mushrooms, \$668,700; pepper, \$3,000,000; perilla (oil), \$2,000,000; psyllium (seed), \$310,000; rapeseed (oil and seed), \$1,600,000; sugar beet (seed), \$1,456,000; tea, \$16,669,000; tung trees (oil), \$10,999,000; vanilla (beans), \$1,661,500; flaxseed, \$20,156,000 and many others.

Already test plantings of castor beans, perilla, coriander, caraway, fennel, safflower, anise and sunflower have been made. The yield in castor beans has been as high as 1,000 pounds per acre at the Urbana station of the University of Illinois. Last year experimental plantings of castor beans were made in the region from Florida and Georgia to Texas, Oklahoma and Kansas. Some individual plots were grown in New Mexico, Arizona and California. In the region marginal to the cotton and corn belts the average yield was about 500

(Continued to page 166)

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Even at the old price of \$5.50, the Univex TWIN FLEX was the sensation of the camera world. This marvelous camera, with its matched focusing lenses, shows you the pictures on the ground glass range-finding screen *before* you take the picture. In other words, you can tell *exactly* the way each and every picture will look before you snap it. You automatically focus every picture before you take it. There is no squinting through small view finders! No out-of-focus pictures, whether the subject is close up or far away! **YOU GET EXACTLY WHAT YOU SEE!**

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pounds per acre. In a few cases plots under irrigation yielded more than 2,000 pounds per acre.

Experts warn that in experimenting with any of these new crops, it would be highly advisable that the best varieties of seeds, roots or cuttings be used and that none be planted until a thorough investigation has been made of soil composition. Care in selecting the crop, equal care in planting, cultivating, harvesting, handling and marketing, plus a lot of hard work, may add up to a profit. But each of these crops is a specialty in itself and the farmer would make a mistake in attempting to grow and handle several at the same time. In this, like any other endeavor, success must be earned.

## Dust the Destroyer

(Continued from page 91)

one building to another, in the course of manufacturing processes. In these conveyors, often of the wood box type, there is a definite and forever present explosion hazard.

Notwithstanding every precautionary measure for preventing explosions in the enclosed conveyors, it has been found advisable, because of heavy dust concentrations in the enclosed areas, to devise "chokes," "seals," and flame arrestors in the conveyor systems themselves. These serve to confine explosions to comparatively small areas in the conveyor systems, thus preventing spreading throughout entire systems and to other buildings. Safety pressure vents likewise have been designed to help prevent structural damage to buildings in case of explosions.

Despite the continual educational efforts by industrial safety groups, the dust hazard persists. Factory owners say "It can't happen here." But it can. Any factory doing grinding has an explosion hazard. The dusts of lead, antimony, zinc, tin, aluminum and magnesium have high explosive power. There have been estimates that explosions have occurred in a third of all the magnesium plants in the world.

One laboratory built a special explosion chamber to test the explosibility of various dusts. The engineers found that, with a high enough concentration of oxygen, even diamond dust will explode.

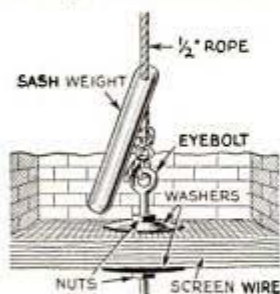


## Nail Polish Prevents Fraying Of Ribbon Ends



You will never be bothered by having ribbons on your dresses and hats fray if you apply fingernail polish to the ends. Just run the polish applicator along the edge of the ribbon, using colorless polish or a shade to match the ribbon.

## Simple Brush to Sweep Chimneys



Cleaning a chimney is a simple matter with this inexpensive brush. It consists of six to twelve thicknesses of screen wire sandwiched between two large washers

and nuts on an eye bolt. The pieces of wire should be of a size to scrape firmly against the sides of the chimney. A long rope tied to the eye of the bolt is used to raise and lower the brush inside the chimney. Weight to push the brush downward is provided by a sash weight.

## Repairing Refrigerator Door

In one case what was thought to be weakened or defective door fasteners, causing the door on a refrigerator to remain slightly opened, proved to be worn hinges. In such cases the hinge pins can be withdrawn, permitting the insertion of a bronze washer to take the thrust and to raise the door position. In others it may be possible to place a piece of copper wire around the pin and bend it into the form of a washer in the worn space.

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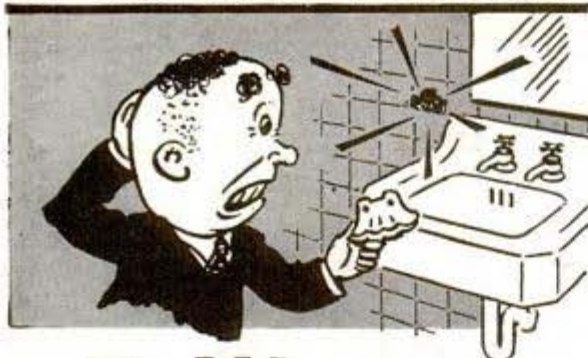
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## Modern Miracle

(Continued from page 11)

gested one change in making foreign-designed 40-millimeter antiaircraft guns which saves 30 pounds of material per gun and eliminates six machine tools.

The list of war implements that are pouring from automotive and allied plants is fabulous. Frigidaire refrigerators have given way to airplane parts, and machine guns; those machine guns consist of 292 parts, and 118 spare parts accompany each gun. A partial list of war products built in automobile factories totals 150 items, including airplanes and ambulances, armor plate, air pumps, ammunition hoists, guns, fuses, artillery ammunition and carriers, assault boat carriers, batteries, bombers and bomb loaders, buses, cantonment furnaces, cartridge cases and clips, jeeps and peeps, communication equipment, crash cars, earth borer and dump trucks, field kitchens, radio cars, fire engines, flood-lighting trucks, gas mask parts, instruments and gauges, generators, grinders, gun control apparatus, helmets, lathes and jigs, marine engines, oxygen cylinders, shells, radios and radio compasses, gun recoils, spark plugs, tanks, tools, torpedoes, tractors and trailers, gun turrets and troop carriers. That's merely suggestive of the job they're doing.

Most Americans have been blasé about mass production. Millions of new cars, millions of radios every year have come to be expected, and it's hard to get excited about the achievement.

But even the most sophisticated of us would get a kick in his amazement if he could look behind the curtains of what used to be the automobile industry. Four-motored bombers were flying from the end of a half-mile assembly line 13 months after they broke ground for the Ford Willow Run plant, which is so unimaginably colossal it could swallow Hollywood and all its adjectives without gagging. It's the largest aircraft plant in the world, and about the end of this year will be outproducing Boeing, Douglas, Consolidated, Lockheed and Vega combined. Now Chrysler is building an airplane engine factory big enough to swallow the Willow Run plant and 20 baseball diamonds besides. The famous River Rouge plant of Ford is already rolling out Pratt & Whit-

ney airplane engines, trucks, jeeps, tires, army automobiles and 30-ton tanks. The bomber program of Ford alone is as big as the whole motor car business used to be, and Ford war production will be twice as large as the company's entire peacetime production.

Chrysler was four months ahead of schedule in medium tank production on Jan. 1, and in the first four months of this year more than doubled its 1941 total output. In three consecutive months Chrysler tripled production of anti-aircraft guns and the accelerator was still down to the floor, with delivery 39 percent ahead of promises at this writing. Hudson has been turning out the 20-millimeter Oerlikon anti-aircraft gun at several times the contract rate. Willys is building 30,000 four-wheel-drive cars for the army. General Motors plants turned out 50 percent more war goods in the first quarter of 1942 than in the last quarter of '41. One entirely new plant built by Buick was turning out 1,200-horsepower airplane engines eight months after ground was broken. Packard, building engines for the "mosquito" boats, has doubled its plant capacity three times. Studebaker and Nash are both building planes and parts.

Mass production it is, but precision is as vital as bulk. An anti-aircraft gun built with the accuracy of a watch and hurling shells at 500 a minute is coming from one automobile factory at 30 times the rate specified in the Navy's orders.

In one month early this year, more American tanks were built than in all of the first World War. By the end of 1942 tank production will be more than four times the present rate.

What if you can't buy a new car? Your next car is an engineer's dream; today's reality is a mighty procession of war machines. You're sitting on the sidelines of a miracle.

### Printing Type Cast From Nylon Saves Use of Metals

Nylon may take the place of metals in printing type, according to a patent recently assigned to E. I. du Pont de Nemours & Co., Wilmington, Del. Type cast from nylon is declared to make sharp and clear impressions, and extremely thin-lined letters can be printed with it.

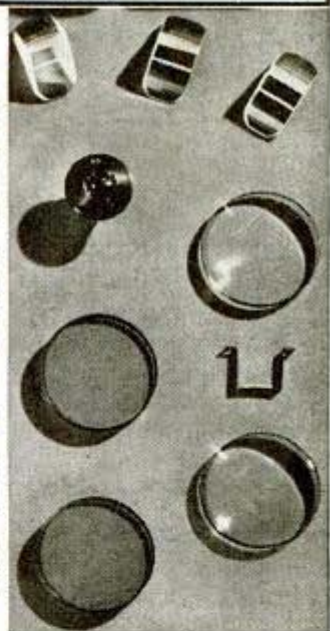
## The GREEKS Had A Word for It\*

\***PANOPTES**, the all seeing, was the word the Greeks had for the hundred-eyed Argus [ ἄργος. ] of ancient mythology.

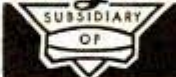
**I**N COMPARISON with his modern namesake—the ancient Greek Argus could see but little.

Optical science has become one of the "fine arts" in manufacturing, and Argus, with greatly increased facilities is rapidly becoming one of the leaders in this industry.

Its research, quality and precise mass production methods are now applied to the manufacture of lenses and precision instruments for the Government services.



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*More Vital-  
More Dependable  
than ever!*

TO SAVE GASOLINE • KEEP YOUR SPARK PLUGS CLEAN

## Shortcut to Tokyo


(Continued from page 31)

wildest part of America is a Paul Bunyan task no one but the Corps of Engineers would undertake. Once the crust of that sponge-like muskeg is broken, it won't even support a man. For a beginning, they're laying mats or building trestles over the bog to keep the supply convoys above ground. One of the first photographs to come back from the scene of operations showed one truck hoisting back to the rocky road another that had gone over the shoulder—reminiscent of the Burma Road.

They picked a he-man to handle this job—Col. William Morris Hoge, U. S. Army Corps of Engineers. In the World War he was awarded the Distinguished Service Cross for bridging the Meuse under shell fire. They have given him a year and 30,000 men to do the job. The latest word is that a passable road will be ready by winter, the full length of the route. Others have attempted smaller trail-making projects in this desolation; back in 1905 the Northwest "Mounties" superintended the construction of a wagon road from Peace River Crossing to the mountains 400 miles away. The job was abandoned after three years of work. But if Col. Hoge's engineers annihilate time as American industry and armed forces are, there'll be troop and supply convoys rolling overland to Alaska on a permanent, 24-foot rock-topped highway in less than a year. Then reinforcements will reach our northwestern bastion in three to four days instead of the eight days by steamer up the Inside Passage.

Military considerations are paramount at the moment. But after the war, what vistas of commercial developments the highway opens! The lands northwest are

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Thread Length	7/32	7/32	5/32
Weight, Grams	8	3 1/2	2 1/2

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unopened treasure chests of precious ores. Not far from Fort Nelson there are oil fields. The vast storehouse of mineral wealth lies waiting, and transportation has been the principal obstacle to its realization; freight planes have only begun to tap it. Alaska—still an almost unexplored wilderness twice the size of Texas and with a population under 80,000, half of it native—holds vast stores of timber and ore and game, yet its principal industry is—salmon.

Hardly had the road building begun when Canada and the United States agreed on a survey to determine the feasibility of a railway to Alaska. Army engineers took over that job, too.

And after the war—perhaps it will be a highway to Asia. A dream? Until now, yes. But the engineers pour dreams in concrete.

Years back, there was talk of tunneling under Bering Strait and driving a railroad across to Russia. The strait is only 55 miles across, only 30 to 60 feet deep. Motorists drive over the ocean to Key West, Fla. Why not a bridge to Russia?

That's looking ahead, but not too far. If Russia built roads from Khabarovsk or Vladivostok or some point on the Trans-Siberian railway to the peninsula opposite Nome, eventually a motorist might journey across a Bering Strait bridge on a highway reaching from New York—yes, from Buenos Aires to Gibraltar.

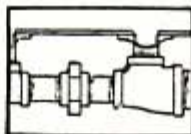
### Self-Sterilizing Silver Varnish Kills Germs on Tumblers

In the war against germs, it is now possible to make drinking glasses, bottle caps and similar items self-sterilizing by application of a silver-containing, varnishlike, viscous fluid developed by scientists at California Institute of Technology. Applied by brush, spray or impregnation to materials like plastics, glass, wood, paper and cloth, it quickly kills germs of the type found on drinking glasses, as well as molds in cider, and retains its sterilizing ability over relatively long periods. The compound has no odor or taste, and resists weak alkaline and acid action and boiling water.

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

SEPTEMBER, 1942

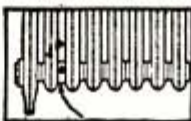
Ref: dr. A. Goetz, dr. R. Tracy & dr. S. Goetz  
of Calif. Inst. of Technology, Pasadena, Calif.



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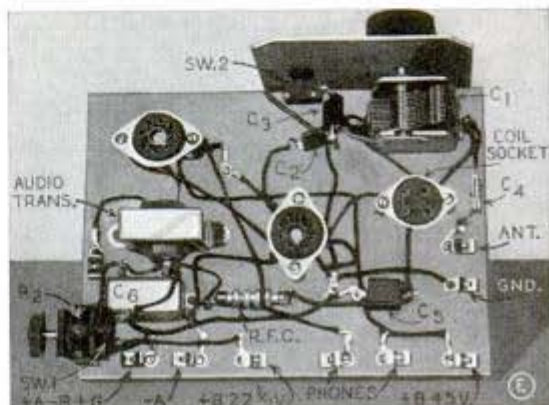
**The ROSICRUCIANS**  
 SAN JOSE (AMORC) CALIFORNIA

**Beam-Power "Twin" Two-Tuber**

(Continued from page 157)

menter's junk box or may be salvaged from old sets.

Either a tapped 45-volt B-battery or the "junk-box B-eliminator" described in the August issue, and shown in photo B, may be used for the "B" supply. If the B-battery eliminator is used, do not use a ground connection as no direct ground can be used with the B-eliminator. To keep line hum pickup at a minimum it may be necessary to place the B-eliminator several feet away from the receiver. If you are a beginner it is best to use the 45-volt B-battery, and



then replace it later with the B-eliminator. When using the B-eliminator, use the "low" tap to supply the non-critical 22½-volt lead to the set and either the "medium" or the "high" tap to supply the 45-volt lead. If the builder finds it necessary to use a ground on any set with which the B-eliminator is used, a .1 mfd. 400-volt tubular-type paper condenser must be connected in series with the set ground lead.

All of the coils are wound with No. 30 enameled wire on the forms shown in Fig. 2. Tube bases from old 4-prong tubes serve nicely for the three smaller coils and, should manufactured forms for the larger coils not be available, the experimenter can improvise by cementing two tube bases end to end with china cement, sawing off the spare set of prongs. The slight difference in the diameter of the forms will not matter. Solder all coil prong and circuit connections carefully with rosin-core wire solder.

The small metal panel may be cut from scrap sheet metal; it serves both as a shield to eliminate hand capacity, and as a mount

(Continued to page 174)

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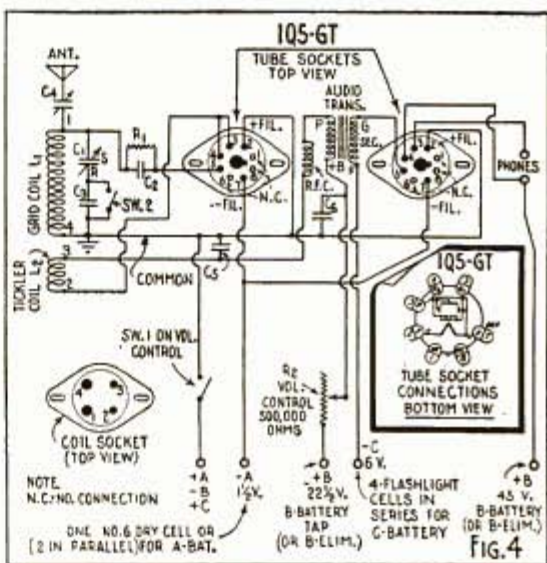
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for switch No. 2. The variable condenser is mounted on the baseboard by means of an 8-32 machine screw countersunk on the underside of the baseboard. Short wood screws mount all other parts. The volume control ( $R_2$ ) is used to control regeneration; switch No. 1 is combined with this control. A detailed list of materials is available to students and experimenters, from Popular Mechanics radio department without charge, if desired. The antenna should have a total length of at least 50 feet



for best results. Use a good pair of 2,000-ohm headphones and do not expect too much on the short waves until you are familiar with short-wave tuning which is more critical than broadcast-band tuning.

Check all wiring carefully before inserting the tubes in the sockets. To tune the broadcast band, insert coil No. 1 in the coil socket and see that switch No. 2 is closed to short out condenser ( $C_3$ ). Turn the variable condenser until a whistle is heard, then back off the volume control  $R_2$  until the whistle stops and the station comes in clear. For short-wave reception, open switch No. 2 and insert the coil for the short-wave band desired. The set is most sensitive at the point just where the whistle stops and the station comes in. Adjust antenna trimmer ( $C_4$ ), photo D, for maximum results on each band. When the set is not in use be sure that switch No. 1 is turned off and if the B-eliminator is employed there will be another toggle switch to throw. The blueprint number for this two-tube set is R-307.





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**Tin Fish for Nippon**

(Continued from page 53)

and the spent tube floats on the surface. Under war conditions, torpedoes are adjusted to sink if they miss their target. This removes them as a menace to navigation and prevents them from being captured by the enemy.

When the newly built torpedoes get the official O.K. of Navy inspectors, they are fitted with "war heads" of TNT. They are then ready to send Axis warships to Davy Jones's locker.

A modern American submarine carries from six to 12 torpedo tubes, some fore and some aft. A torpedo is loaded in each tube and spares are carried within the sub itself. The tubes can be fired when the submarine is on the surface, partially submerged or completely submerged.

Among our Navy's surface craft, torpedoes are used for the most part by destroyers and motor torpedo boats. Some of our older battleships and cruisers used to be equipped with torpedo tubes, but they have been abandoned in the newer ships. Destroyers, sometimes called the "cavalry of the sea," usually carry eight to 16 torpedo tubes, mounted in quadruple rows amidships. Each of the fast little motor torpedo boats, nicknamed "mosquito boats," mounts four torpedo tubes.

The torpedo-carrying plane has also proved its worth. Lugging a 21-inch torpedo in its belly, the plane swoops low over the water toward its objective and drops its cylinder of destruction near its target.

Torpedoes are sent thundering from their tubes aboard ship either by a charge of black powder or a puff of compressed air. Once a torpedo is free from its tube, it is on its own. Modern torpedoes are small, high-speed submarines — equipped with their own turbine-propelling engines and automatic depth-control mechanism.

When a torpedo hits the water, a lever is tripped which immediately starts the propeller's mechanism. Compressed air is mixed with alcohol and water to produce a hot steam. This steam is directed against the blades of turbines which drive the two propellers. Horizontal and vertical rudders control the direction of the torpedo and prevent it from turning over.

Against a deep-draft vessel such as a battleship, the torpedo is usually set to

travel from 20 to 25 feet below the surface of the water. Against a destroyer a depth of from five to 10 feet is sufficient.

Around 1900 the torpedo was equipped with a "brain." The gyroscope was added to the torpedo's internal mechanism for the purpose of increasing accuracy. It allows a torpedo, launched with its nose pointing anywhere within an arc of 120 degrees, to swing back on a pre-determined course. Therefore, a destroyer with torpedo tubes mounted at right angles to its keel, can fire straight ahead. The torpedoes shoot from their tubes at a 90-degree angle and, as if guided by a ghostly hand, turn and head straight for their target.

Torpedoes plow through the water at speeds varying from 30 to 50 knots. The range of the modern torpedo is up to 13,000 yards—about seven and one-half miles. The longest hit on record, however, is only about 3,000 yards, made by a German U-boat in 1917 on the American destroyer Jacob Jones.

World War I torpedoes often left a wake of bubbles which could be spotted and avoided. But these telltale signs have now been largely eliminated and usually the first sign of a torpedo attack is the explosion itself.

One of the newest developments in torpedoes is the "gun torpedo." When this type of torpedo pierces the side of a ship, it sets off a gun that fires an eight-inch projectile and causes further damage. It is thought that German U-boats are using this weapon.

As yet the world's best military brains have failed to perfect a device which will give adequate protection against the torpedo. The torpedo does its deadly work below the water line where armor protection is thin.

Many experiments have been made—double bottoms, intricate compartments, armor plates or shields carried at some distance from the ship's hull, blisters, nets, booms, negative electric fields, etc. But none has proved satisfactory. A smart skipper, however, can sometimes out-manuever a torpedo attack by zigzagging at top speed.

But as one veteran Navy officer said, the best protection against the torpedo is "a good, old-fashioned prayer—and that is none too good!"

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## Planes of Tomorrow

(Continued from page 5)

000-pound airplane will carry a payload of 50,000 pounds—equivalent to 100 passengers with 80 pounds of baggage apiece, plus 25,000 pounds of mail, cargo and express. This flight would be at sea level to avoid the higher head winds at higher altitudes, at a cruising speed of 200 miles an hour. Eastbound, the flight would be at 10,000 feet, taking advantage of the tail wind of 30 to 40 miles an hour. The saving in fuel would enable the ship to cruise with 60,000 pounds of payload at 230 miles an hour. Elapsed time eastbound would be about 13 hours, westward around 19. We could ride from New York to London faster than by train from New York to Chicago. If the airplane carries 75 percent of the maximum permissible payload, an operating profit can be had if a passenger pays \$225 one way, \$400 round trip.

Passenger accommodations will be luxurious indeed. Lavatory facilities will include bath and shower. Lounge space will be ample for such amusements as table tennis. Observation rooms will afford a spectacular view. Except for swimming pools and air promenade decks, we shall compete very favorably with the comforts of a luxury surface liner.

Navigational aids and safeguards required for a 25,000-pound airplane can be doubled in our 250,000-pound ship. The old standard of four engines will be increased to six or more with standby equipment in case of mal-functioning without adding appreciably to gross weight.

Out of the perils of this war is coming, paradoxically, safety for postwar air travel. The very instruments by which we locate hostile aircraft and assail them will assure both air and surface craft safe passage in any weather. We all read of the soldier, on watch at Pearl Harbor the morning of December 7, who clamored into deaf ears that there were airplanes 150 miles from his post. Imagine such a power devoted, by airplanes and ships, to detecting navigational hazards many miles away without dependence on visual or audible warning signals.

Or consider another device by which we see through fog. Grim enough when we know it is used by fighting pilots fingering triggers in wait for the enemy planes thus

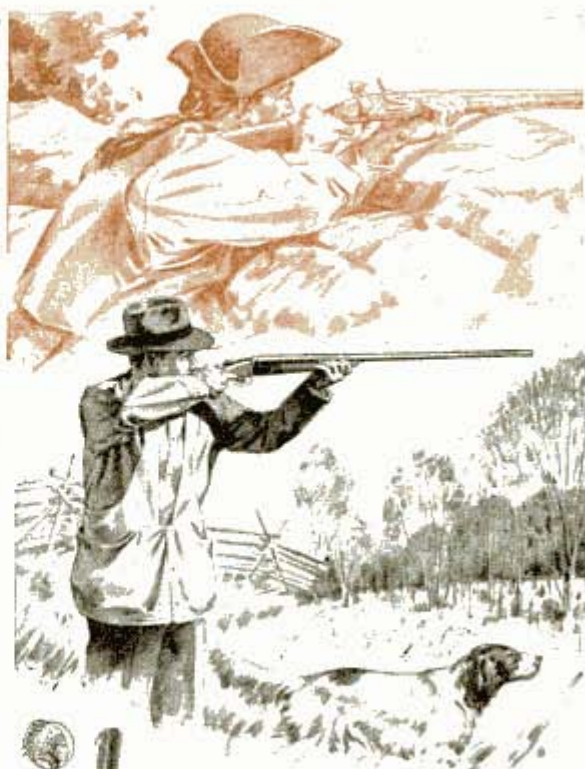
spotted. But what a blessing for the commercial pilot coming in for a landing with his precious freight of human lives.

What part the very large airplane will play in this war I am not prepared to say. Our big Martin Mars is designated a patrol bomber. She is heavily defended with guns. But I can easily see what a part a ship of the 140,000-pound size might play as a naval auxiliary, serving the surface forces and their bases.

Even as we contemplate the plans for our 250,000-pound ship, the size of the Mars—not much over half as big as the projected liner—still staggers us. The flight deck of this “flying battleship” of the U. S. Navy is actually larger than the interior of a 21-passenger air liner. It takes a crew of 11 men to operate the Mars. Up where the pilot and co-pilot sit, the cockpit is much like that of any ordinary air liner. But when they turn around, they face a vast “bridge” occupying 2,175 cubic feet, office of the captain, navigator and engineer officer. Yet this is but a small part of the great ship. Through the windows the pilot catches a glimpse of the wings and their enormous engines, so far back they seem to be on some other craft. A staircase leads from the bridge to the lower deck and its spacious wardroom. High above are passageways to rooms behind the engines, where mechanics service them in flight. In a room on the upper deck, auxiliary motors drive eight generators supplying electricity. There are 24 telephone stations on the Mars. The ship’s control surfaces are tremendous; each of the twin rudders is twice as tall as a tall man; between them are 30-foot elevators, and each aileron is longer than the entire wing span of an average pursuit plane.

Air freight, domestic and foreign, will be a very important part of our commerce when the war is over. The Army has done more to develop air freight than any other operator—and it is surprising to some people to discover that in the last several years the Army has carried more cargo by air than all the airliners of the United States together. That all first class mail will travel by air in the future is a foregone conclusion. That domestic air travel will boom after the war is another reasonable conclusion. The great safety record hung up by the air lines in the last several years

(Continued to page 180)



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continues. Air travel is filling every available seat, and people are irked at being turned away from ticket windows. It is human nature to want what you are denied. Besides, hundreds of thousands of men, trained to the air by the war, will see no other means of transport when they return to peaceful pursuits.

But the spectacular development, I repeat, will be in the ocean field—the field of flying ships that will grow larger and larger. With them we shall rehabilitate a weary world, draw it closer together, reestablish the broken threads of commerce, cross the last frontiers of isolation.

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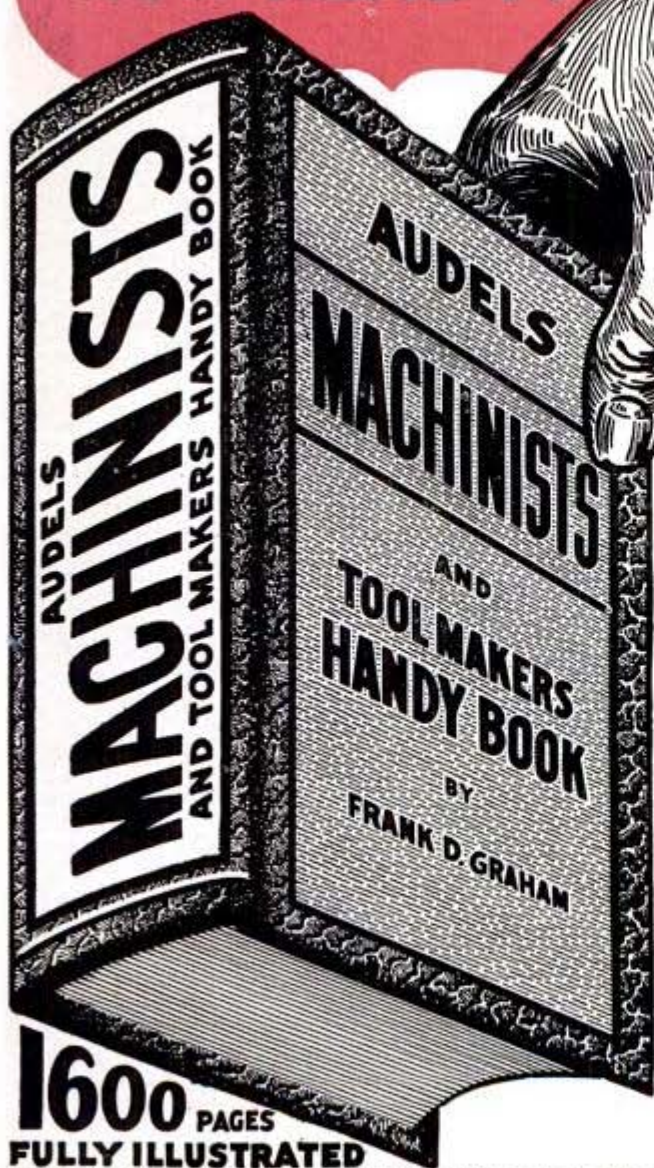
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