

POPULAR MECHANICS

MAGAZINE

WRITTEN SO YOU CAN UNDERSTAND IT



OCTOBER
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SEE PAGE 50





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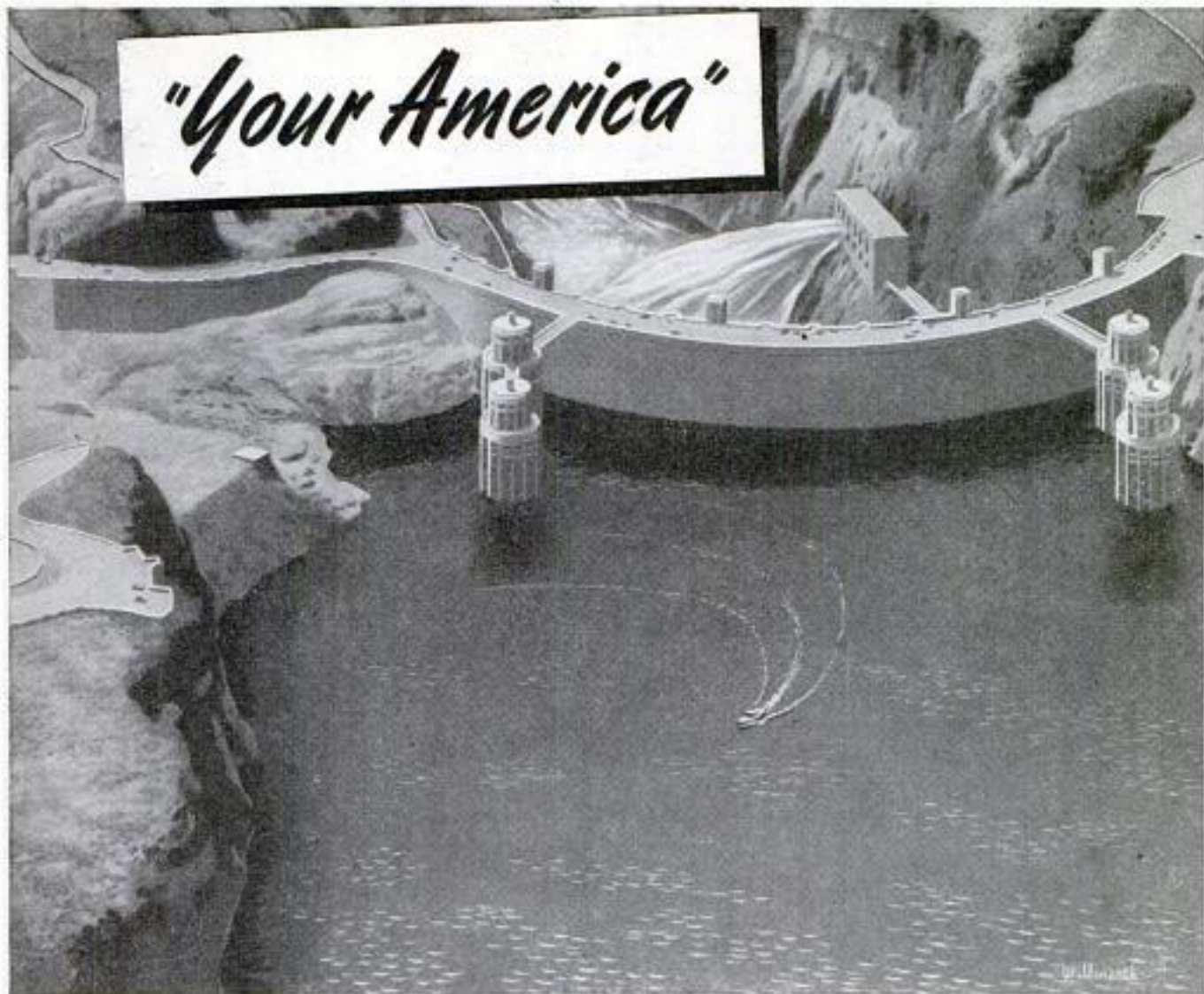


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this progressive western state. Vast quantities of ores and minerals are yet to be mined. There are the facilities—and the space—for industrial expansion.

Opportunity looms large in Nevada. All that is required to convert the state's resources into prosperity for a business or an individual is the same driving spirit of enterprise and initiative that helped to develop Nevada and to build this great nation—*your America*.

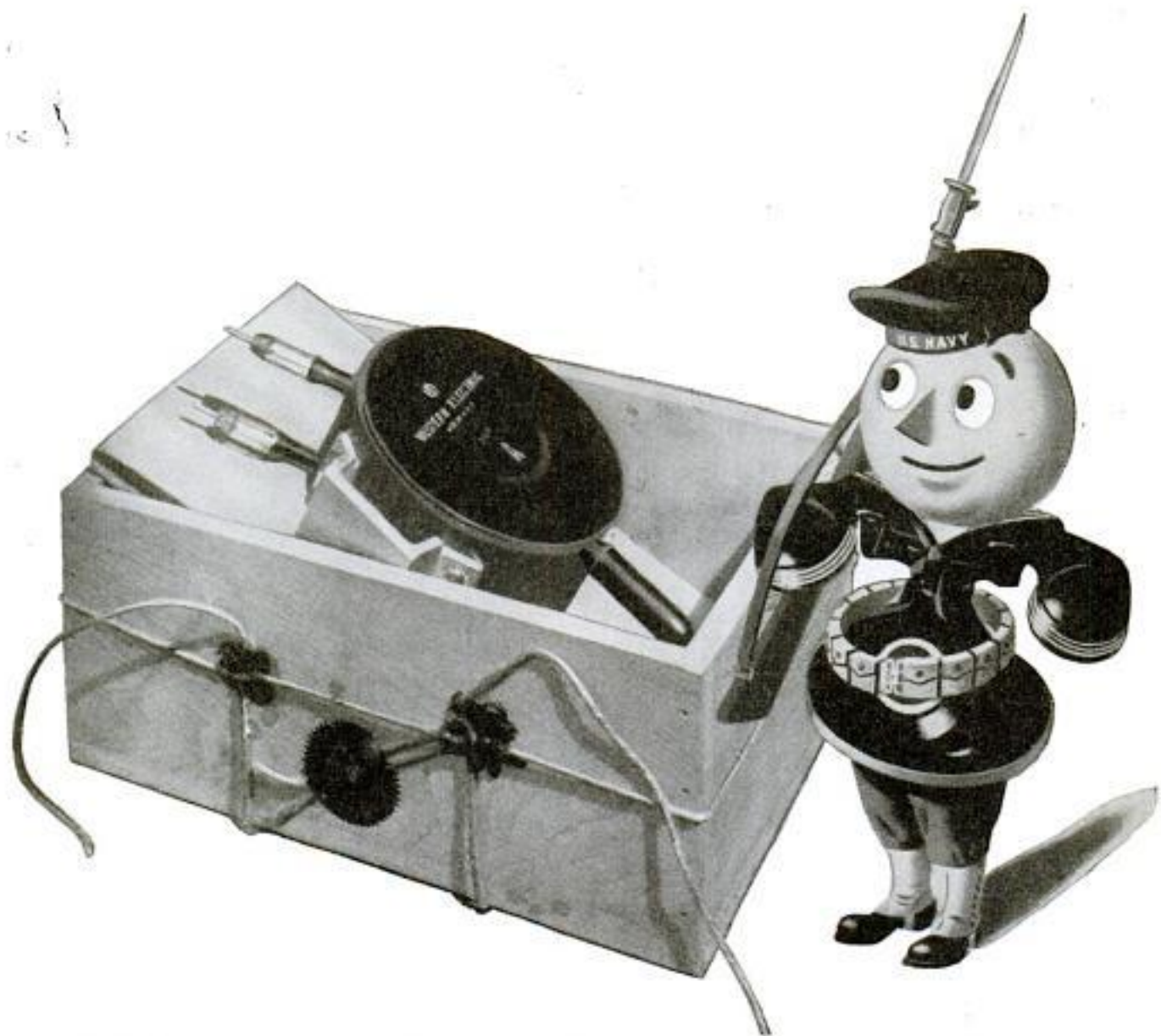
NOTE: Write Union Pacific, Omaha, Neb., for information regarding industrial or business sites in Nevada or other western states.



This One



FNZH-YGH-TOF4



VICTORY REVEALS A MYSTERY

More than two years ago, an engineer of the Laboratories visited *U. S. S. Boise*, returned with a mysterious box which went into the Laboratories' vault. Now, victory opens the box and discloses a special kind of electron tube called a magnetron. It was part of a Radar which furnished data to aim *U. S. S. Boise's* guns during the night action off Savo Island on October 11-12, 1942. Because of the high frequency generated by this magnetron, the Radar was not detected by the enemy, and the action was a complete surprise. Six Japanese warships were sent to the bottom in one of the early Pacific victories.

This magnetron is a symbol of the Laboratories' enormous war program. Half of it was devoted to Radar, the other half gave birth to radio transmitters and receivers, sonar apparatus for the Navy, loudspeaker systems for ships and beach-heads, fire-control apparatus for anti-aircraft artillery. Coming months will unfold the story.

Bell Telephone Laboratories' war work began before the war; until now, it claimed practically all our attention. With victory, we will go back to our regular job—helping to bring you the world's finest telephone service.

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

Next Month

NO ONE is going to put all the railroad bridges in America end to end. But if it were done by some Paul Bunyan, you could ride all the way from Newfoundland to beyond San Diego on railroad bridges. There is one for every mile of track. One old-timer described in a November feature is 112 years old and still going strong.

ARE you dumping a shovelful of coal in the ashcan every time you fill your stoker? Of course you aren't, but maybe the stoker is wasting an equivalent amount of fuel because of inefficient operation. A story next month explains how to adjust and operate a stoker to get the most heat.

MECHANICAL slaves consisting of robots driven by electrical motors and hydraulic pressure will fly the giant postwar airliners. How the human pilot and his crew of robots will fly you to the end of the world with maximum safety is told in November.

MAKING scrap sheet metal into costume jewelry is an easy way of solving a gift problem, and may be turned into a profitable hobby. An article in the November Craftsman section tells how to fashion brooches, bracelets and other items.

WHEN an ancient art, such as making fine china, teams up with modern U. S. industrial genius something's bound to happen. It has. The result is American leadership in ceramics. An article next month tells how we got "Our Turn at the Potter's Wheel."

ELECTRONICALLY controlled timing takes guesswork out of photoprinting and enlarging. An article in the Radio and Electronics section next month tells how to build and calibrate an inexpensive electronic photoprint timer.

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Managing Editor.....	Roderick M. Grant	
Assistant Managing Editor.....	Wayne Whittaker	
Associate Editor, Shop Notes and Crafts.....	James R. Ward	
Radio and Electronics Editor.....	Frank L. Brittin	
Art Director.....	Frank Beatty	
Associate Editor.....	William E. Taylor	

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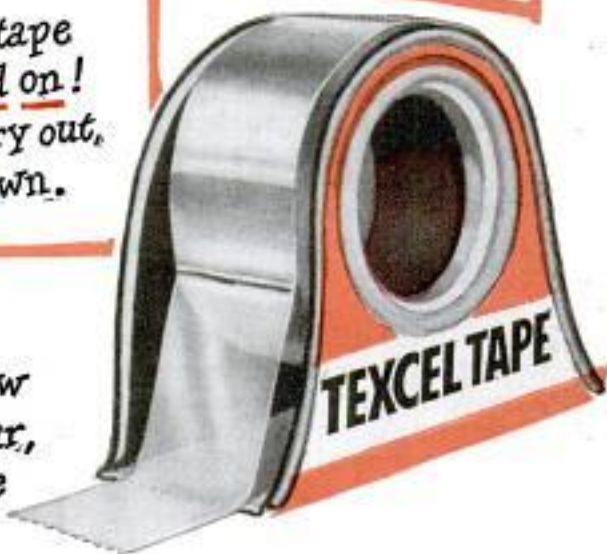


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Outwitting the weather

 How science copes with Old Man Weather is illustrated by these ideas and devices from General Electric laboratories.

How high are the clouds? A ceilometer measures this for airmen. How wet is the weather? A fungus farm in a G-E laboratory helps design military equipment to resist fungus in the world's wettest areas.

On this page are a few more examples of the way General Electric research and engineering are being devoted to this phase of human comfort and health. *General Electric Company, Schenectady, N. Y.*



Cloudy but bright. When clouds darken the sky, lights come on in this schoolroom. No one has to remember; a General Electric automatic light control with an "electric eye" keeps constant watch on daylight, safeguards young eyes by turning on the lights whenever they are needed.



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Weather detective goes aloft in the small box suspended from the balloon. Some 12 miles up the balloon bursts, and the box is parachuted back to earth. On the way up, this electronic device, called the G-E Stratometer, gives a running commentary on the weather—temperature, humidity, air pressure—and sends this information back to earth by radio signals. The information gathered by the G-E Stratometer can be used to help predict the weather.

★

Hear the G-E radio programs: The G-E All-girl Orchestra, Sunday 10 p. m. EWT, NBC—The World Today news, Monday through Friday 6:45 p. m. EWT, CBS—The G-E House Party, Monday through Friday 4:00 p. m. EWT, CBS.

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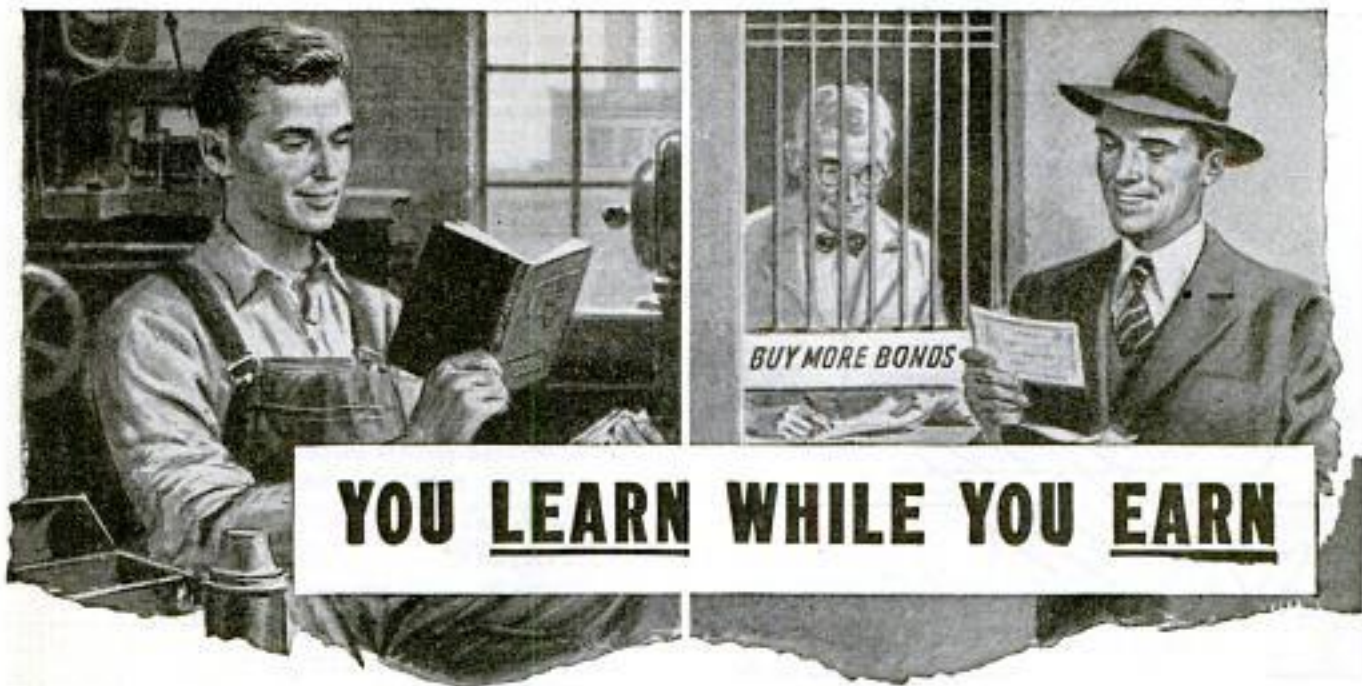
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G. SOGLOW

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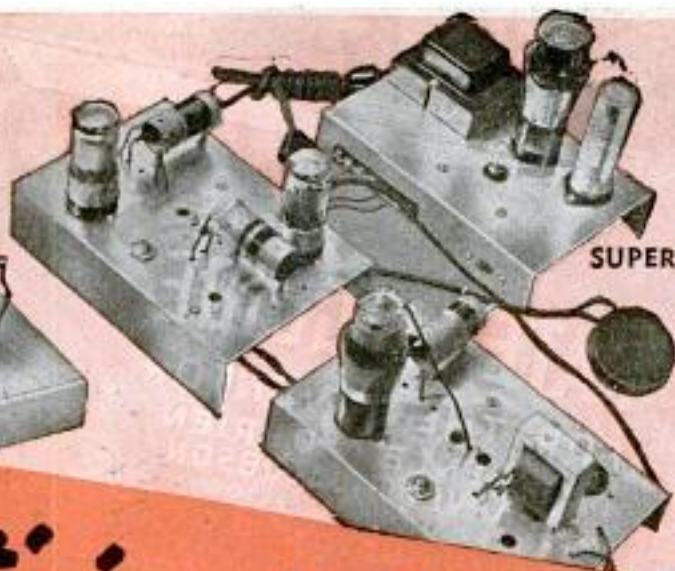
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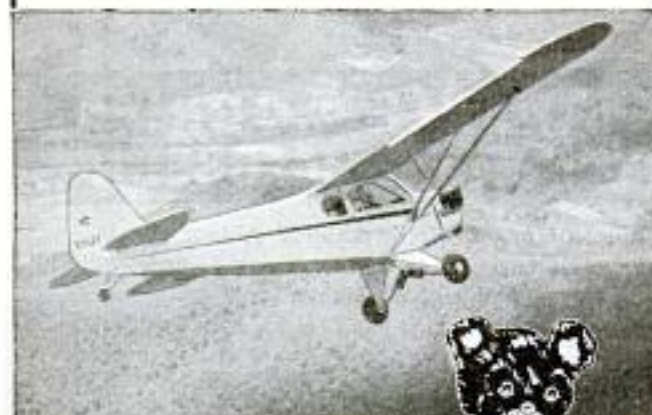
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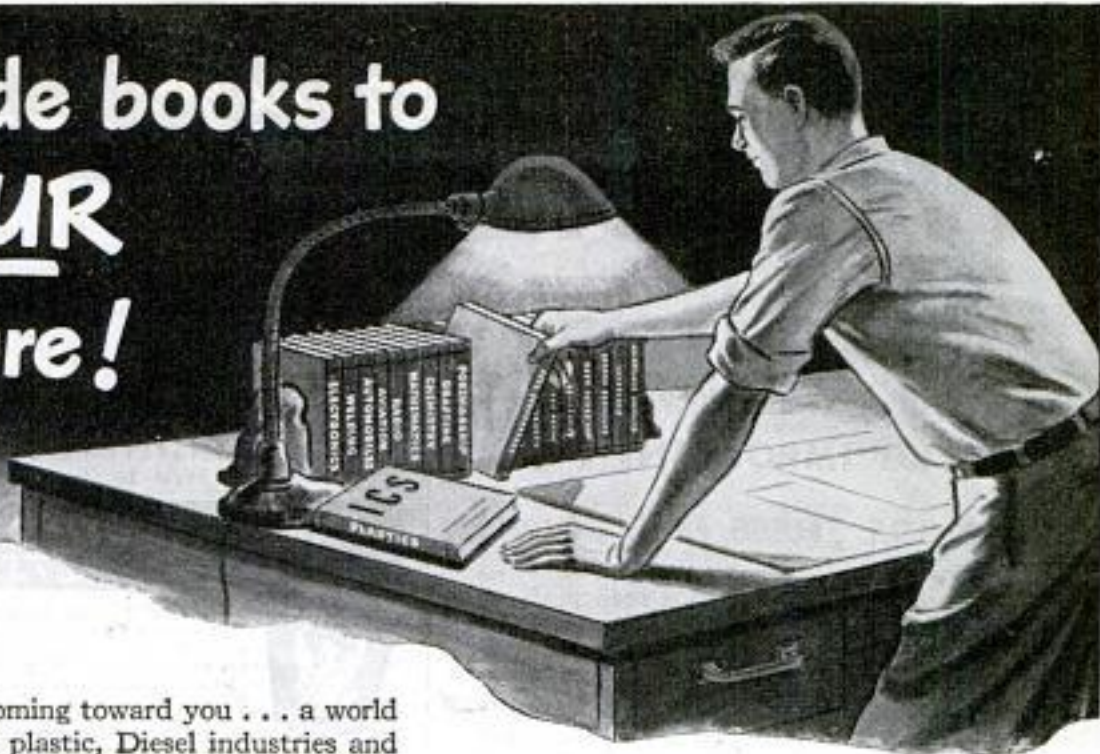
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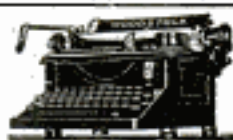
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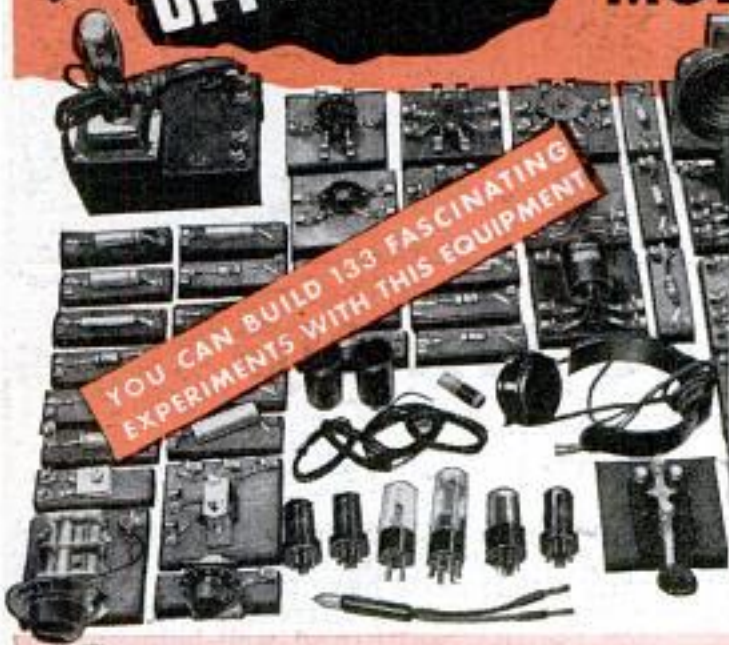
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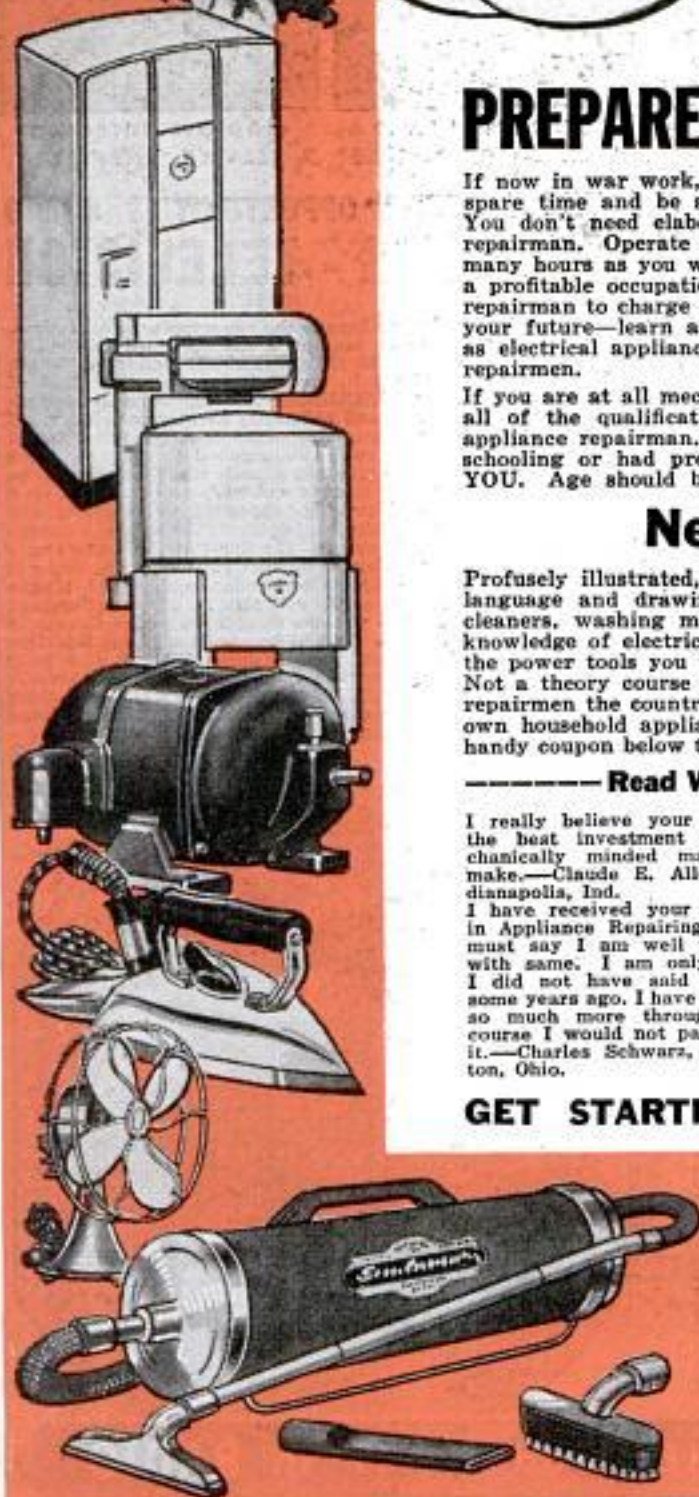
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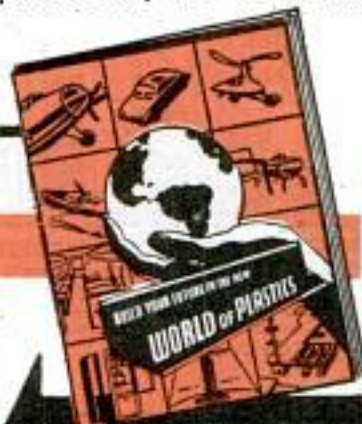
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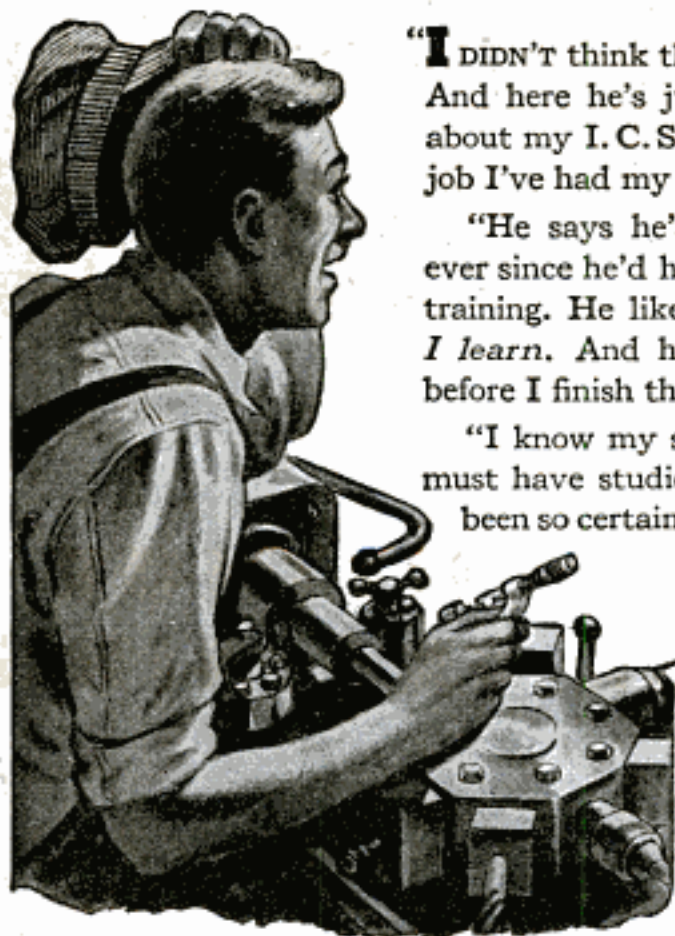


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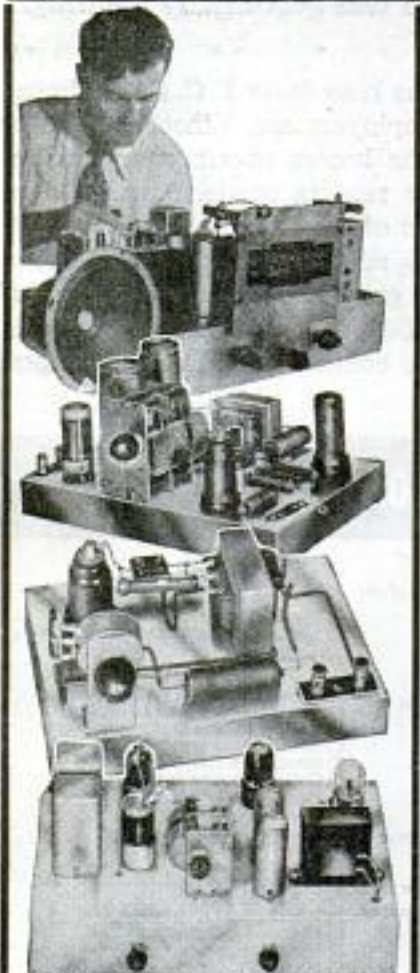
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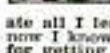
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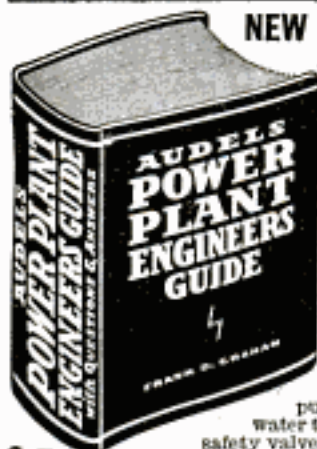
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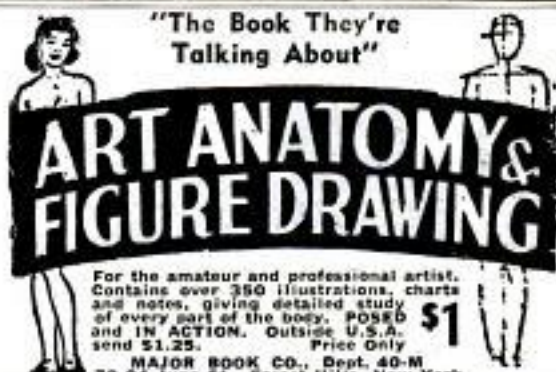
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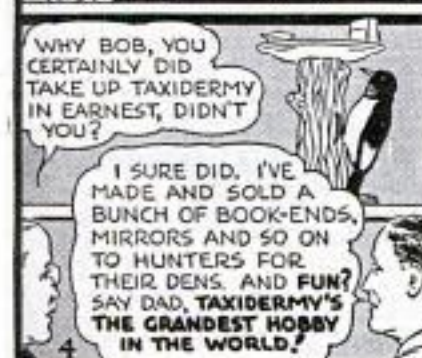
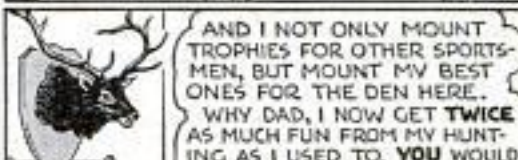
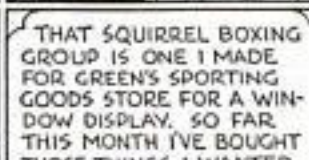
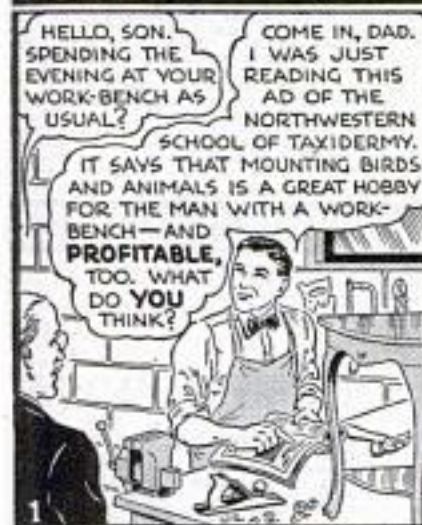
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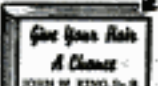
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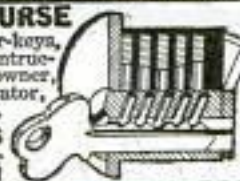
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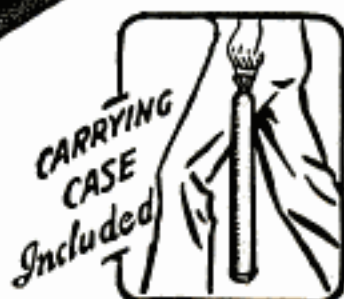
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F. W. Johnson, Manager, Classified Advertising

Popular Mechanics Magazine, 200 East Ontario Street, Chicago 11, Illinois

YOU'LL PROFIT

By reading and answering the classified ads in this section. Hundreds of opportunities to make and save money.

Popular Mechanics Magazine,
200 E. Ontario St., Chicago, Ill.

Dear Mr. Johnson: Our records show that approximately \$500.00 worth of business has been received as a result of the ad which was placed in your magazine in January. About 80% of this business came from the U. S. A., 15% from Canada and 5% from England. We have five small gift shops placing orders regularly, that contacted us through the ad, and we still get an occasional new inquiry or order. (Original letter on file in our office) Very truly yours, L. L. Russell & Co.

AUTOMOBILES, MIDGET CARS

FLOYD Clymer's popular motor books! Mercedes-Benz Book just out. Describes Grand Prix racing, 100 illustrations, photos world's fastest cars, drivers \$2.00, cloth-bound \$3.00. — Power and Speed, 200 illustrations, world's most famous racing book \$2.50. — Ab Jenkins (world's distance record holder) book "Speed on Salt" \$1.50, cloth-bound \$2.50. — Saga Roaring Road, historical book early day American automobile racing \$2.50. — Speed "How to Obtain It" \$1.50. — Motorcycling Manual, wonderful book, dozens motorcycles described, illustrated, \$2.00. (See our ad under Motorcycles). — Motorcycles "How to Manage Them" \$2.00. — English Motorcycle Service Manual, all about servicing various foreign motorcycles \$1.50. — Motor History of America "World's Wonder Book of Automotive Industry," all about Ford, Chrysler, Durant, Willys, Olds, Buick, others, 416 pages, lists 1600 different makes American automobiles \$3.00, cloth-bound \$4.00. — Floyd Clymer's Historical "Motor Scrapbooks" — the book Time Magazine called a "must" . . . specifications, illustrations, photographs hundreds early automobiles and motorcycles . . . No. 1 and No. 2 now ready, entirely different, \$1.50 each, cloth-bound \$2.50 each. — Clymer's Steam Automobile Scrapbook . . . Historical, illustrated review, early and late Steam Cars \$2.00, cloth-bound \$3.00. — Modern Steam Car, different book \$2.00. — All books postpaid. Sent overseas without request. We pay postage, guarantee delivery. Send dime for America's most complete Motor-book catalog. Clymers, 2125 W. Pico, Los Angeles 6, Calif. (See our ads under Motorcycles.)

PROFESSIONAL Midget racer, motor-scooter, midget car and midget motorcycle. Plans, specifications, for all four contained in illustrated handbook, 25c. Big list used motors, motorscooters, Servicelyces, etc., included free! Midwest, 3639 Drummond, Toledo, Ohio.

GARAGE Doors, all types, controlled from dashboard. Complete "Build Yourself" plans \$1.00, refundable. Free particulars. Kaytor Laboratories, Lynwood, Cal.

STEAM Car Scrapbook. Compiled by Floyd Clymer. Historical, authentic, amusing. Ads, photos, descriptions 250 early steam cars, with fascinating story by one-time world's youngest auto dealer. Postpaid \$2.00. Deluxe cloth-bound \$3.00. Clymers, 2125 W. Pico, Los Angeles 6, Cal.

SEE Our ad under Motorcycle classification for motorscooter bargains. Midget Motors Directory, Athens, Ohio.

BUILD Midget racer from castoff parts! Plans, specifications, construction information, \$1.00. Motor Supply, Box 1682-CS, Toledo, Ohio.

INTERESTING, Educational, illustrated English "Motor" magazine on foreign automobiles, 50c postpaid. Clymers, 2125 W. Pico, Los Angeles 6, Calif.

1945 IGNITION Supercharger. \$4.00. Pep, mileage, fast starting. EG Mfg. Co., 355a E. 149 St., New York.

SAVE Gasoline. Complete instructions guaranteed, 50c. Box 270, Edgemont, East St. Louis, Illinois.

REPAIR Your car. Motor parts for all engines, chassis parts, ignition and carburetor parts, etc. New replacement parts. Genuine and highest quality at manufacturers' retail parts. P.O.B. Chicago. No body parts. B & N Engineering Co., Box 3454 Merchandise Mart P.O., Chicago 54, Illinois.

CUSTOMIZE Your automobile. Illustrated, new restyling ideas, instructions, suggestions, specific model changes by simple methods. \$1. Speed Wheel, Box 723-E, Arcadia, California.

AUTOMOBILE Racing book, fifth edition, well illustrated. Instructions on building bodies, frames, engines. Ford A and B conversions. Plans, AAA rules, specifications. Roadster racing, Indianapolis cars. \$1.00 postpaid, \$1.30 C.O.D. Ray Kuns, Dept. 47, Madisonville, Cincinnati 27, Ohio.

AUTO SUPPLIES AND EQUIPMENT

AMAZING New Moto-Vator injects water-vapor into motor just like newest fighter planes. Burns 15% water; saves 20% to 30% gas; prevents carbon; increases power! Eliminates carbon and valve jobs. Not a gadget. Sensational performance keeps motor like new. Let this device start you in business. Wonderful possibilities. Send 10c for booklet giving complete details. Dept. M, SX Laboratories, P.O. Box 37, Middle Village, Long Island, New York.

SPECIAL Big 15-lb. box of over 3,000 popular size assortment of steel bolts, nuts, screws, washers, cotter pins, hose clamps, etc. \$3.00 postpaid. Melts Aircraft, Hardware Department, New Brunswick, N. J.

INVENTION Uses kerosene to run motors. Circular on plans. Rush name. Houston Maupin, Tipp City 36, Ohio.

GASOLINE Saving, center flow carburetor throttle. Walert Company, 3429 N. 10th St., Milwaukee 6, Wisconsin.

CONSTRUCT Auto burglar alarm, which when auto is touched, charges auto with electricity that shocks anyone, but yourself. Illus. instructions \$1.00. L. D. Blythe, White City 3, Kans.

POWER Booster—New Aqua-Charger, a scientific device designed by aircraft engineers applies to your car or truck the famous water-injection that has given aircraft extra speed and power. Aqua-Charger reduces carbon formation and kills ping even under heavy load and on steep grades. Has effect of raising octane rating of gasoline over 10 points and increasing gasoline mileage. Aqua-Charger and installation instructions \$17.95 postpaid. Give make and year of car. Associated Machine and Engineering Company, 46 George Street, Torrington, Conn.

CARBURETOR Repair kits containing all the essential parts for completely rebuilding a specific carburetor. Lists on request. Carburetor Service, 600 LaPrairie, Ferndale, Mich.

HAVING Car trouble? New, used, guaranteed auto, truck parts save money. Transmission specialists. Describe needs; immediate reply. Victory, 2439½ Gunnison, Chicago 25.

SMITHY'S Dual exhaust system for V8 Ford and Mercury. Increased horsepower, gas, mileage, performance and life by eliminating back pressure. Instructions included, simple to install, price \$20.00. Also replacement mufflers for all other cars \$4.75 to \$6.25. Smithy's Muffler Shop, 2335 India Street, San Diego, California.

UNIVERSITIES And Oil Corporation tests prove Whirligns Turbinator, \$3 carburetor amplifier, increases motor mileage and power. Users report gasoline economy exceeding 40%. Wrench installs 15 minutes. Give auto make, year. John Hanley, 5719 Loraine, Detroit 8, Mich.

GENERATORS. Magnetos, distributors, carburetors, new and rebuilt, for most any model car, truck or engine. Many old models in stock. Hundreds of electrical items, parts, etc. Order anything you need from us today at list price or less. Simms Magneto, 53 E. Callerton, Chicago 16, Ill.

UNLOCKEEZ Is a patent pending device, guaranteed to open push button auto locks instantly, also many other cars. \$2.00 per unit with instructions. Unlockeez, Box 209, White Plains, N. Y.

FLUORESCENT Driving lights for any car or truck. Blueprints, instructions—\$2.00. Superior Tool, Box 1036-A, Anderson, Indiana.

ANTI-FREEZE, Noncorrosive, inexpensive—manufacture yourself. Send stamp. Box 699, Berger, Texas.

PLATING Outfits for auto parts. Connect to a battery. No tanks used. Free particulars and proofs. Gunmetal Co., Ave. J, Decatur, Ill.

AUTO TRAILERS

BUILD Your own trailer! Save money! Have every feature you want! Plans for house, sport, camp and utility trailers. Catalog describing 9 models 10c. 15c in Canada and overseas. Jim Dandy, Box 123-A, Wausau, Wisconsin.

MOTORCYCLES, BICYCLES, MOTOR-SCOOTERS AND SUPPLIES

1942 CUSHMAN Motorscooter \$60; Briggs-Stratton motorbike \$45; midget car \$30; Briggs-Stratton motor \$10; tires for motorscooters and small cars at factory prices, mailorder only. Send 25c for big War-Bargain catalog Number Ten, just out of hundreds of bargains. (35c by first class mail.) Midget Motors Directory, Athens, Ohio.

FLOYD Clymer's Motorcycling Manual, 120 illustrations. Information, specifications, descriptions dozens motorcycles. Engines, transmissions, carburetors, square four, two piston singles, overhead camshafts, spring frames, hydraulic forks, sidecars, riding instructions. Two cycle engines and power bicycles described, illustrated. \$3.00 postpaid. Clymers, 2125 W. Pico, Los Angeles 6, Calif.

BUILD America's lowest priced motor-scooter speedster! Complete plans, specifications, \$1.00. Big list used motors, etc., included free! Motor Supply, Box 1682-CS, Toledo, Ohio.

DEPENDABLE Bicycle generators \$2.85 prepaid. Ten day trial. L. Kimley, Highland, Williamsville, N. Y.

FLOYD Clymer's popular motorcycle, automobile books. See advertisement under Automobiles! Clymers, 2125 W. Pico, Los Angeles 6, Calif.

TIRES, Tubes, wheels, for industrial trucks, carts, wheelbarrows, scooters, midget cars, coaster wagons. Nationally known makes, first-line quality. Sizes 8" to 18" o.d. in 2, 4, and 6 ply tires, separate inner tubes, heavy duty demountable wheels. Also caster forks, straight and swivel types. Free illustrated circular and prices. Jahant Co., 626 East Exchange Street, Akron 8, Ohio.

ENGLISH "Motorcycling" Magazine. Interesting, educational, foreign motorcycles. Racing, new-old models, advertisements. 50c sample copy. Clymers, 2125 W. Pico, Los Angeles 6, Calif.

MOTORBIKE Manual. Contains motorbike, scooter plans. Helpful hints and catalog section, also a small motor tuncup leaflet \$1.00. Variety Enterprise Co., Post Office Box 124, Evansville, Ind.

FOR That odd job keep on hand mixed aircraft bolts, nuts, washers, 5 lbs. \$1.00 postpaid. Alvin, 3704 Gordon, Ft. Worth, Texas.

PLANS, Scale drawings, specifications, illustrations for building attractive motor scooter complete \$2.00; plans electrically driven bicycle \$1.50. Postpaid, Clymers, 2125 W. Pico, Los Angeles 6, Calif.

SEND 25c For complete motorbike plans and parts list. Motorbike Service, 1304 Indiana, New Albany, Ind.

HARLEY Davidson parts, accessories, supplies, expert service. Send \$2.25 for army motorcycle instruction book and bulletins or 10c for bulletins only. Knuth's, 2491 Fondulac Ave., Milwaukee 6, Wis.

TIRES and industrial wheels, suitable for scooters, wheelbarrows, farm equipment, etc. All sizes. Bicycles and accessories. Largest assortment in America. Send dime for list. Cycle Transport Company, 1241 So. Michigan Ave., Chicago 5, Illinois.

"**MODERN** Motorcycle Mechanics" manual, enlarged, revised, second edition, 560 pages, 300 illustrations. The most up-to-date and complete motorcycle book published. Extensively covers design, operating, maintenance, and reconditioning. Harley-Davidson, Indian and British makes. "A book no motorcyclist can afford to be without." Immediate deliveries. Price \$3.00. Nicholson Brothers, Motorcycle Engineers, Saskatoon, Canada.

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PARTS, Accessories, pistons, chain Harley Davidson motorcycles. McCann's, P.O. Box 114, El Paso, Texas.

ELECTRIC Motorbike built from your bicycle. \$1.00 brings instructions-specifications. Mowery, Box 994, Lancaster, Pa.

BOYS! Repair your own bike. "Bicycle Repair Manual" 65c. R. G. Klausner, Shelbyville, Ill.

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PROPELLERS, High grade—fast delivery—lists free. Fit any motor, for planes, sleds, boats, deboosters, fans. Aircool conversion diagrams 50c. Standard Aircraft, Ft. Worth, Texas.

ACTUAL Airplane photographs: Packets, each containing 20 genuine glossy prints: B-29 Superforts, Flying Fortresses, Naval Aircraft, Army Fighters, Army Trainers. 25c each packet; all 5 for \$1, postpaid. Lloyd, 1411-PO Northwest 17th, Oklahoma City 6, Oklahoma.

HUNDREDS of war-bargain airplanes and gliders, some probably located near you. Send 25c for complete directory. Used Aircraft Directory, Athens, Ohio.

PROPELLERS For airplanes, ice-snow sleds, air boats. Lowest prices, fastest service. Literature 5c. Banks Propellers, R.P.D. 7, Ft. Worth, Texas.

JET Propulsion experiments. New principle to drive boats, bicycles, model helicopters. Circular on plans. Rush name. Houston Maupin, Tipp City 53, Ohio.

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EDISON Batteries. Light, Power. Fifteen year life. Five year guarantee. Complete lighting plants. Free literature. See Jay Company, 321 Yonkers Avenue, Yonkers, New York.

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SURPLUS Lighting fixtures used on U. S. navy flattops in airplane stowage spaces for general lighting. 300 w. to 500 w. Water tight and vapor-proof. Excellent outdoor lighting fixtures for farms, gasoline service stations, parking lots, amusement parks, and for all other outdoor general purposes. \$12.50 each. Times Appliance Company, Inc., 72 Duane Street, New York City.

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NOW—Repair your own electrical appliances with Chanite Self-Welding Electrical Heating Element Flux. Instructions delivered, price \$1.00. Chanite Sales Company, 914 South Main, Fort Worth, Texas.

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MULTIWELD Production type A-C welders. Single hairline control, over 200 heats, 1-ph. 110-220 volts, 150 or 225 amp. \$82.50, \$112.50. Two year guarantee. Garages, shops, farmers—write: Phillip Wilson, 309-E Bridge, Streator, Ill.

ARC Welders wanted by the thousands. Learn with 516 page lessons manual. Over 500 how-to-do-it photos. \$2.00 copy. Money-back guarantee. Hobartweld, Box M-1054, Troy, Ohio.

WELDING Equipment and supplies, gas or electric, new and used. Sell, buy and exchange. Welding Headquarters, Chicago 47, 2425 Milwaukee Ave.

FREE Information, make guaranteed electric welder, easy from old scrap, costs about \$1.00. Write "International," 6347 Farnell-G, Chicago, Illinois.

BUILD Your own arc welder. We furnish all parts. Plans, catalog 25c. Frazee Electric, Box 5086, San Francisco 1.

SELF-WELD Electric element fix packets: 50c; \$1.50. Alvin, 553 William, Winnipeg, Manitoba.

NEW Model electric welder 110 volt a.c.-d.c.; will weld all metals; easy to use; full directions. Complete with power unit, flame and metallic arc attachments, carbons, fluxes, rods, mask; all for \$19.95. Used by the navy. Magic Welder Mfg. Co., 239-MP9 Canal St., New York City.

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SUPER Welder—For home, farm, factory. Makes even beginner an expert. Improved on type used by navy. Fully equipped with metallic arc and flame torch handles, carbons, rods, fluxes, mask, etc. Complete directions. Operates a.c.-d.c., 110 volts. No extra wiring needed. Guaranteed. \$19.95. Save 2% send check with order. Super Welder Manufacturing Co., Dept. A, 23 East 20 Street, New York.

WELDING, Cutting, aircraft welding and soldering equipment. Electric arc welders. Superior Oxy-Acetylene Co., Hamilton, Ohio.

A.C. Arc welders, all sizes. Catalog dime. Frazee, Box 5086, San Francisco 1.

SLIGHTLY Used arc welders. Recommended by R.E.A. Guaranteed. Forney Mfg. Co., Fort Collins, Colo.

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TOOLS: Vise-grips, Cee-Tee, waterpump, needlenose, diagonal cutter pliers, crescent wrench, pipewrench, plastic screw-driver, clawhammer, hacksaw and 12 sockets 7/16 to 1" including 1/2" flex handle and universal joint. Universals complete 25 piece guaranteed tool kit only \$49.35. Immediate shipment! Try us first, we have it, can get it, or it isn't made! Catalog and price list free! Order now! Universal Tool Company, 1527 Grand PM, Kansas City, Mo.

PLAN Your postwar workshop now around Lewis mills, shapers, drill presses and other metal and woodworking tools—and save up to 80% of usual cost by completing them yourself. Plain or semi-finished castings furnished with all materials and construction blueprints. Send 10c to cover cost of mailing catalog describing 23 items. Lewis Machine Tool Co., P.O. Box 116, Station A, Dept. M-57, Los Angeles 31, California.

ROTARY Vacuum pumps \$60.00. 28" vacuum 3 c.f.m. at 850 r.p.m. William Reid Co., Chicago 14, Ill.

MILLING Attachment for Atlas lathes. Photographs for dime. Depoy Model Shop, Muncie, Indiana.

1/2" AND 3/4" Saw mandrels, \$2.50 to \$12.50. 20 oz. anvil, 50c. Growlers \$5.00. Catalog 10c. Frazee, Box 5086, San Francisco 1.

QUICK, Get on mailing list—receive illustrated catalog sheets surplus and stock engines, motors, tools, parts, materials. Suggestions for uses. Rush name. Houston Maupin, Tipp City 65, Ohio.

AD Entitled "Super Drill Grinder"—See our ad page 192.

HIGH Speed drills, taps, milling cutters, end mills, tungsten carbide tipped tool and lathe bits, etc. Bargain prices. Send for price list. Box 212, Milwaukee 9, Wis.

BUILD Quick-change gear box for 12" Craftsman lathe. Complete drawings, instructions \$3.00. No castings. Stevens Engineering, 2904 Military, Los Angeles 34, Calif.

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HIGH Speed drills. We are closing out our entire stock of 15,000 dozen at less than wholesale price. Number 19 or 23, \$2.25 per doz.; Number 34 or 35, \$1.75 per doz.; Number 42 or 46, \$1.50 per doz.; Number 52, \$1.35 per dozen. More than 100 other sizes at comparable prices. All well known brands, made by such companies as Cogsdill Twist Drill Company, Standard Tool Company, Union Twist Drill Company, Chicago-Latrobe, Cleveland Twist Drill Co. No orders accepted for less than one dozen of any one size. The Adams Co., 1210 Farnam St., Omaha 2, Nebraska.

HOUSE Plan template. Draw plans for new homes and remodeling, faster, neater. Made of clear sheet plastic, with accurate cut-outs for drawing doors, windows, plumbing and electric fixtures, fireplace, stairs, molding, roof-pitch, etc. Standard 1/4" scale. Satisfaction guaranteed. \$1.50 postpaid. Timely Products, Box 206-C, Columbus 9, Ohio.

STAINLESS Steel, bar or sheet assortment, ten full pounds \$1.50 prepaid. Industrial Engineering, 1155 S. Kenmore, Los Angeles 6, California.

GEARS For inventors, experimenters, model makers, schools, work shops, laboratories, etc. Government surplus made of brass, bronze, Dural, steel and stainless steel. 12 matched pairs; 24 gears, bevel, spur and ratchet. List price \$12.00, our price \$2.50. 25 matched pairs; 50 gears, includes larger gears, also sets of worm gears. List price \$30.00, our price \$5.00. 50 matched pairs; 100 gears better assortment, also crown, helical, internal and worm sets. List price \$75.00, our price \$10.00. Limited quantity. Order now. Met Exchange, 323 Canal Street, New York 13, N. Y.

BLOWERS, Metal blower cabinets, gas burners, oil burners, furnaces. Blower wheels, bearings. Wholesale, retail. Peerless Sales, 4322 Sheridan, Lincoln 6, Nebr.

EXPERIMENTERS, Craftsmen, repairmen—409 valuable new springs, 75 kinds, numerous sizes, 10,000 uses. \$2.00. Utility assortment, \$1.00. Deluxe assortment, \$3.00. Jumbo, \$5.00. Guaranteed. Technico, Box 248-A, West Hartford, Conn.

INDEX Heads for sale. Very inexpensive. Sixty-two different divisions. Used on small lathes, drill press, milling machines, etc. Make gears, hobs, cutters, etc. Very accurate, and durable. Not a toy. Used by defense schools and hobbyists. Write for free folder, Long's Index Heads, 2117 East B St., Torrington, Wyo.

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BIG Pay jobs in welding. Complete welding lessons and reference books. 516 pages. 41 lessons. \$2.00 copy. Money-back guarantee. Hobartweld, Box 1065-M, Troy, Ohio.

SEL-SYN Motors; 110 volt, 60 cycle, a.c., army surplus. Can be used for remote control, beam antennas, bingo, signaling, wind indicators, many other uses. Light weight, high torque. Original cost \$100.00 pair, our price \$20.00 pair. Guaranteed new, original packing. Met Exchange, 323 Canal Street, New York 13, N. Y.

WATER Motors—Cancelled war orders. 3"—\$3.00, 4"—\$4.00, 5"—\$5.00, "6"—\$6.00. Prepaid, order now. Duplex Motors, Burlington, Iowa.

MODEL Engines, castings, supplies, catalogue, 25c. Howardsco, AS, 2417 N. Ashland, Chicago 14.

MOTORS, Small 6 volt d.c. reversible 3000 r.p.m. 2" diameter, short shaft extension, suitable for operating models and gadgets. Postpaid \$1.25. Walthers, 247 Erie, Milwaukee, Wis.

DUPLEX Motors, Burlington, Iowa. The Universal motor built for water, oil, air, steam. Pressures 250 lbs. or less. Specials built to order. Novelty motors \$3.50 and \$7.50 prepaid.

WINDING Data, listing 225 motors, single and three phase, \$1.00. Motor Data Co., Box 7631, Kansas City 3, Mo.

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BUILD Your own boat, blue prints, list materials and instructions for 12' row-boat \$1, for 16' inboard motor boat \$4 postpaid. P. Boreland, 250 W. 57 St., New York 19, N. Y.

BOATS And all about them. How to select, build, repair and operate. For 40 years the leading practical boating magazine. Trial subscription, 12 issues for \$1.00. Motor Boat, 82 Gold Street, N. W. York 7.

USED Marine motors, propellers, marine fittings, conversion manifolds. Charles F. Stokes, Coldwater, Michigan.

MARINE Power—Easily convert any Ford motor (domestic and foreign) with Osco parts and kits. Complete catalogue 25c (coin). Osco Motors Corp., 2020 East Orleans St., Dept. M, Philadelphia 34, Pa.

USED Outboard motor parts. Outboard Exchange, 1194 Remsen Ave., Brooklyn, 12, N. Y.

FULL Size, cut to shape boat patterns, blueprints. 7 1/2 - 32 feet. Illustrated "Build a Boat" catalog, 10c (coin). "How to Build Boats" book, \$1.00. Cleveland Boat Blueprints Co., Dept. A-66, Cleveland, Ohio.

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BAR-BELLS, Exercise equipment. Courses, Special offers! Free booklet. Good Barbell Co., 3261-PM Watson Rd., St. Louis (9), Mo.

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SCOOP! New .22 bolt action target rifles available for immediate delivery! H&R single shot (.22LR) with new post-war features; 22" barrel, pistol grip walnut stock and full forearm; Lyman rear prep. ramp blade front sights; thumb safety, swivels; weight 6 1/2 lbs. Precision made; beautifully balanced, accurate. Satisfaction guaranteed or your money back. OPA approved price, \$28.24 prepaid. Trade in your old gun, reel, rod, etc.; or send check, money order in full (20% deposit on C.O.D.s.) Klein's Sporting Goods, 501RH South Halsted, Chicago 7.

KRAG Rifles, \$20.00 to \$30.00; antique and modern guns and pistols, war relics, 52 page catalog, 25c coin. Retting, Shokan, N. Y.

INFLATABLE Rubber boats and life-belts—(Dual life preserver belts.) Ideal for sportsmen. Belts use Sparklet cartridges or inflate by mouth. With cartridges, new, \$2.98. Mae West life vests, used, repairable, with repair kit, for mouth inflation \$2.95. Used but tested and guaranteed \$3.95. New (seconds) with automatic inflation \$9.95. Collapsible rubber boats \$39.50 to \$99.50. Order from this advertisement or write for circular. Karl Ort, Dept. PM-6, York, Penna.

GUN Bluing solution, (hot water, chemical process) formula, instructions, 25c. F. Washburn, Battle Ground, Indiana.

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GUNS Refinished like new by factory methods, as used by leading gun manufacturers. Send for circular. Middletown Metal Finishing Company, 45 River Road, Middletown, Connecticut.

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MAKE Your own efficient compound microscope. Lenses and instructions \$5 to 200 power \$2.00, 400 to 800 power \$3.00. Instructions alone 10c. Carl Jamer, Manorville, N. Y.

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REAL 17 Power telescopes \$3. United, 2309-P Lawrence, Toledo, Ohio.

STEP Up your vision 40 times! Master Magnifier No. 40 magnifies 40 diameters, furnishes its own bright illumination, is fitted with scale, intervals of 0.001 inch. Shows clearly many things invisible to normal vision and measures to within 0.001" minute details not measurable by other means. For precision inspection of textiles (weave, strands, uniformity of dyeing), paper, printing, engravings, fine cracks in weldings; crazing in plastics; texture, pinholes and blisters in plating; incipient corrosion; deterioration of paint, varnish; degree of polish, smoothness, accuracy and wear of dies, tools, fine edges, sharp points; fineness and uniformity (adulteration) of powders. Many applications in industry, technical problems and scientific hobbies. Battery model: \$38.50, Electric model: \$42.35. Portable case: \$4.00. Full details free on request or you can send order with remittance on absolute 30-day money-back guarantee. Address R. P. Cargile, 118-P Liberty Street, New York 6, New York.

BUILD Your own telescope objectives and mirrors, plans, parts. Send for free list. Mayfor Prod. Corp., Katonah 1, N. Y.

MAKE Your own powerful, efficient astronomical telescope. Perfect lenses and instructions. 50X \$1.00, 100X \$2.50, 200X \$3.50, 400X \$5.50. Instructions alone 10c. Carl Jamer, Manorville, N. Y.

TELESCOPES, Microscopes, cameras, binoculars: bought, sold, repaired. Lists 10c. Specify instrument wanted, Rasmussen and Reece, 41 Market, Amsterdam, N. Y.

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50,000 ANCIENT Indian arrows, tools, rainbow variations. Don McKillop, Regina, Sask.

COINS, Minerals, glass, Indian relics. Catalogue 5c. Cowboy Lemley, Las Cruces, New Mexico.

ANTIQUE Firearms, swords, daggers, powderhorns, tomahawks. Lists free. Nary's, 8 South 18th, Philadelphia 3, Pa.

ANTIQUES List 25c. "Antique Shop," 111 1/2 W. High, Piqua, Ohio.

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RAISE Snowwhite English Angora rabbits. Wool sells as high as \$14.50 a lb. Send 25c for literature. Snowwhite Angora Colony J. Malta, Mont.

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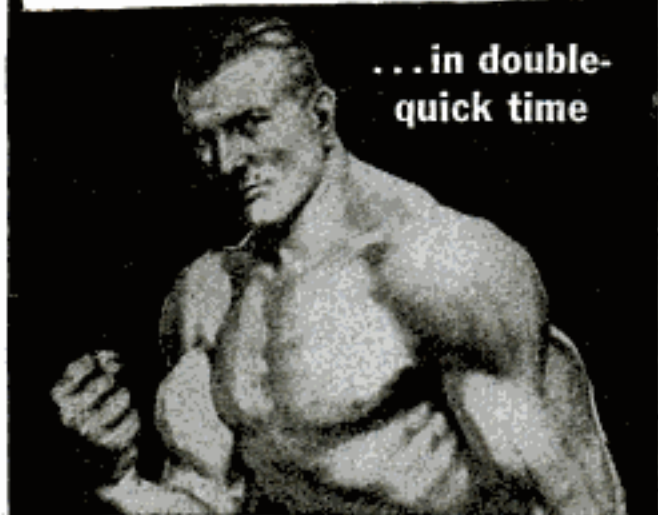
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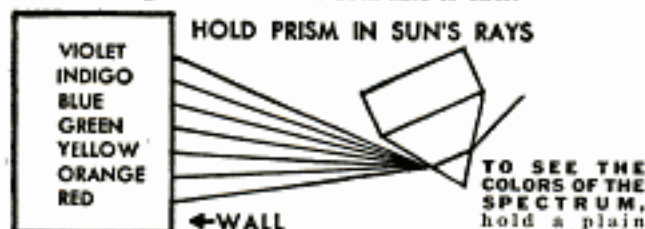
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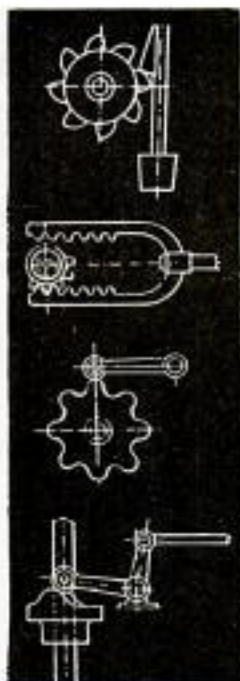
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Vol. 84

OCTOBER 1945

No. 4

By William E. Taylor

THEY say up in the North Country that Paul Bunyan dug the Big Pit with his bare hands when he wanted a spot for a gargantuan barbecue. That's hard to believe. Even the legendary hero of the timber camps couldn't have rounded up enough oxen to fill more than half of that colossal hole in the ground in Minnesota.

From the Big Pit has poured, in incredible quantities during the last decade, the ore for the iron and steel that armed the United Nations. Now its red earth is melting in the blast furnaces for the iron and steel products of peace.

Imagination runs wild at your first glimpse of this monstrous gash in the earth,



Electric shovel loads iron ore into small "Dumpton" at Spruce open pit near Eveleth, Minn. Below, around the Big Pit iron ore trains run on terraces at different levels removing ore and waste material

Oliver Iron Mining Co. photos



OCTOBER 1945

1
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Great Northern Railway photo
 Three miles long and 420 feet deep, the Hull-Rust-Mahoning open pit mine is world's largest. It supplied 20 million tons of iron ore in 1944



Map shows location of famed Mesabi and other ranges which provide U. S. industry with fabulous amounts of iron ore. Below, underground mine in which ore is being loaded by electric scraper hoist. Note timbered entry



three miles long, from one-half to one mile wide, up to 420 feet deep and still growing. Mesabi, the range of the Big Pit, stands for giant.

Bill Bates, chief engineer of the Oliver Iron Mining Company at Hibbing, operator of the Hull-Rust-Mahoning open pit, world's largest iron ore mine, likes to think of the British journalist whom he showed around one day. The visitor stood staring down into the Big Pit for nearly five minutes, without a word. Finally he spoke, almost in a whisper:

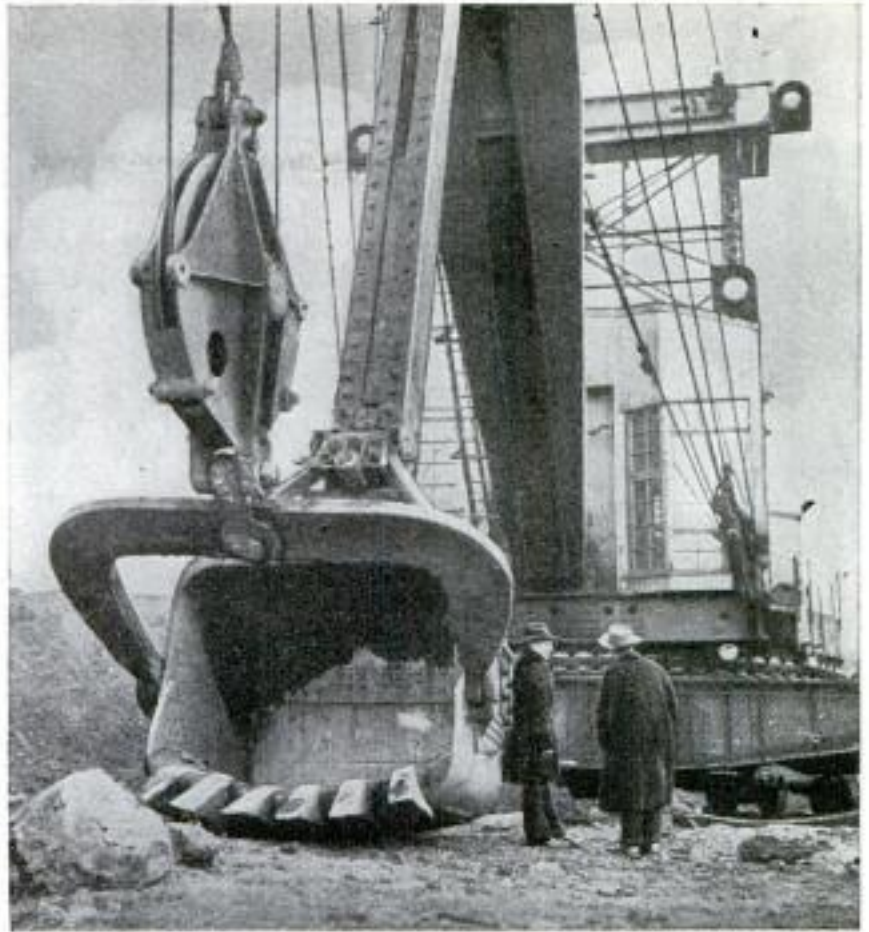
"When I used to see the convoys steaming endlessly into England, I wondered where all the stuff was coming from. Now I know!"

The Big Pit doesn't supply all the iron ore from the Lake Superior district, of course, but the approximately 20.5 million tons shipped from Hull-Rust-Mahoning in 1944 was about one fourth of the district's total shipments of 81,874,930 tons from mines in Minnesota, Michigan and Wisconsin. Back in 1917, peak year of World War I, the Big Pit

shipped out more than 12,000,000 tons, a record until World War II came along. Demands of war upon iron mines are reflected in the total shipments from the six ranges of the three states—Mesabi, Cuyuna, Vermilion in Minnesota, Gogebic and Menominee in Michigan and Wisconsin, and Marquette in Michigan. For the five-year period, 1940-44, shipments totaled nearly 406,000,000 gross tons, compared with only 320,000,000 tons in the ten years 1930-39.

Increasing mechanization of the mines has made possible the necessary colossal production. Shooting ahead with new devices in recent years, nearly 650,000,000 tons of material had been taken from Hull-Rust up to January 1, 1945. That's a terrific amount when you realize that only 480,000,000 tons of material were removed in digging the Panama Canal!

The ore is extracted by two methods: open pit or strip mining, and underground mining. In the Big Pit, ore channels run northwest and southeast. Huge shovels, the largest having a 15-ton bite, cut below the tracks on which they rest and move to lower levels as the ore is removed. Layers



This huge shovel has moved enough ore to build many a warship and tank

of rock and shale, averaging nearly two thirds of a ton for every ton of ore taken out, must be stripped away to reach the rich ore deposits. Placed in huge piles near the pits, the waste rock has a future, too.

Most of the Lake Superior ore is hematite, which contains 70 percent iron when pure. It never is mined pure, but the Lake

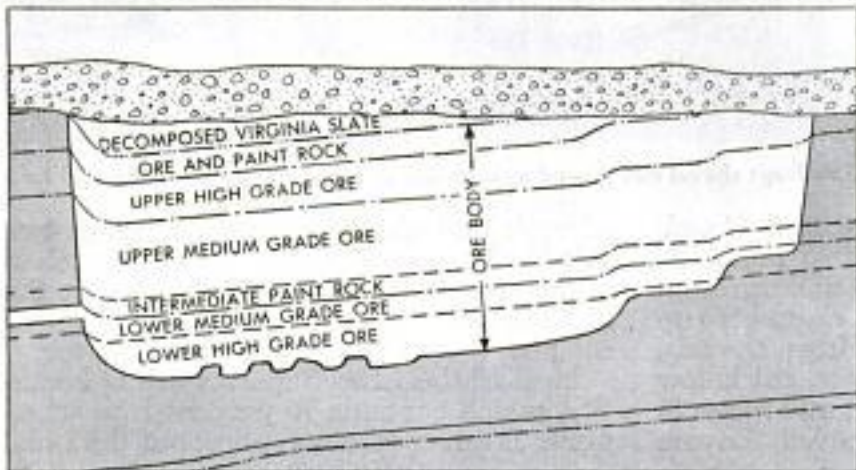
Caterpillar "scraper wagon" takes heavy load of iron ore out of the Hull-Rust open pit at Hibbing, Minn.





Inland Steel Co. photo

Iron ore pours into railroad car from the head frame of loading device. Below, a typical cross-section of the Mesabi Range showing layers of ore



Adapted from U. S. Steel News drawing

Below, cyclone drills do exploratory work at Rouchleau mine, Virginia, Minn. Reserves of ore on Mesabi Range are estimated in billions of tons



Superior ore contains a high amount of iron, about 52 percent. It's a dark red granulated powder or rock, and when you flounder around the Big Pit on a damp day, it sticks like airplane glue.

All the shovels at Hull-Rust are electric or Diesel-powered, the older ones having been converted from steam. The older models move on wheels and tracks, but the new ones propel themselves on Caterpillar tracks. Bulldozers are everywhere, many hauling two-wheel scrapers which pick up several tons of ore as they're dragged along.

All the trucks at Hull-Rust now are Diesel-powered. They can start up the seven percent grades easily with full loads. Trucks vary from pint-sized Dumpsters, which back into incredible nooks and corners, to monsters which take a full load from the biggest shovels. Small "cats" penetrate into regions hitherto inaccessible and scoop out ore with hoe-type dippers of three eighths cubic yard capacity.

The mechanized operations permit removal of ore deposits passed up previously as too small to justify laying tracks to take the ore cars to them. Walls of the pit are lined with tracked terraces, but the maximum grade, three percent, for rail operation often made it impractical to reach some areas. Trucks, "cats" and small shovels have solved the problem of cleaning out the bottom of the pit.

Back in 1940, one Diesel-electric locomotive was ordered for Hull-Rust, just to see how Diesel power would haul the heavy ore cars. Today about 30 Diesel-electrics of 1000 horsepower bring the ore cars up the sides



Oliver Iron Mining Co. photo

Loading ore cars at Hull-Rust-Mahoning mine; the Big Pit contains more than 55 miles of railroad track

of the mine, and steam locomotives are used only for switching and emergencies. There are more than 55 miles of track in the pit and the trackage grows constantly.

Gigantic belt conveyors also make light work of hauling ore up the steep sides of the open pits on the iron range. In the Morris mine, adjacent to the Big Pit, a conveyor belt 2165 feet long, 32 inches wide, can carry 715 tons of ore per hour up a lift of 252 feet, on a grade of 24 percent. This was the first application of a steel cable belt developed by Goodyear. After three sea-

sons of operation, during which it lifted more than 1,000,000 tons of ore, the belt had stretched only $\frac{3}{100}$ of one percent.

Shop facilities have expanded in step with mechanization of the industry. In the locomotive shops at Hibbing, the Diesels are kept in perfect operating condition. No locomotive, Diesel or steam, has to be hauled away for any kind of repairs.

Giant grinding lathes maintain steel wheels of the locomotives at highest efficiency. In the machine shop, the routers,

(Continued to page 160)

Left, open pit with tower excavator at work; right, 2165-foot belt conveyor lifts 715 tons per hour



"Whizz Bang" Blasted Japanese Out of Caves



two and seven-eighths-inch pipe. The pipe was split along one side and had flanges attached so it could be screwed together like a clamp. The forward collar was welded onto the pintle and the rear collar was attached to the traversing and elevating mechanism. A heavy piece of pipe reinforced the trail leg to stand the shock. The original Whizz Bang had a bazooka sight, but this was discarded and the crew had to aim along the barrel and guess at elevation. When the weapon first went into action it was positioned about 50

yards from a tunnel entrance. After it had spewed forth eight 60-mm. shells every Jap inside the tunnel was dead. The weapon was used to capture four caves. It filled a special need for a direct trajectory weapon with sensitive detonation, tremendous concussion and fragmentation. Principal drawbacks were that the enemy could fire right down the muzzle at close range, and also the lack of breech loading. It was invented by Lt. Col. John E. Harbert and Sgt. Loren C. Craig.

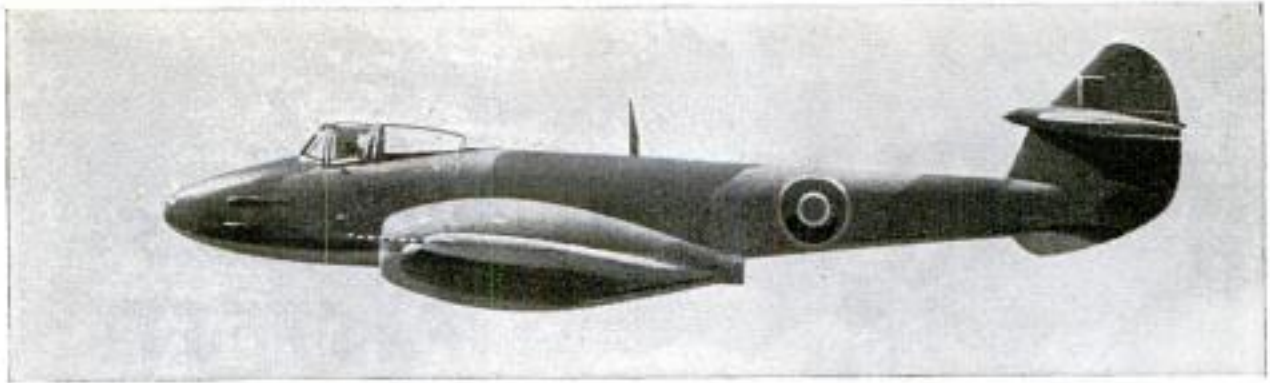
When heavy artillery, mortar and aerial bombardment failed to neutralize Jap caves in northern Luzon, two men of the 32nd Division Ordnance built a special weapon to do the job. They called this hybrid piece a mortar-cannon, but the GIs dubbed it "Whizz Bang." It was made by attaching the tube of a 60-mm. trigger-fired mortar to the tripod of a .30-caliber Browning heavy machine gun. The barrel was held by two collars made of ordinary

Yanks Used Artificial Moonlight in Philippines to Spot Japs at Night

Moonlight was created by anti-aircraft searchlights along a 10-mile front a few months ago near Manila. The lights were

directed at clouds and the reflected beams gave an effect of full moonlight to prevent Japs from slipping into our lines.

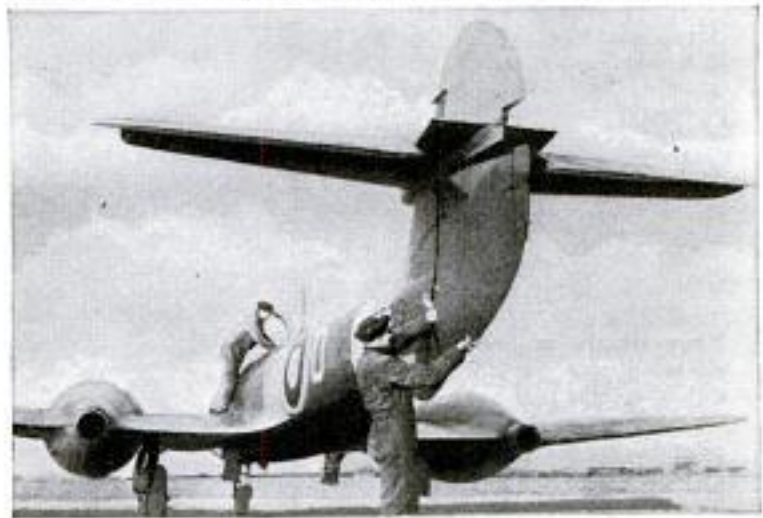




Twin jet British Meteor has high tail and four cannon in nose

British Jet Fighter

First Allied jet fighter to go into action against the enemy was the RAF Gloster Meteor. This twin-engine plane, nicknamed "Squirt" by British flyers, carries four 20-mm. cannon in the nose. It was used to shoot down German V-1 flying bombs over England and saw action in Europe during the last few months of the war. It has a wing span of 43 feet and is 41 feet long. Speed is believed comparable to the "more than 550 miles an hour" announced for the U. S. P-80 Shooting Star.



Hydraulic Ship Telegraph

Signals are transmitted from the bridge to engine room of a vessel with a hydraulic system developed to meet instantaneous transmission requirements of speedy PT boats. When the pilot moves the engine throttle handle to Ahead, Neutral or Back, the motion is transmitted instantly to an indicator dial marked A, N and B in the engine room. The dual hydraulic system automatically compensates for expansion or contraction caused by temperature changes, and is not dependent on electricity or other outside power. Wide application to pleasure and commercial vessels is foreseen.

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P-80 SHOOTING STAR

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Speed—Over 550 m.p.h.
Ceiling—Above 45,000 feet
Wing span—38 feet 10½ inches
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Armament—Six .50-caliber machine
guns, rockets and bombs

Huge nozzle in tail
vents exhaust gases.
Capt. Wallace Lien at
right was first Army
pilot to fly the P-80



IN AMERICA'S fastest fighting plane a pilot can leave La Guardia Field at four o'clock in the afternoon and land at Los Angeles before the clocks on the west coast strike five.

Flying through the time zones at 550 miles per hour he would almost make time stand still although his elapsed time would be something over four hours.

That's a graphic way to indicate the speed of Lockheed's jet-propelled P-80 Shooting Star. Called the world's fastest airplane, a propellerless P-80 recently flew from Dayton to New York in 62 minutes. Its top speed has been announced as "in excess of 550 miles per hour."

The P-80 is no freak racer but a standard military aircraft, equipped with six .50-caliber machine guns in its nose and capable of carrying rockets and bombs as well.

Droppable wing-tip fuel tanks provide a range comparable with that of other long distance fighter planes.

At a recent demonstration of the P-80 the public address system's announcer warned his audience: "He'll be coming in low across the field from the west. Watch closely, for you won't hear him approach!" Then a dot in the sky hurtled toward the field, blasted overhead and was out of sight again almost before the spectators had a chance to turn their heads. There had been a faint hum as the plane approached, a sudden blast of noise from its exhaust nozzle, and it was gone.

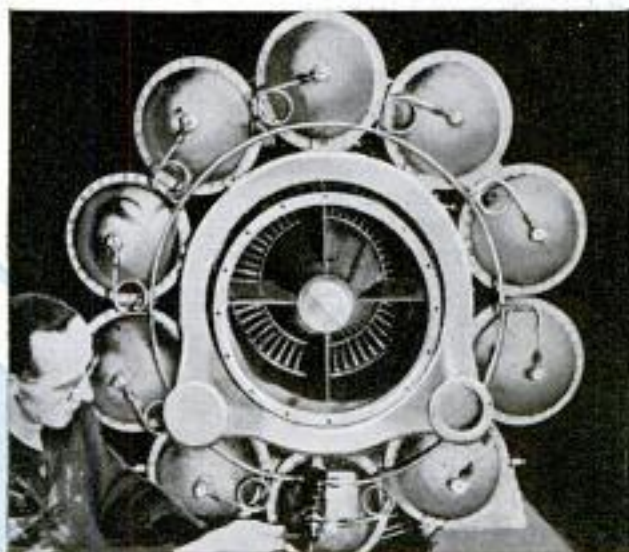
The wing of the P-80 is 38 feet 10½ inches from tip to tip and the plane is 34½ feet long. Its speed results from the terrific thrust of its power plant plus the aerodynamic cleanness of its bullet-shaped fuselage and the knifelike wing. To reduce resistance to a minimum the skin is attached with flush-type rivets that are then surface ground. Butt joints are filled with cement. The entire plane is given a pearl-gray paint baked on in a large oven and then buffed. Final treatment is to spray on wax and polish it to utter smoothness.

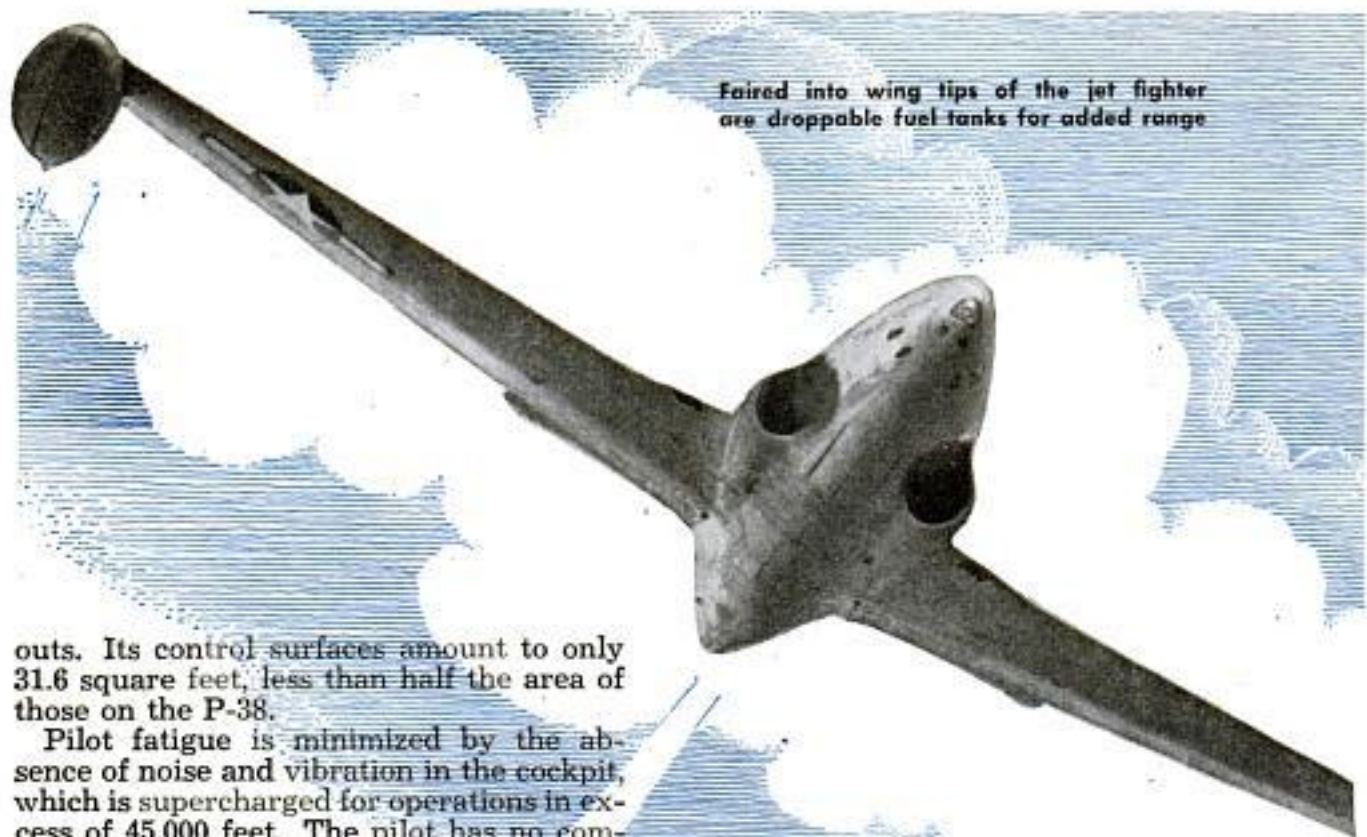
Much simpler in construction than aircraft that are powered with reciprocating engines, the Shooting Star is extremely easy to fly and is highly maneuverable. It has no torque problem and recovers from spins in half a turn or less. The superfighter has the fastest roll in the world and its performance is limited only by the pilot's ability to withstand tight turns and pull-

Even air liners are snails by comparison with the P-80 which flew from Dayton to New York in an hour



"Ears" of the clean-lined "Shooting Star," seen in head-on view, are air intake ducts. Below, engine of P-59 jet plane with ring of combustion chambers





Faired into wing tips of the jet fighter are droppable fuel tanks for added range

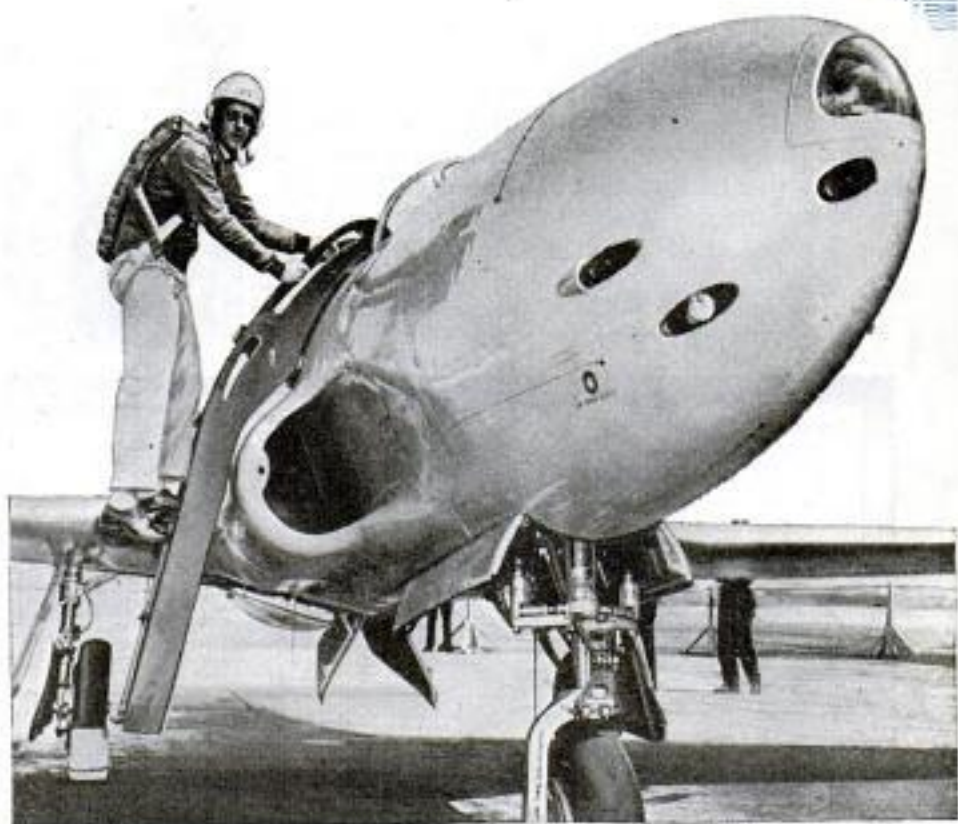
outs. Its control surfaces amount to only 31.6 square feet, less than half the area of those on the P-38.

Pilot fatigue is minimized by the absence of noise and vibration in the cockpit, which is supercharged for operations in excess of 45,000 feet. The pilot has no complicated maze of instruments in front of him. The principal engine instrument is the tachometer and the only engine control is the throttle. These plus a few flight instruments and his control stick are all he needs. He starts his power plant by means of a battery-operated motor that spins a compressor at the same time that a spark plug ignites the fuel mixture. A small metal plug in the combustion chamber almost at once becomes white hot and serves to maintain ignition after the electrical plug is switched off. There is no spark interference with radio and no engine warm-up time is needed. The plane can take off at once.

Its General Electric gas turbine is the most powerful aircraft engine in the world and has but one moving unit, the compressor wheel and turbine wheel that rotate on a single shaft at more than 10,000 r.p.m. The gas turbine weighs considerably less than other types of power plants and its power is measured in thrust instead of conven-

tional horsepower. Thrust exists when the speed of the jetted exhaust gases exceeds the speed of the plane.

The power plant fits into the fuselage aft of the cockpit and the entire tail end of the plane may be detached, at the trailing edge of the wing, for servicing the engine. This



Tony LeVier, chief test pilot of Lockheed Aircraft, climbs into the tight cockpit for a trial of the fastest plane in the world



Air ducts hug the fuselage without marring aerodynamic lines; the cockpit is supercharged

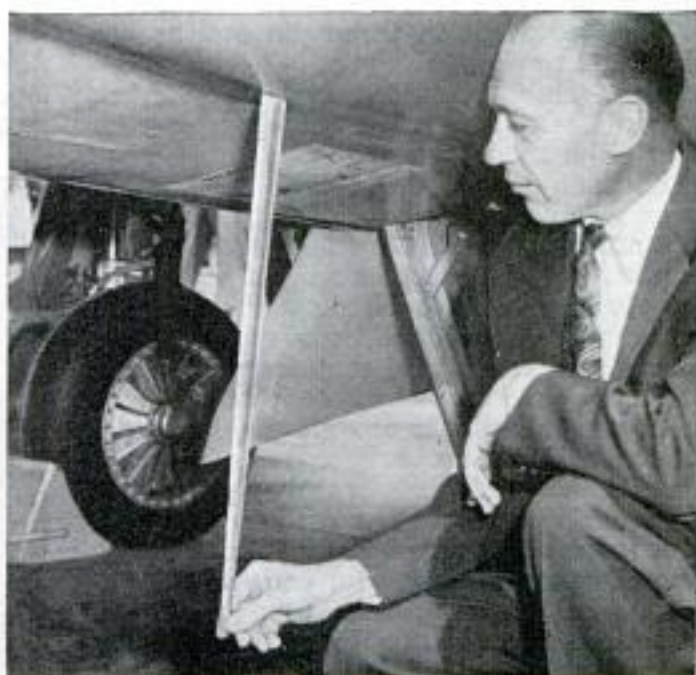
is done by removing three fittings, the tail pipe clamp, and the control cables. A complete engine change takes less than 20 minutes.

Air for the turbine is drawn in through a large duct at the leading edge of each wing root and the exhaust gases jet from a large exhaust nozzle at the tail of the plane. Combustion of the kerosene fuel is complete and the plane leaves no trail of smoke or flame.

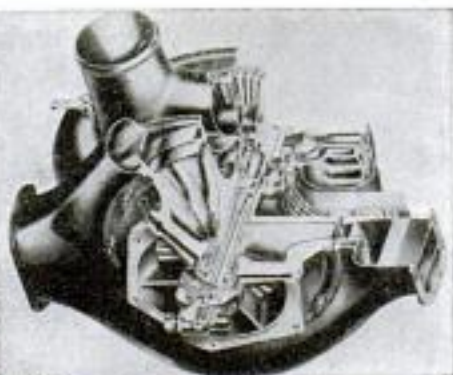
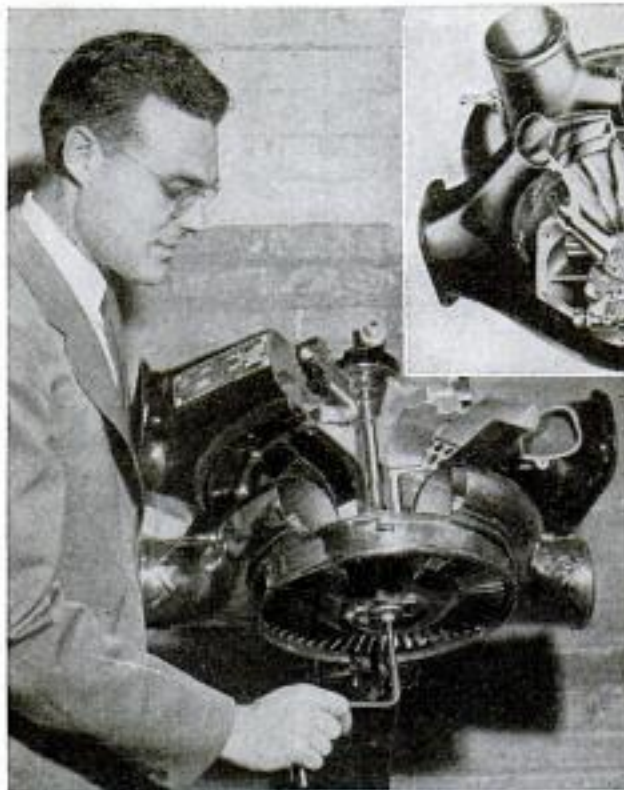
The guns in the nose are positioned to avoid blinding the pilot by muzzle flash, and are aimed with the aid of an electrical gyro-lead computing gun sight. Each gun is supplied from an ammunition box that feeds bullets perfectly even under the multiplied gravity pull of combat maneuvers. Guns and magazines can be replaced in less than 15 minutes. A gun camera in the right-hand air intake duct takes pictures of each combat action. The whole nose forward of the cockpit may be detached and a photo nose with camera equipment substituted. Able to outrun anything in the sky, the P-80 makes an ideal photographic reconnaissance plane. The pilot is protected by an armor glass windshield and steel armor plate forward and aft of his position.

Dagger-like radio antenna—there are two, side by side—projects from under fuselage

One of the many amazing things about the P-80 was the speed with which it was designed and built. Because of the war, Lockheed was asked to get its fighter into the air as fast as possible. Under Kelly Johnson, chief research engineer, the plane was designed, research was done, and construction of the first plane was completed in 143 days. The Shooting Star represents revolutionary changes in design from conventional aircraft and yet it was ready for flight in less than one third of the time usually taken.



Exhaust Runs Turbosupercharger to Boost Plane Speed



Cutaway, above, of the Wright "turbo." Left, a demonstrator hand-run model

up to 150 horsepower. This force spins the turbo's centrifugal compressor to create a compressing power sufficient to raise water to the top of a six-story building, inflate truck tires, or ventilate the average home. Installed in aircraft, the turbo acts as any other supercharger, but without inroads on horsepower of the engine itself. "Baffling" of exhaust noise in the surge of the gas through the turbo also reduces sharply the noise level in an airliner.

Thread Made of Stainless Steel Used to Sew Up Wounds

Stainless steel threads as fine as human hair are used as a nonabsorbable suture material. Wounds sewed with the chromenickel alloy suture can be exposed to heat and X-ray treatments with excellent results. The metal suture also can be left safely in place should a wound become infected. The stainless steel thread is pliable, has high tensile strength and can be knotted easily. This metal suture is expected to take its place along with such materials as silk, catgut, nylon, cotton, linen and horsehair now used in surgery. It was developed in the laboratories of Davis & Geck, Inc.

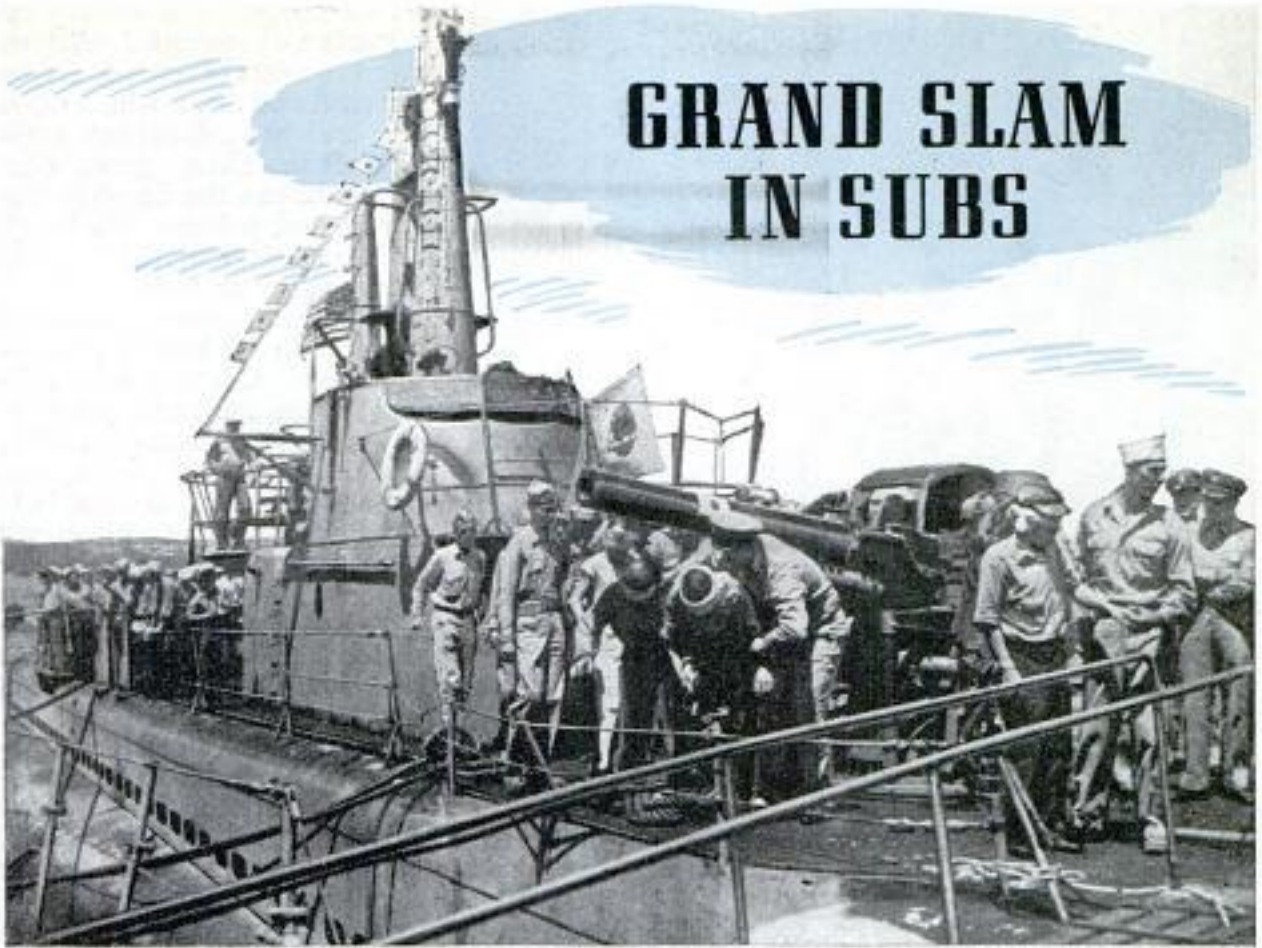
Jack-in-Box Map for Flyers Shows How to Dodge Cyclone

Weather maps in three dimensions are designed to teach flyers how to dodge cyclones, icing conditions and other flying hazards. Colored plates which spring up when the maps are opened show typical conditions of air masses over a 1000-mile area when a storm is brewing. The maps are made in sets of three. One shows the conditions that exist in an early stage of development of a cyclonic storm and the other two show conditions on cold and warm fronts. Frontal surfaces are shown in color—cold front in blue, warm in red, occluded (air shut in or shut out) in purple and rain in green. Arrows indicate usual movements of air masses and help the pilot determine conditions at various altitudes. The maps show where dangerous updrafts and downdrafts may occur and what direction a pilot should turn to avoid them. Practical data include 15 important icing rules for pilots. This three-dimensional aid

for flyers and students of physics, meteorology and aviation was prepared by the Special Devices Division of the U. S. Navy Bureau of Aeronautics.



GRAND SLAM IN SUBS

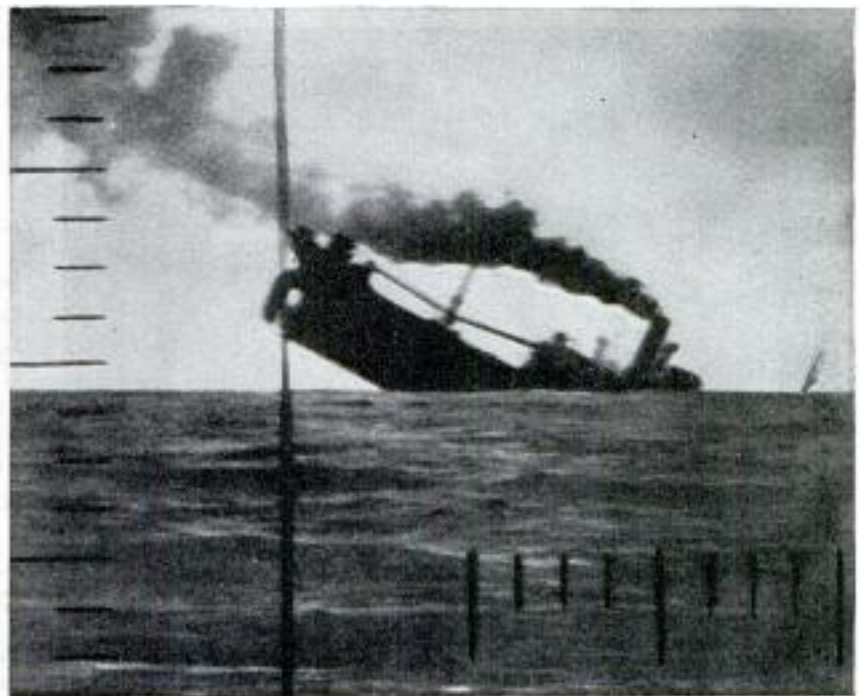


IN THE MIDDLE of bustling Pearl Harbor Navy Yard is a tall, cylindrical building which looks like a camouflaged Kansas silo. It is the submarine escape tower. Clustered below are office buildings, barracks, shops, warehouses, docks. Into these docks slide the graceful black hulls of United States submarines returning from war patrols. Some of them have had broomsticks at their masts denoting a clean sweep, and all of them have displayed tiny freshly painted red and white Jap flags on their conning towers.

Some of the more dramatic stories of the war are to be found aboard these ships and in the hearts of men who wear the golden dolphin insignia. However, until recently, the Navy turned thumbs down on submarine adventure stories. The more colorful aspects of the underwater war against Japan were closely guarded secrets.

Such secrecy has paid off. From December 7, 1941, to May 7, 1945, some 993 Jap ships—126 of them warships, including four carriers, 17 cruisers and 53 destroyers—have been sent to the bottom by our submarines. This represents about 4,500,000 tons sunk, approximately 75 percent of Japan's total loss.

U. S. Navy photos
Back from patrol in enemy waters, sub's crew looks on while Marines take charge of four Jap prisoners picked up after sinking a ship. Below, a periscope view of Jap cargo ship plunging bow first to its doom





Officer sights target through periscope while crew mans stations

Such attrition doomed the entire Nipponese war effort. It made extremely difficult the job of supplying outlying garrisons, cut off the flow of raw materials to her factories and took an alarming toll of warships.

When the war began, we had exactly 111 submarines in service—ranging all the way from the obsolete "O," "R" and "S" types and the freakish, mine-laying giant, the Narwhal, to such modern types as the Grampus and the Gudgeon. Since December 7, 1941, building programs have called for 150 new subs of the long-range fleet type. Modern United States submarines are of about 1500 tons displacement and are a little over 300 feet long. Diesel-electric powered, they will cruise about 20 knots

on the surface and about 8 or 9 knots submerged. Armament consists of torpedo tubes forward and aft, a 3-inch deck gun and two .50-caliber anti-aircraft machine guns. Our new subs are the finest in the world and possess the latest scientific devices for waging underwater warfare.

Submarine crews consist of more than 60 highly competent men. Commanding officers, of the rank of commander or lieutenant commander, are the cream of Annapolis-trained officers. Unlike battleship or destroyer crews which, for the most part, are trained after they get on board, submariners are trained to perfection before they set foot on the slim decks of their craft.

Submarine duty requires a certain informality between officers and men. Submariners are picked not only for their perfect physical condition and high degree of skill, but also for congeniality and tolerance in their personal relations.

In spite of close quarters, long patrols and the hazardous nature of the work, submarine duty has its pleasant side. Vitamin pills and ultraviolet lamps insure good health. Radios, portable phonographs and the latest books and magazines provide relaxation. You won't find many submariners who would swap for any other kind of duty.

With impressive scores to their credit, submarine skippers are pretty cocky about knocking off Jap ships. One of the favorite stories around the Sub Base concerns a commanding officer on patrol. He had just been dealt a fistful of bridge cards when a Jap ship was sighted.

"Nobody touch this hand!" he ordered as he jumped up.

He made his way to the periscope and glued his face to the eyepiece. There was a big, fat Jap transport—10,000 tons if she weighed an ounce. He took careful aim, fired a spread of torpedoes and grinned happily as two of them found their mark.

Then he returned to the bridge game—and made a grand slam.



Fish-eye view of snow-capped Fujiyama was made through sub periscope

It might be said that the United States Navy has made a grand slam in subs against the Japs. Courage and skill are routine, and the chests of the submariners are among the most highly decorated in the whole Navy. A submarine skipper feels almost naked if he doesn't sport a Navy Cross or two. Commander Roy Davenport, USN, a sub skipper from Los Angeles, recently became the first Navy officer to win five Navy Crosses.

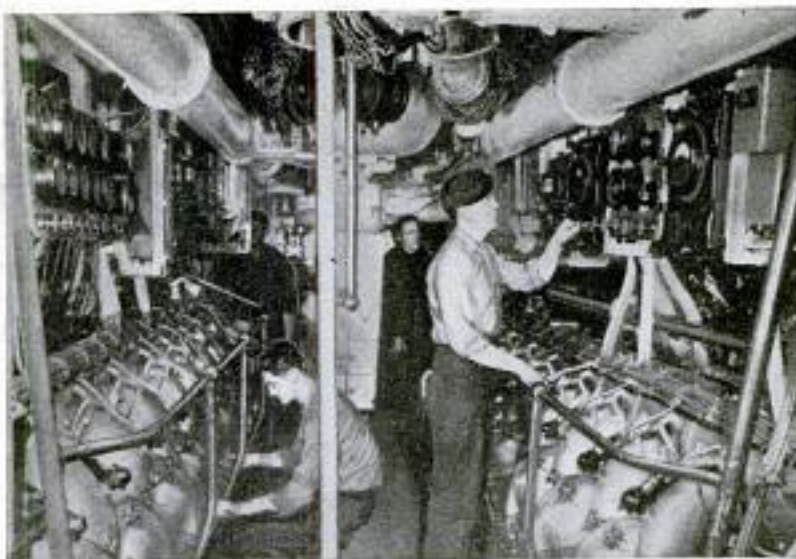
The first submarine skipper to win a Congressional Medal of Honor was Commander Howard Gilmore, USN. As he lay wounded on the bridge of his sub under attack by a Jap gunboat, he uttered his own death sentence in words that will live in naval history:

"Take her down!"

The crew obeyed and the submarine dove to safety without its skipper.

Tribute has been paid to the submarine time and time again by Fleet Admiral Chester W. Nimitz, USN.

"When the war first started," he said, "we were quite weak in surface ships and air forces, but we had a branch of the service that was immediately able to take the field and penetrate into enemy waters unsupported and start the war for us. I speak of our submarines.

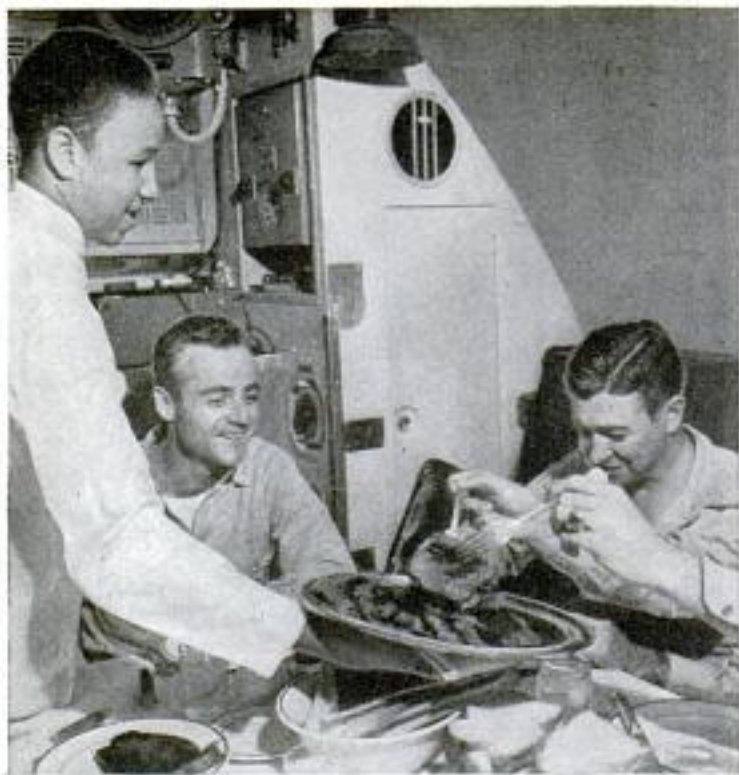


Machinist's mate checks huge twin Diesels which power U. S. subs operating on the surface; they provide speed of about 20 knots



Stowaway aboard! This hitch-hiking seal surprised crew when hatch was opened. Below, new U. S. sub has a distinctive conning tower





Chow time and a juicy steak bring smiles; food is Navy's best

"They have operated continuously throughout the war, day and night, between the surface and amphibious operations that we conducted, and they have turned in a fine performance of duty."

In the early, tragic days of the war, a few submarines of our Asiatic Fleet kept General MacArthur's forces fighting in the Philippines. Supplies, food, ammunition and medicines were carried into Manila Bay.



Shortly before the fall of Corregidor, one daring sub skipper stole past enemy shore batteries at night. Reaching the island fortress, he put ashore anti-aircraft ammunition to help Army gunners fight off the waves of Jap dive bombers. He then loaded up with a vast amount of gold, silver, jewels and securities belonging to the Philippine Commonwealth, banks and individuals. He also brought out several high-ranking American and Filipino officials, including the United States High Commissioner, Francis B. Sayre. Another American submarine was sent to the Dutch island of Timor in the Netherlands East Indies to rescue a group of fever-ridden, emaciated Australian flyers. The daring rescue was successfully accomplished, even while Jap patrols were searching the jungles and the beaches for the airmen.

Supplies, ammunition and instructions were also taken to Filipino guerillas during almost three years of Jap domination of their islands. In one instance, an American sub nosed its way several miles up a river and tied up at a pier while a Filipino welcoming party trotted out a band and played "Anchors Aweigh." The Japs nearby thought it was merely a local Filipino holiday celebration.

United States submarines have done to Japan what Nazi subs tried to do to England and failed. Japan, as an island power, bears the same relationship to the Asiatic continent that England does to the European continent. It was essential to our strategy of sea blockade that the homeland of Japan be deprived of oil, iron ore, coal, copper, aluminum, cotton, lumber and food.

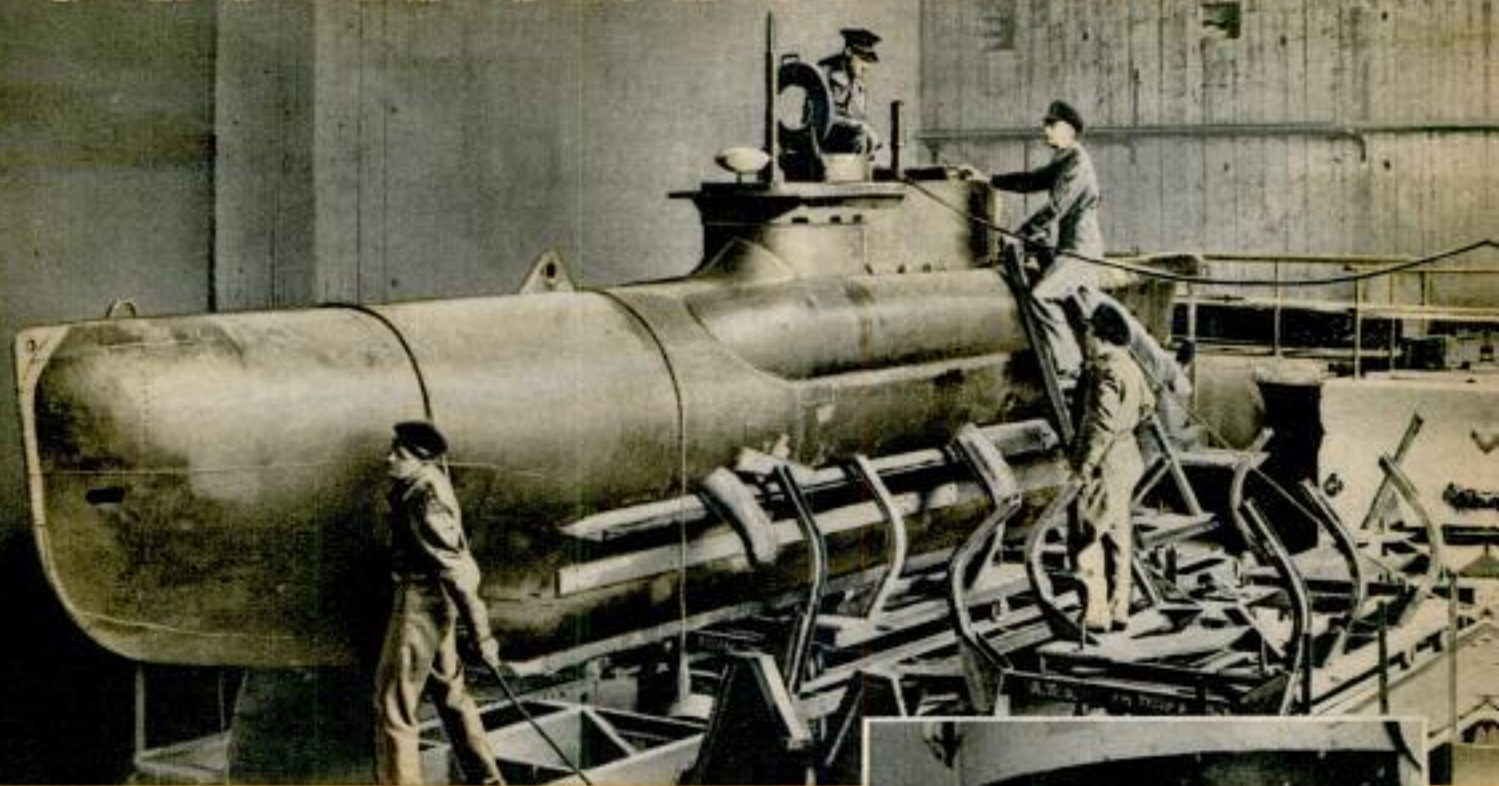
The subs did their job well. Navy announcements on Jap shipping losses reveal that for the past year and a half coastwise steamers, fishing smacks and barges seem to be the only ships sunk. The big transports and cargo ships were picked off long ago. Sub skippers often complained they couldn't find anything to sink.

United States subs have long been operating right off Japan's front door. One of the more dramatic photographs of the second year of the war was a shot of

(Continued to page 158)

Old Glory flies from ice-coated conning tower as sub enters an Arctic port

U-BOATS GIVE UP SECRETS



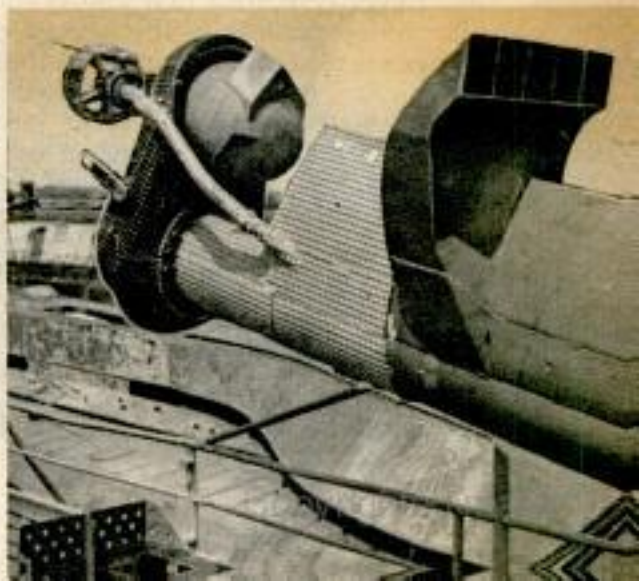
Captured two-man midget U-boat is inspected by British officers in gigantic shelter at Kiel. Delivered in sections, the U-boat was assembled there. Called the Seehund, midget is 39 feet long and is powered by Diesel engine and electric motor. Speed upon surface is 8 knots, submerged, 3 to 4 knots. It has two torpedoes




Looking through periscope of U-boat 234, which surrendered at Portsmouth, N. H., and disclosed sub secrets




That's no gun barrel you see on the 234, but a "Schnorchel" or breather, which enables U-boat to take in fresh air and eject foul air while totally submerged. It rests on deck when not in use. Radar equipment fitted to breather is shown at the right






Smoke from atomic bomb rises 40,000 feet; blast is felt 250 miles away



Equals bomb load of 2000 Superforts



5000 atomic bombs could destroy all Japanese cities



Atomic bomb equals 4 trainloads of TNT



ATOMIC BOMB FOR WAR-

HARNESSING of atomic power appeared rather remote five years ago and Dr. R. M. Langer, atom research physicist of California Institute of Technology, seemed to be a trifle optimistic in his article, "The Miracle of U-235," which appeared in the January 1941 issue of Popular Mechanics. But dropping of the first atomic bomb on Japan made it evident that Dr. Langer actually was being overcautious when he wrote:

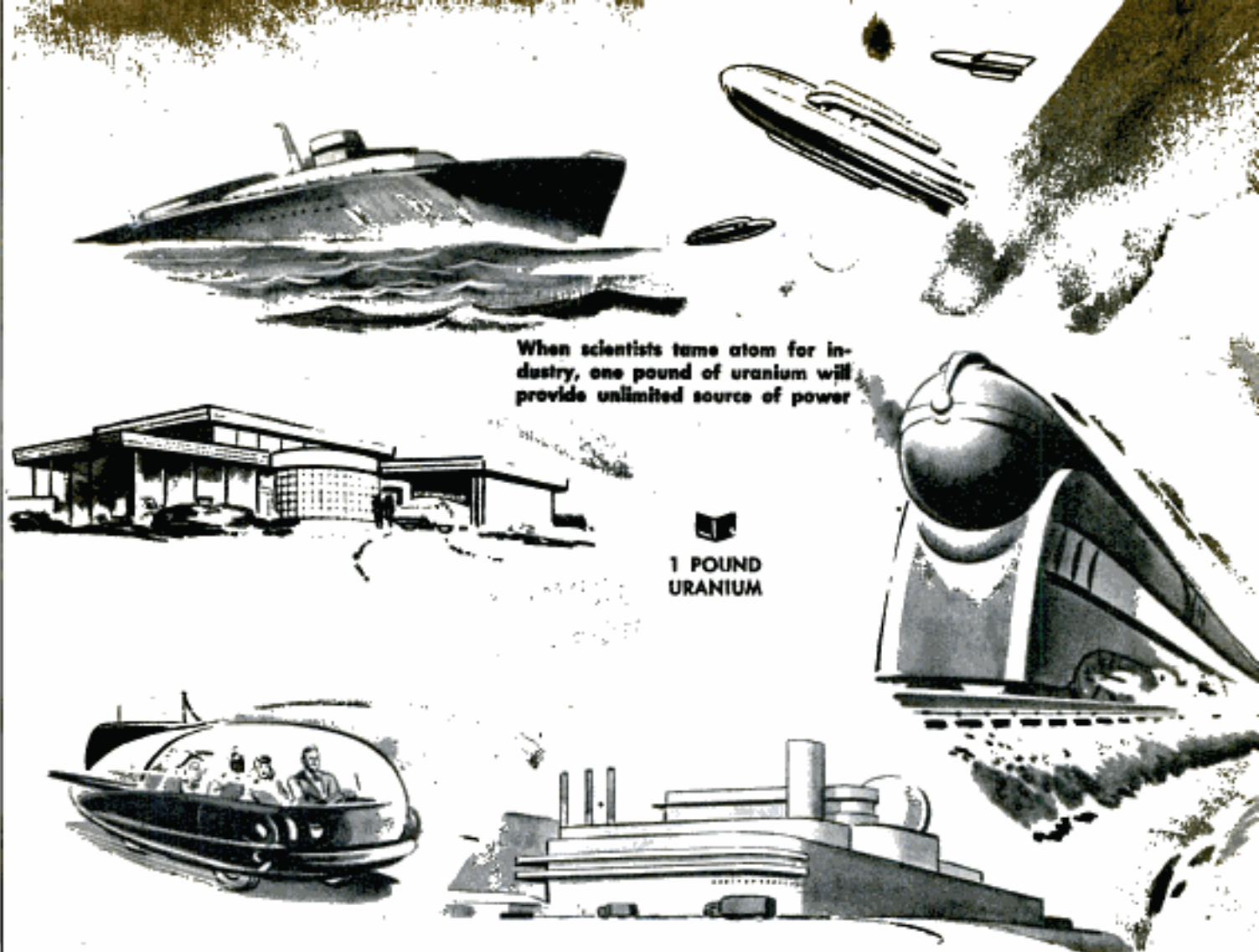
"Several months ago you read in Popular Mechanics that the secret of atomic power is close to solution and that possibly within a decade civilization will be using the tremendous amounts of energy contained in U-235, an isotope of uranium. Since then, additional research has opened up greater possibilities than ever."

Today's atomic bomb is a grim illustration of the incredible force unleashed when the energy that holds the atom together is released. Basis of the bomb is Uranium 235, a lustrous white metal having the same chemical proportions as uranium, but three points lighter in atomic weight. Bombard-

ing U-235 with neutrons, highly penetrating particles of matter thrown off by ordinary radioactive material, scientists were able to split the U-235 atom and release its tremendous energy.

Stored in the first atomic bomb was an explosive force greater than 20,000 tons of TNT, the total bomb load of 2000 Superforts. A single atomic bomb packs a punch nearly 2000 times that of the largest conventional bomb, the 11-ton "Volcano."

Hiroshima is—or was—proof of the atomic bomb's power to destroy 4.1 square miles of a city. In a test of the bomb in New Mexico, the pressure wave from the blast knocked down two men six miles from a steel tower from which the bomb was suspended. First came a blinding flash of light, then a great ball of fire. A flyer at Needles, Calif., 500 miles away, reported seeing the flash, and the blast rattled windows 250 miles away. Witnesses rhapsodized over the lights, calling them beautiful beyond comparison. Following the visual shock a huge varicolored cloud of smoke billowed up more than 40,000 feet. The steel tower



When scientists tame atom for industry, one pound of uranium will provide unlimited source of power

1 POUND URANIUM

ATOMIC POWER FOR PEACE



vaporized, and intense heat from the explosion fused the sand on which it stood into a silica-like crater.

Diverted into peacetime applications, atomic power possesses tremendous possibilities in providing cheap power and heat that promise to revolutionize our present concepts of living. Just when these can be achieved only time can tell, but wartime developments certainly will bring the atomic dream to realization years ahead of the most rosy estimates. Dr. Langer predicted these constructive uses of atomic energy:

A power plant the size of a typewriter, in its heart a one-pound package of uranium containing the same amount of power extracted from 250,000 gallons of gasoline. With a "butterfly" motor or U-235 engine, al-

ready well on its way to perfection, a car could be driven 5,000,000 miles without refueling. This power could be applied to all forms of transportation.

Cheap power for every home and factory without distribution lines. Electricity at less than $\frac{1}{10}$ cent per kilowatt-hour.

Jet-propelled aircraft, using uranium power, of a simple airfoil or flying wing design and able to fly several hundred thousand feet above the earth at several thousand miles an hour.

THE ENERGETIC ATOM

All matter is composed of atoms. Everyday objects differ from one another only because of a different arrangement of the same electrical forces which make up all atoms. Each atom is a tiny solar system, its sun a nucleus or spot of positive electricity, its planets the electrons. The nucleus is made up apparently of two particles of nearly equal mass: Protons, which have a positive charge, and neutrons, which have no charge. Uranium atoms are the largest known, and splitting the atoms of one gram of U-235, about .03 ounces, releases energy equivalent to 11,700 kilowatt-hours of electricity or about 5 million times the energy produced by burning a gram of coal.

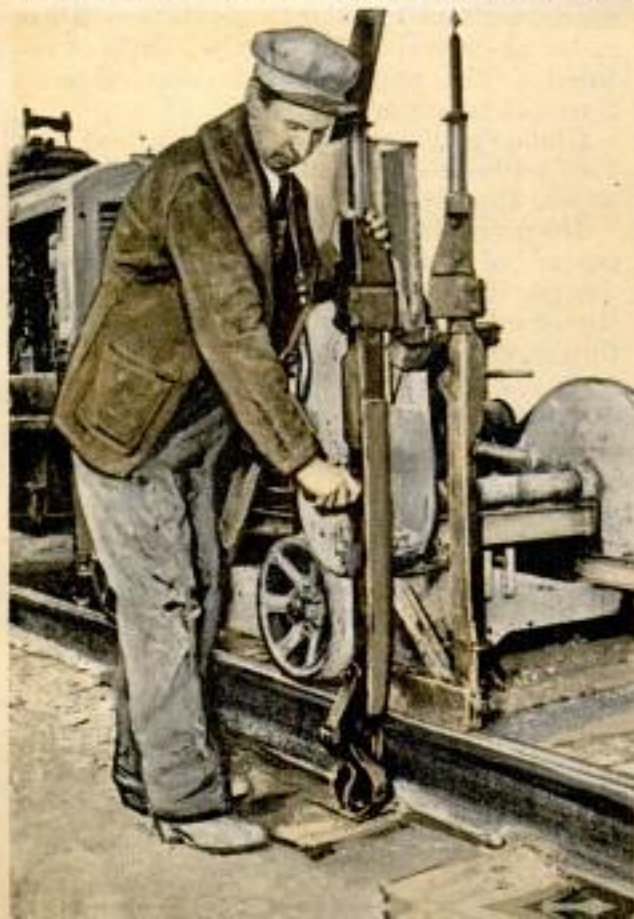
One big community of the world, with no two points more than seven flying hours apart and no excuse for difference in material welfare. Most activities, including farming, located underground, with only transportation and recreation above the surface.

"WORKIN' ON THE RAILROAD"



Santa Fe photo

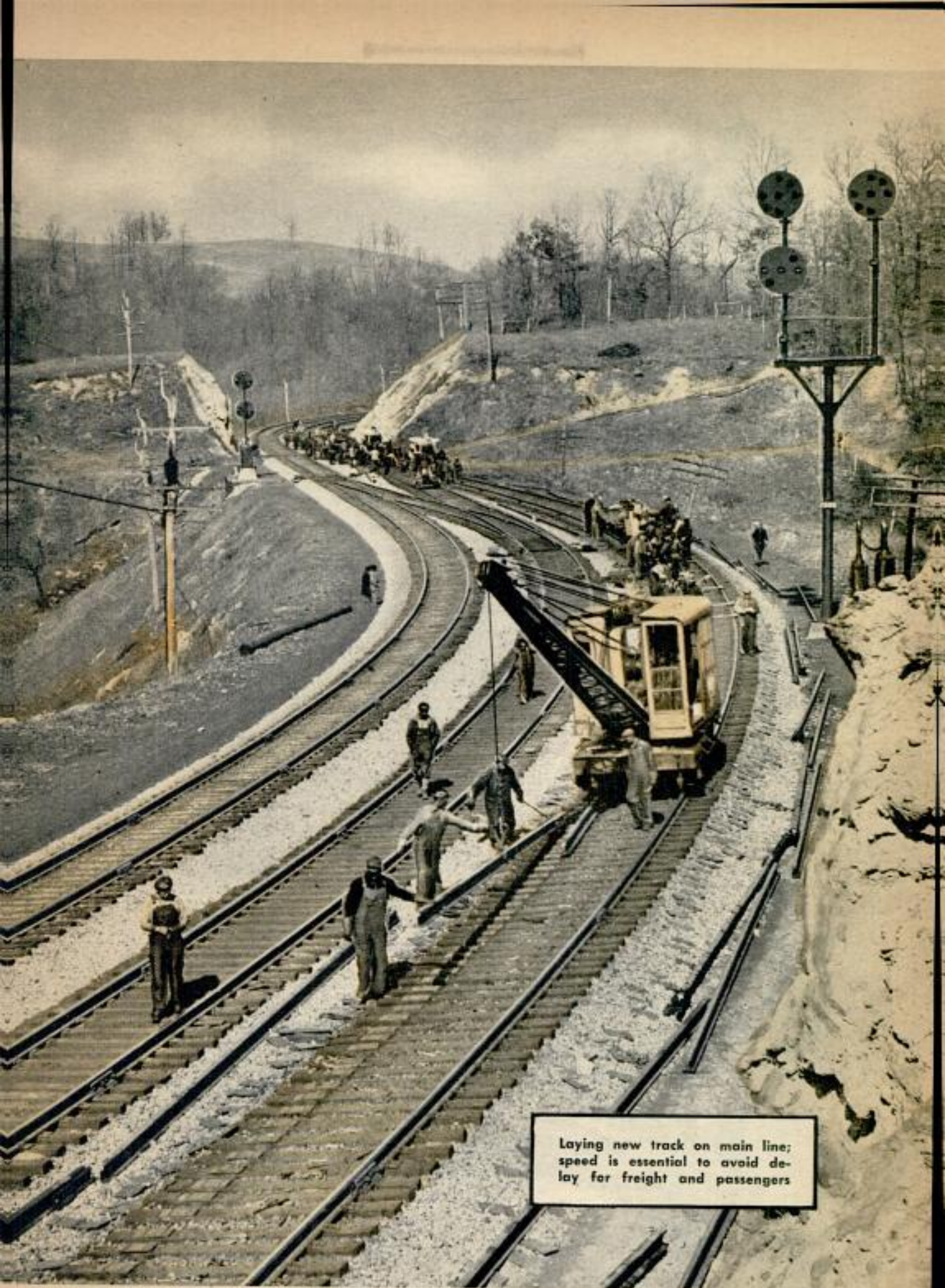
Off with the old, on with the new. Track gangs still use crowbars to remove rail, but a mechanical spike puller, below, is rapidly taking the place of muscle



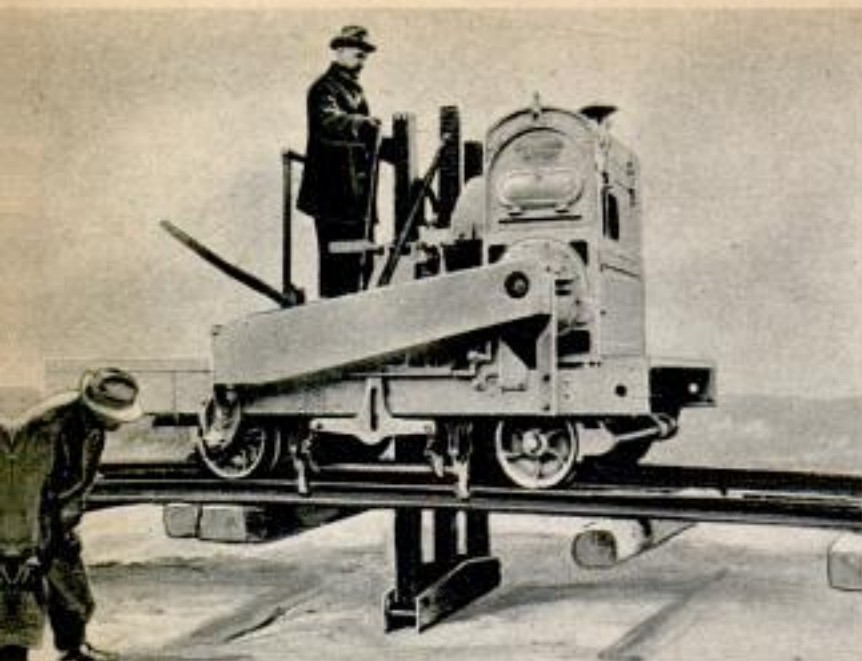
THERE was a time when "workin' on the railroad" meant a sweaty job with pick and shovel, gangs of tampers pounding the ballast hard in the new roadbed, three-man teams swinging steel mallets rhythmically against iron spikes anchoring the rail to clean new ties.

It still means that. Housekeeping along the right-of-way is still largely a tough, tiring job for muscles. But beyond the routine inspection and repairs by track walkers and section men, the scene is changing. Engine-driven spike pullers, pneumatic and electric tampers, rail-laying cranes, power jacks that hoist the track right out of its bed, "moles" that pick up and clean and replace ballast—these are a few of the mechanical advances which enable the railroads, desperate for help, to keep the house in order under the heaviest burden in history.

This housekeeping job isn't one for pikers. Maintenance of way and structures cost Class I railroads a record \$1,330,000,000 last year, according to estimates based on official figures for the first nine months of 1944. It shattered the previous high with a 20 percent increase over the 1943



Laying new track on main line;
speed is essential to avoid delay
for freight and passengers

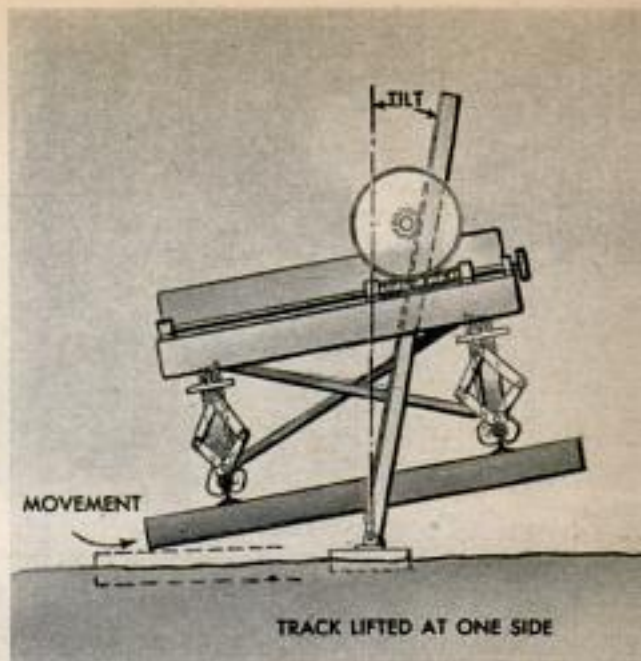


Nordberg Mfg. Co. photo

Track machine works in difficult places, can lift rails and ties three feet, or raise only one side of the track

maintenance bill of \$1,108,281,000. The Pennsylvania Railroad alone spent over \$108,000,000 in 1943 to maintain tracks and structures. Mechanized operations take a bow here, for without them the railroads would have been hard pressed to do the job in the face of higher costs of labor and materials.

Track laying and track maintenance took the lion's share of the 1944 bill—\$289,636,000—part going to the nearly 24,000 high school boys who enlisted for track work from May to October. Another part went



to the 50,000 Mexican laborers working on railroads north of the border under international agreement. The import quota for the Mexicans was raised to 75,000 for last summer. With record wartime traffic pounding the 414,000 miles of rails in the United States, the roads need all the manpower and all the equipment, new or salvaged, they can find.

A railroad, they say, is only as good as its track. Spurred by the manpower shortage, mechanized equipment is being called on more and more to assist the engineers,

Special loader attached to Caterpillar tractor removes old ties and tosses them into truck





Screen and flaps of power adze above keep chips from flying up. Cleaner for ballast, right, ejects dirt and cinders

steel gangs, section men, bridge builders, carpenters, tie makers—nearly a fourth of all railroad employees—in the year-round vigil required to keep track in good condition and wheels rolling safely.

Maintenance begins at the moment rails are manufactured. Each rail is lettered, dated, and given a heat or serial number which designates the five to seven rails made from a single ingot. Records show



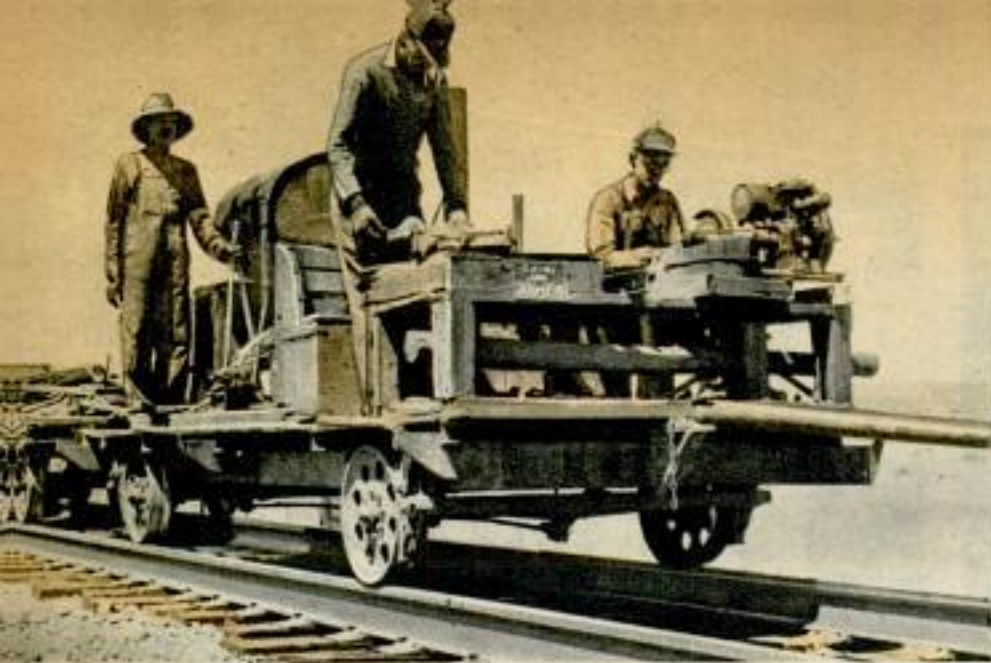
Denver & Rio Grande Western photo

where each rail is laid, and if a flaw develops in one, all rails of the same series are examined.

Modern machinery eases the ballasting headache long suffered by the railroads. Chips of stone and other surfacing material are deposited from six to 12 inches deep under the ties as ballast, facilitating drain-

Another type of ballast cleaner moves along edge or center of ballast, deposits dirt along right-of-way Bessemer & Lake Erie photo





Santa Fe photo

Machine shop on wheels carries tools for almost any repair job

age, holding ties more firmly in place, and adding to roadbed stability. Ballast creates an almost continual job. Periodical replacement is necessary to remedy damage from high water and the pulverization caused by the pounding of heavily loaded cars.

Today the "mole" takes care of ballast with dispatch. A low-slung vehicle moving along the ballast's outer edge, the mole raises the stones into the machinery, cleans out dirt and cinders, and replaces the clean ballast on a smooth grade. The dirt is deposited alongside the



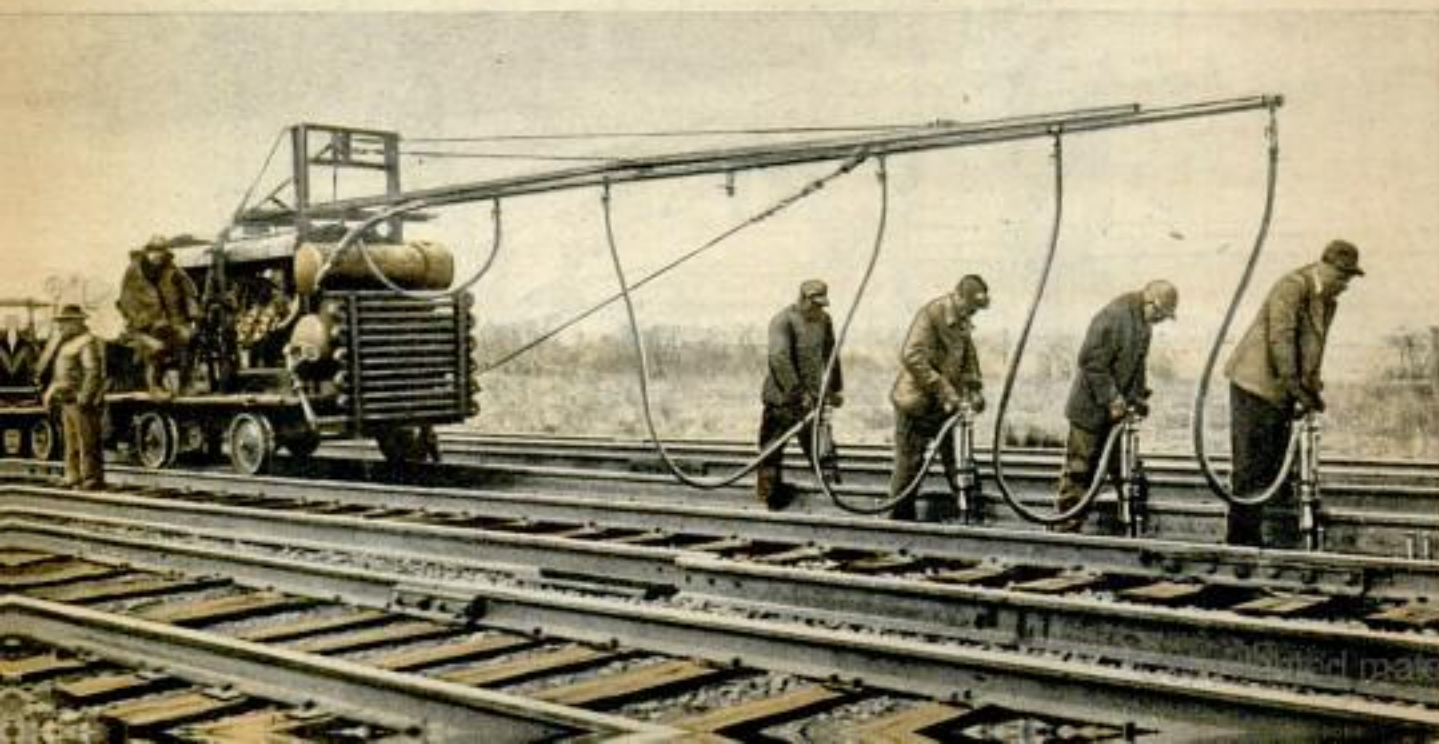
Air hammer spiking machine fits on head of spike and drives it into a tie with ease. Below, a compressed air unit, self-propelled, provides power to run the spiking machines
 Pennsylvania Railroad photo

right-of-way. The Pennsylvania Railroad uses a larger ballast cleaner "train," operating on the same principle, for the area between the tracks. This machine deposits the dirt in hopper cars that are hauled behind it.

Removal of old ties and rails once called for the last ounce of muscular energy, but today it can be done in a flash. Gasoline-powered self-propelled cranes lift worn steel in a jiffy, and Caterpillar tractors equipped with a special loader make short work of the ties. The loader has a two-pronged wedge-shaped fork which picks up six to 10 ties per load and averages 10 ties every 20 seconds. Especially useful in removing ties from abandoned trackage, the tractor and loader can cover a mile a day, pulling along with it a truck into which the ties are deposited.

Spikes are removed from ties with the greatest of ease by the mechanical spike puller, powered by a gasoline motor. The puller draws the spikes from both sides of the rails at the same time while moving along the track.

Speed is more important than ever in rail and tie replacement today, for every inch of track is needed to move military supplies to





Pennsylvania Railroad photo

Gasoline-powered crane cuts heavy labor in lifting out worn tracks

their destination. Pneumatic tampers quickly pack ballast into a compact mass, and the roadbed is ready for new steel. Rails, ties, plates, spike bolts and other fastenings have been distributed, the rails unloaded from flat cars by derrick. Weighing from 116 to 152 pounds per yard, the rails must be dropped carefully, both ends landing on an even surface at the same time, to prevent damage.

Ties are adzed or trimmed to receive tie plates by a rotary power adzer which has two series of circular steel saws about $\frac{1}{4}$ inch thick. One series adzes the tie to the proper width inside the rail, and the other does the same outside. Screens and flaps keep wood chips from flying up. Pioneering with this machine,



Maintenance of signal box equipment is important on any railroad, and Santa Fe uses electrical shops on wheels to keep boxes working

Caterpillar Tractor photo

Too much time isn't spent on laying temporary track. Left, a Caterpillar tractor with bulldozer straightens out shifting rails for coal trains



It's a far cry from the old handcar to this one, motor-driven and light



Fairmont Railway Motors photo

the Norfolk and Western is able to replace approximately 1000 tie plates a day, covering about a sixth of a mile.

The gasoline crane lays the rails in position. A tie borer quickly bites into the ties, opening holes for the spikes. Pneumatic spike driving machines, powered by compressed air from a self-propelled unit, hammer the spikes home in a few seconds.

Even the bolting of new rails to plates is speeded up by a motor-driven rail bolter. First the bolts are run through and nutted by hand, then the machine comes along and tightens the nuts firmly.

Where lifting and shifting of track is necessary, the Nordberg track machine can do the work of 80 men with crowbars. A welded steel-framed car powered by a 40-horsepower gasoline engine, the machine can lift 25 tons and can function in

soft footing and other places where it is virtually impossible to work by hand. It can move track that is deeply frozen in the ground, and with the aid of a leveling device, can raise track as much as three feet. With the addition of a mast, boom and hoist, the machine also can lay and load rail.

Other mechanical aids to railroad maintenance include machine shops and electrical shops on wheels. Small cars carry oxy-acetylene apparatus used to build up worn rail ends by welding, thus adding to riding comfort and prolonging life of the rails.

Ties once had to be replaced every six or seven years in moist areas and lasted only a little longer in dry or desert regions. Creosote treatment has extended the life of a tie to 30 years. The solution, half creosote and half petroleum residuum or fuel oil, also is applied to all poles, crossing planks, and bridge and timber foundations. It forestalls decay and prevents damage by termites. Timber also is being treated chemically to resist fire hazards. The Santa Fe, with 13,137 miles of track and 60,000,000 ties, estimates that creosote alone saves it about \$5,000,000 yearly.

Rail corrosion, especially severe where there is brine drip from refrigerator cars, long has been a great problem. The Norfolk and Western combats it by removing scale with an oxyacetylene flame process, and covering the rails with an oil coating. Chemicals added to the brine have been

This ballast cleaning machine used by the Pennsylvania deposits dirt in hopper cars carried behind



found to neutralize the corrosion, and practical methods of application are being sought.

But the railroads do not live by machine alone. Once track has been laid, every mile must be tended as diligently as if it were sacred soil. Section crews must destroy weeds, grass and brush which create shade and dampness that foul ballast, corrode metal and rot ties. Because of a shortage of distillate, chemical sprayers have replaced burners which sear weeds with an intense flame. Operated like small automobiles, the sprayers remove all growth 18 to 24 inches from either side of the track.

Section men must watch for fire hazards on bridges and trestles, must attend at once to threats of landslides. In bad weather, they must be on constant duty against high water, ice, snow and other storm dangers, so that nothing imperils the safety of the trains with their precious cargoes of freight and humanity. Structures must be kept tidy and track drainage in order.

They no longer use "elbow grease" to get about on hand cars, however, but ride comfortably in motor-powered vehicles. On the Santa Fe and many other roads, extra track and bridge gangs live and travel in specially built trains with bunk cars, dining and kitchen cars, and tool and material cars. Often a recreation car and showers are provided.

Increased mechanization has made safety training even more vital for maintenance men. Power tool operators get special training. Shin guards and goggles are common equipment.

Conditioning track to stand up under modern 90 to 100-mile speeds has added to maintenance problems, but once the proper standards have been obtained the additional costs are not regarded as excessive. Many roads are carrying out bridge strengthening programs for their high speed lines. Track problems created by higher speeds and heavier tonnages have been solved generally by improved design and increased maintenance, rather than by changes in fundamental structure.



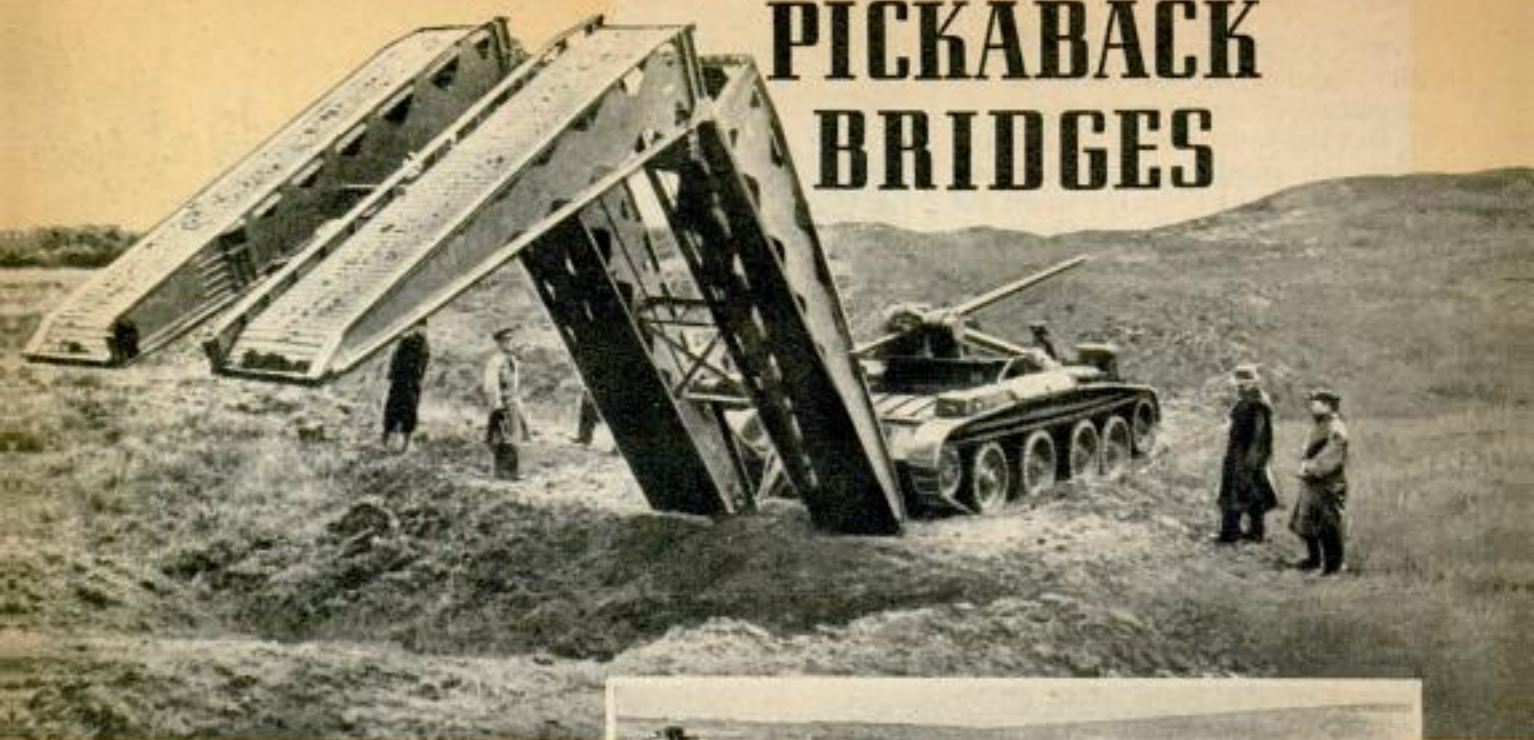
Tie borer in foreground works in team with spike drivers, rear



"Cat" with special loader above is used for loading ballast into cars. Portable phone below warns workers trains are due



PICKABACK BRIDGES



British official photos

British tanks which carry and lay their own bridges proved valuable in Europe and Burma. The bridging operations are controlled by crews inside the tanks, so they can carry on under fire in crossing of small rivers or canals, surmounting anti-tank ditches and scaling seawalls and cliffs. Above, scissors-type bridge built on Valentine tank as it automatically unfolds across a gulley. Bridge is carried on top of tank. Right, a tank crosses the scissors bridge. Tank that placed bridge in position is in background. The bridge-tank Twaby Ark, below, is driven directly into a gap and its ramps lowered, enabling other vehicles to pass directly over it

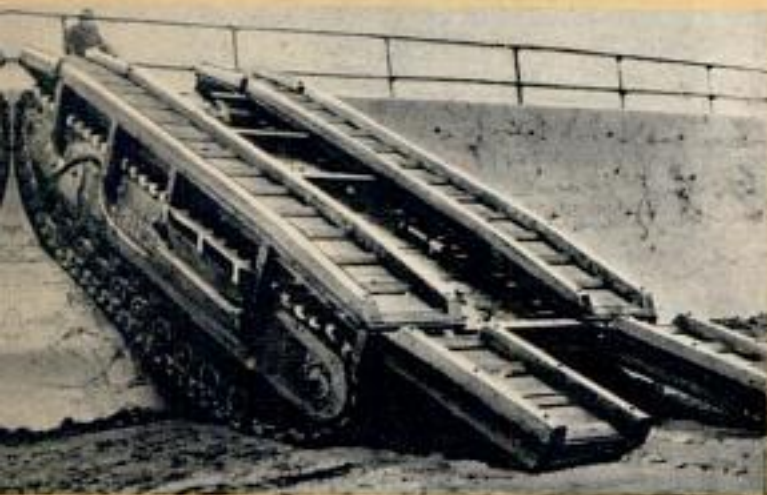


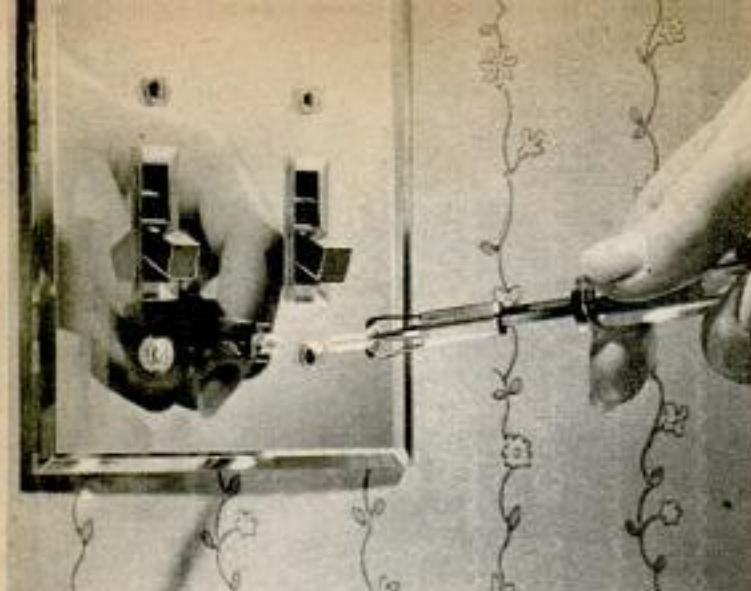


Churchill Bridgelayer is a 30-foot steel span trackway mounted on a Churchill tank. The tanks above are crossing a crater on span laid by the bridgelayer. Hydraulic arm of bridgelayer lifts the span, as at right, then moves it forward and lowers it across gap to be bridged



Still another type of bridge-tank, The Ark is a Churchill tank equipped with two trackways made of hornbeam sections of a small box girder bridge. These are fixed together to form a bridge projecting in front of the tank and held in place by wire rope. Ark at top left forms a ramp against a seawall, and another Churchill tank then scales the wall successfully by climbing over The Ark's ramp, left





Plastic Screw Reduces Damage

Designed to prevent breakage of mirrored electric switch plates, a plastic screw made of Tenite is reported to exert less pressure than a metal screw. It is available now only in $\frac{1}{2}$ -inch length, with oval head, but $\frac{1}{4}$ to 1-inch sizes with oval, flat and round heads are planned for the future.

Wingless B-29s Train Gunners

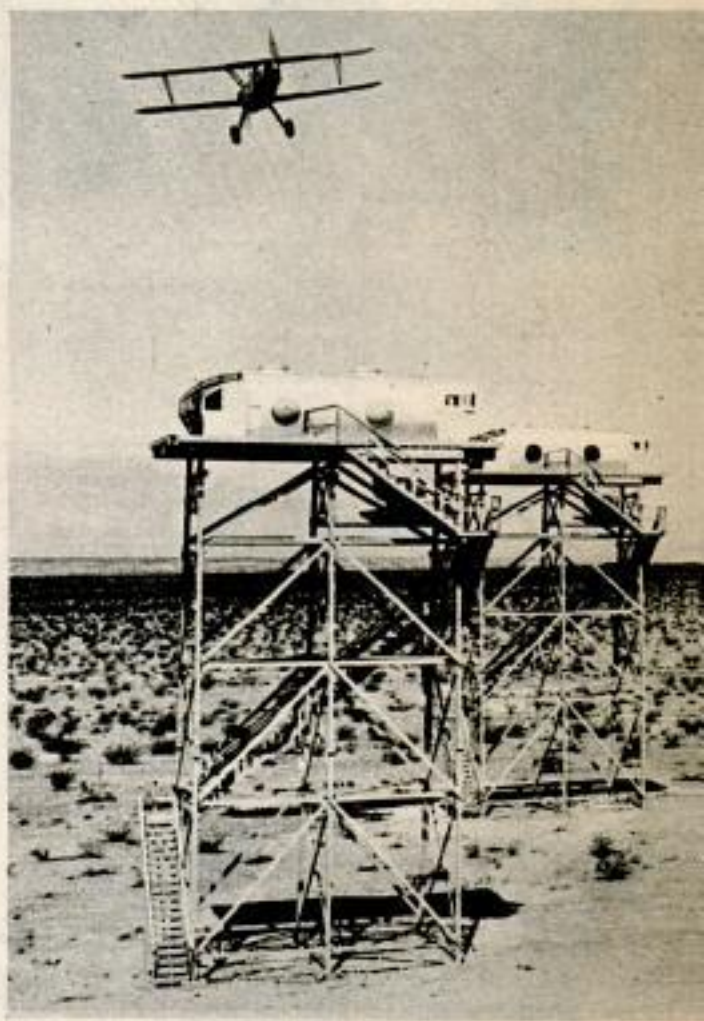
Mounted on towers in combat formations, B-29 Superfortress fuselages, with sighting blisters and remote control turrets,

Tape Helps GIs Correct Speech

Air Force veterans who wish to correct their speech and improve their enunciation find aid in "talking back" to themselves via a tape recorder at the Army Air Force re-



gional and convalescent hospital at Miami Beach, Fla. In the "Mirrophone," resembling an oversized radio cabinet, a magnetic ribbon makes one-minute recordings which may be played back instantly, enabling flyers to listen to their words as often as they wish until flaws are eliminated.



give student gunners realistic training at the AAF Western Flying Training Command, Las Vegas, Nev. Gun cameras record scores as "attacking" aircraft approach.

Disks Aid Drawing Curved Lines

Drawing a line parallel to a curved line can be done simply with a set of graduated transparent Plexiglas disks. The pencil point is inserted in the center hole of the disk, which then is propelled along the edge of the curve. Previously it took several minutes to adjust instruments for such a line.





ALUMINUM OVERHEAD GARAGE DOOR, built by aircraft methods so it won't sag or buckle, can be opened and closed by a small child. The entire operating mechanism is enclosed in a small box on the back of the lightweight door, eliminating tracks, weights and exposed springs. The door can be installed in less than 30 minutes, the builder declares

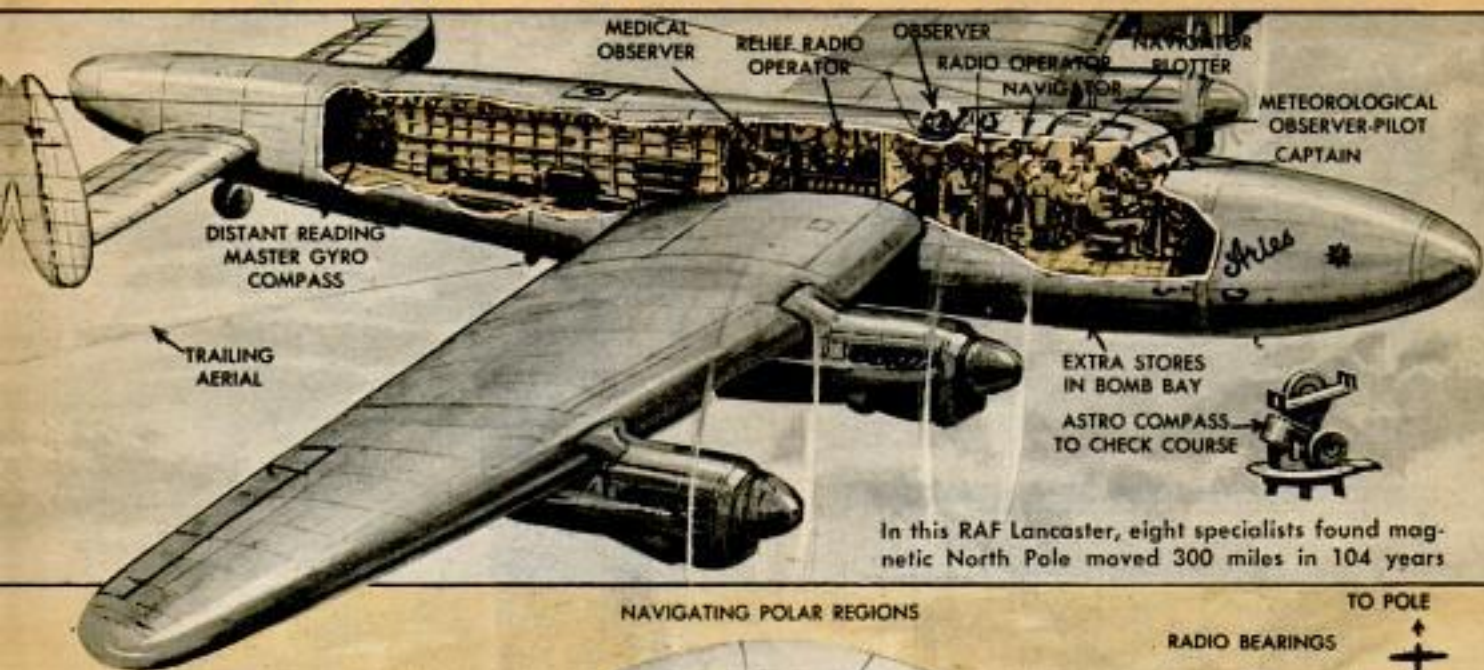


MINIATURE SHIPYARD an exhibit at the Los Angeles County Museum contains models showing various stages in the complex construction of cargo ships, from the laying of the keel to launching. Here is a replica of section of Consolidated Steel Corporation Yards with model of 10,000-ton C-1 cargo and passenger vessel about to leave ways to enter basin

COLLECTION OF 1100 WAR INSIGNIA of the United Nations military forces resulted when the soldier brother of Richard Marco sent him a shoulder patch. The 16-year-old youth has mounted and catalogued the emblems, which he loans for patriotic meetings or bond rallies. His latest project is collecting the patches of enemy units



Wandering Magnetic Pole Is Plotted by Plane



In this RAF Lancaster, eight specialists found magnetic North Pole moved 300 miles in 104 years

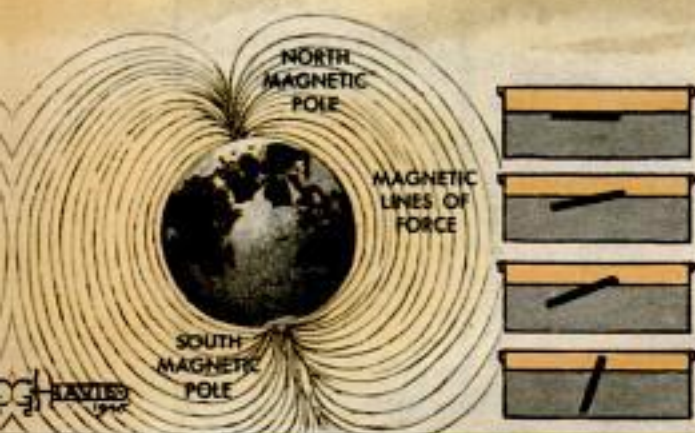
NAVIGATING POLAR REGIONS



Lines of force below are caused by earth's magnetism, are never parallel with surface except at equator. Aircraft go by geographic pole on map, but compass points to magnetic pole. Courses must allow for variation



On flight, Aries used radio bearings. By strength of signals over aerial, course A was corrected to true course for North Pole, B



Top left, compass needle near equator. Next, dipping toward nearer pole. Then dip increases as magnetic pole is neared. Last, dip near pole of approximately 90 degrees. At that angle in final stage, compass is useless for navigation work



Arrows on map, above right, trace flight of Aries in locating true position of magnetic North Pole. Plane flew from Britain to Iceland, then over geographical North Pole. Flight over Magnetic Pole followed course to Goose Bay. Polar flights of Aries totaled 17,720 miles. Craft carried 7 compasses, 18 special devices



Carrier Jack Changes Wheels of Heavy Planes With Ease

Replacing the canvas sling and ropes formerly used with heavy manpower to change the 56-inch, 450-pound wheel and tire assembly of the B-24 Liberators, the hydraulic carrier jack makes the task a simple two-man job. While one man holds the wheel, the jack operator adjusts the carrier shaft to the proper height to fit the wheel bearings, then rolls back the jack so the shaft passes through the bearings.

The wheel then is lifted off the ground by a built in hydraulic jack which raises and lowers the shaft. The carrier jack, which runs on ball bearing wheels, then is moved to the plane and the carrier shaft raised to the height of the plane axle. A lock nut holds the jack to the plane axle shaft so it won't move while the wheel slides into place. The device was developed by G. A. Deming, a foreman at Willow Run.



Westinghouse photo

Cream Keeps Fresh for a Year After "Flash Sterilization"

Cream which is sterilized by a new process will keep fresh for a year at room temperatures. It is said to retain a fresh flavor. After "flash sterilization" at a temperature of about 270 degrees Fahrenheit, the cream is bottled and hermetically sealed in an electrically cleaned room. Air in the bottling room is cleaned by a Westinghouse Precipitron, and ultraviolet ray lamps kill all germs in the atmosphere. The actual sterilizing process requires only four minutes to kill all bacteria, compared with 30 minutes needed for standard pasteurization. The process, developed by the California Milk Products Company, Gustine, Calif., is used extensively to prepare cream for shipment to our forces overseas.

Ⓛ During the last decade (1935-1944), 170,000 persons have been burned and disfigured by fire in the United States.

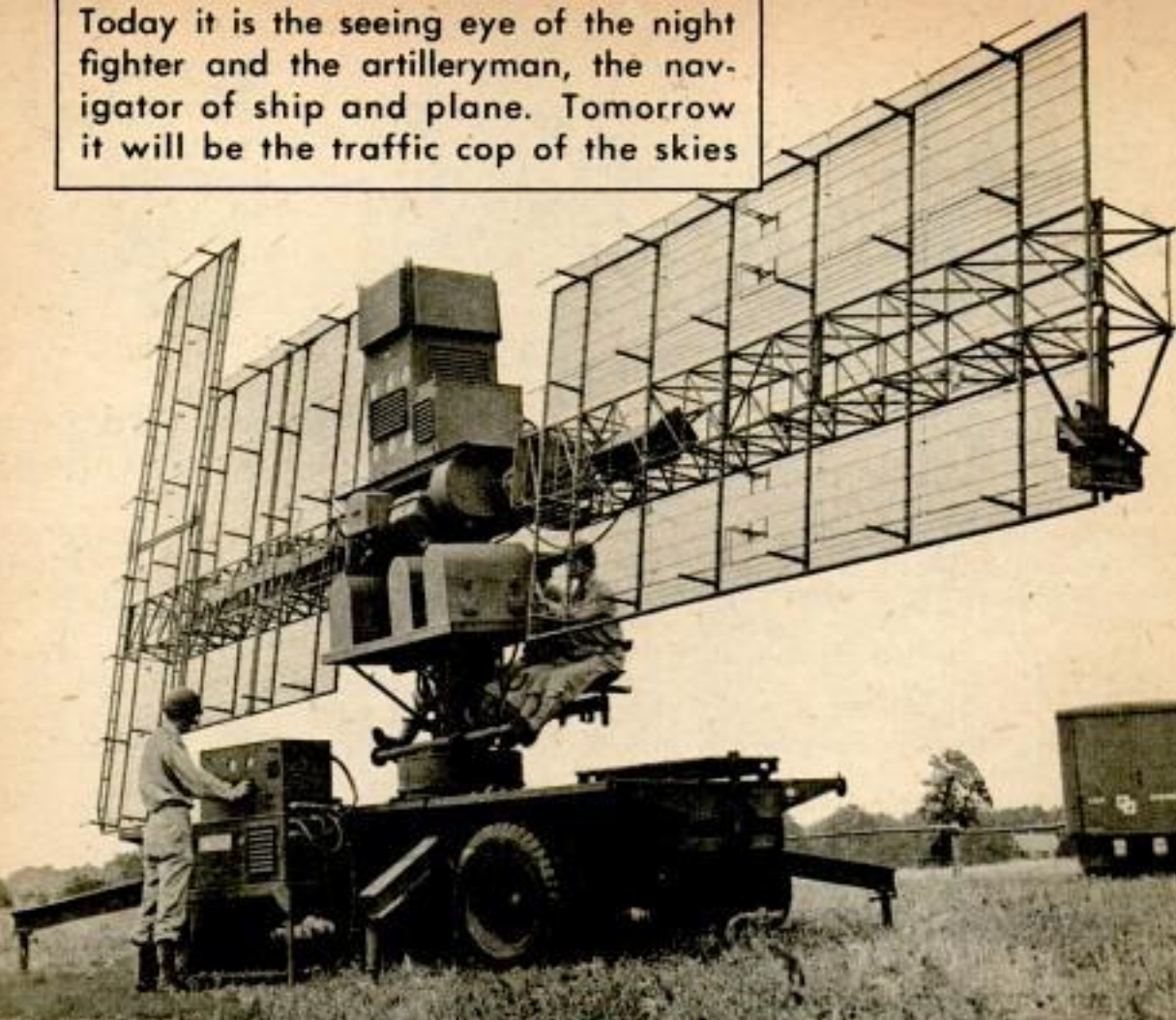
Boat Built of P-38's Tanks

Two GIs of the 15th Air Force built a catamaran-type boat entirely out of scrap. The twin hulls are formed by gasoline tanks from a P-38 fighter plane. The power unit, which is suspended between the hulls, is a rebuilt air compressor motor and the propeller is made of scrap metal.



RADAR SEES THE UNSEEN

Today it is the seeing eye of the night fighter and the artilleryman, the navigator of ship and plane. Tomorrow it will be the traffic cop of the skies



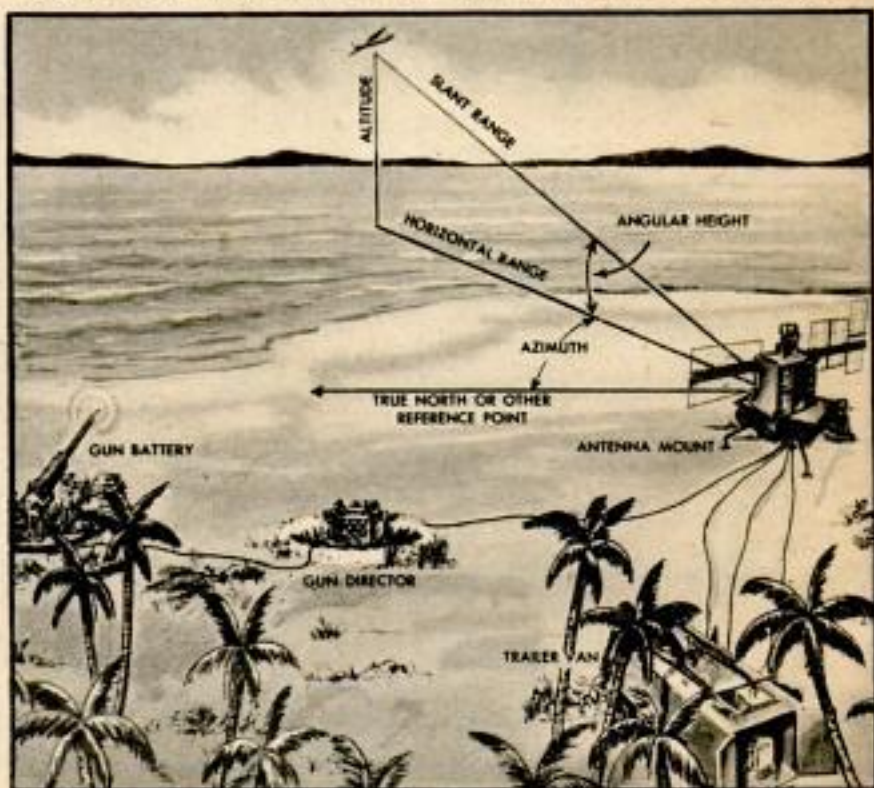
IN THE predawn blackness of Surigao Strait a column of destroyers was proceeding toward an advancing Jap task force. The captain of the lead destroyer was on the bridge, conscious that the force of battleships, cruisers and lesser ships had set a deadly trap for the Japs.

Then came the fireworks as brilliant broadsides plowed through the Jap craft. It was probably the greatest surface battle in naval history—and the destroyer captain, aware that the commodore of the destroyer force was below decks, called to him:

"Come up here for the sight of your life!"

"No, thanks," came the answer from the commo-

Mobile radar machine scans skies for aircraft; men on elevated seats operate vertical, horizontal and range scopes that fix position of the target. Below, sketch shows a radar unit linked with director and guns



dore. "I can see it better from here."

His location was in Combat Information Center — CIC — the focal point for radar information aboard the ship. In spite of the haze of the sea, the smoke of battle and the blackness of night, radar, the invisible electronic searchlight that reflects what it sees, was picturing to him every detail of the battle going on above.

That is the big point about radar, the coined word meaning "radio detection and ranging." It can see farther than the eye can. Neither dark, nor fog, nor artificial smoke, nor the glare of the sun can longer lend the concealment that, in all military history, has been the basic element in surprise attack. From the beginning, Allied radar has been better than the enemy's.

We licked Germany and Japan in the laboratory, no less than in the factory and on the battlefield. The electronics industry, as applied to radar, hardly existed before 1940, but by July of this year approximately \$2,700,000,000 of radar equipment had been delivered to the Army and Navy. Co-operative efforts of the armies and navies, the scientists and industrialists of Britain and the United States, developed radar to the point where scores such as these were rung up:

Destruction of all but three of 105 buzz bombs sent against Britain in one day.

Destruction of enemy U-boats at the eventual rate of one every day.

Constant protection against enemy planes through a radar modification that immediately identifies the plane as friend or foe.

Protection of convoys so reliable that only one tenth of one percent of all types of convoyed ships were lost.

Antiaircraft gun control so accurate that crews use it instead of their own eyes.

Automatic alignment of searchlights on enemy aircraft.

Destruction by one China-based B-24 squadron of 110,-



U. S. Navy photos

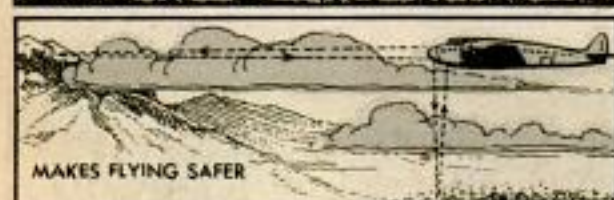
Radar antennae of flat-top, radar-equipped carrier plane and five-inch guns directed by radar testify to tremendous role of "silent weapon" of World War II. Below, radar plot room on a big carrier





General Electric Co. photos

Navigator views radar screen which shows any obstacle above water in ship's path. Right, radar screen shows how obstacles as far as 30 miles away appear. Below, some of radar's varied uses

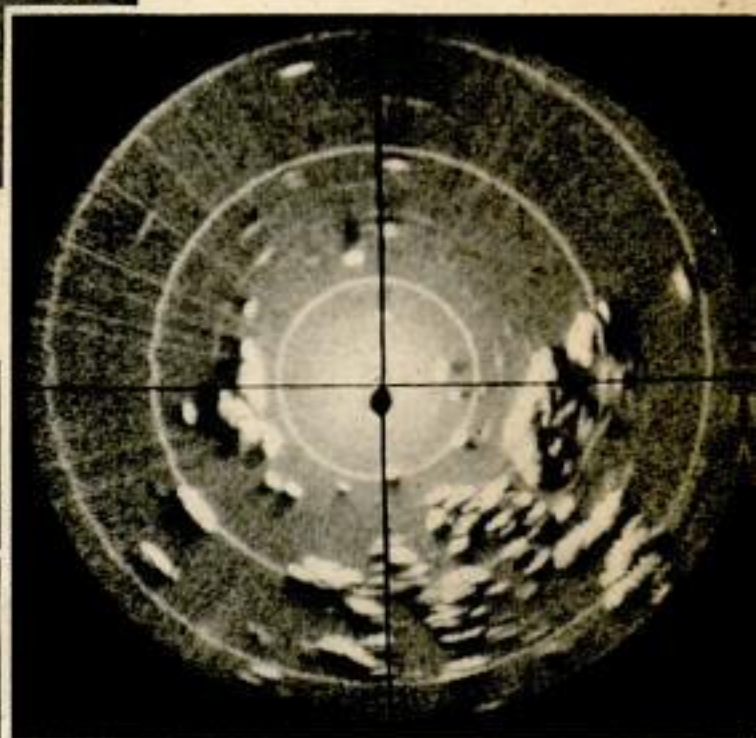


000 tons of Jap shipping in one month, entirely at night and guided by radar.

Development of blind-bombing techniques that enabled the Eighth Air Force to drop its greatest tonnage of bombs in a two-month period when targets were obscured all but four times.

Tactical air assaults during the "Battle of the Bulge" that not only overwhelmed German supply lines but also assured that Allied transport would not be bombed in error.

The complete radar unit con-



sists of a combination of a transmitter and receiver and indicators. In radar, unlike in communications, the transmitter and receiver are located at the same place, generally with a common antenna. The transmitter sends out energy in short, intense bursts—perhaps only a millionth of a second long—and during the intervals between transmission the receiver "listens" or, more accurately, since the signals are transformed into visual impulses on a radar screen, "looks." Because the signals travel at 186,000 miles a second, the elapsed time from transmission until the signal is reflected back to the station tells the distance of the reflecting object. As the reflected signals enter the receiving system, electronic devices register and measure the time interval in split microseconds and convert it into visual form which appears on the indicators. It is possible to measure this time-lapse with an accuracy that corresponds to only five or 10 yards' range—



U. S. Navy photo

Once painted out by censors, radar dome atop Martin Mariner houses antennae which guide plane to target

or one thirtieth of a millionth of a second.

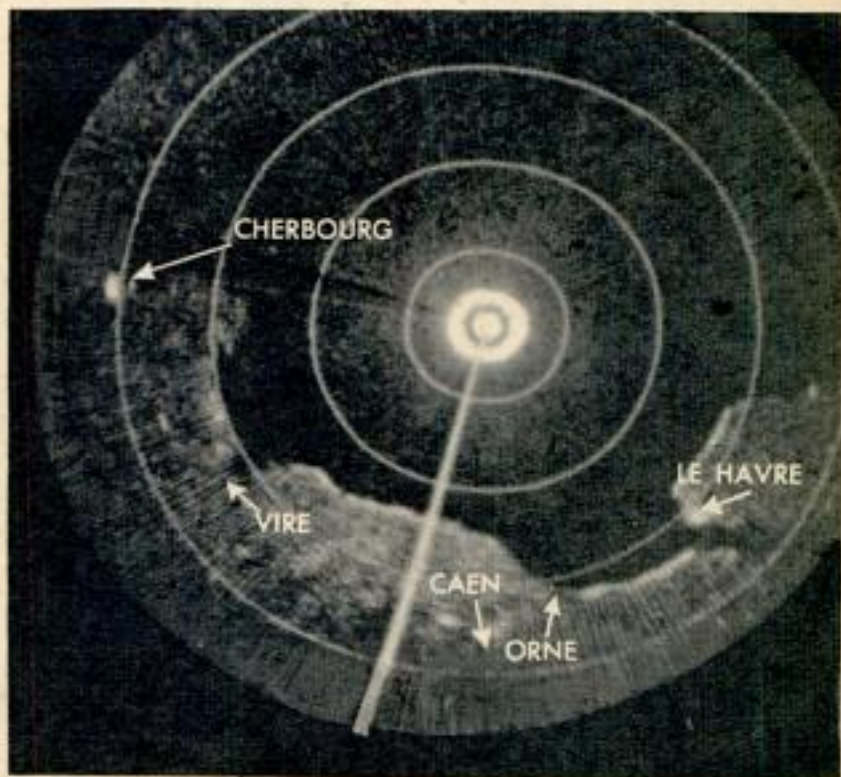
Using a directional antenna, the radar set gets back a "pip" (slang for target indication) when the antenna is directed at the target. An even more spectacular indication of the direction and range of the target is obtained with PPI (Plan Position Indicator). In this case, the radar echoes draw a map on the face of a cathode-ray tube. The radar operator could imagine himself suspended high above the set, whether on a ship or plane or on the ground, looking down on the scene spread out below.

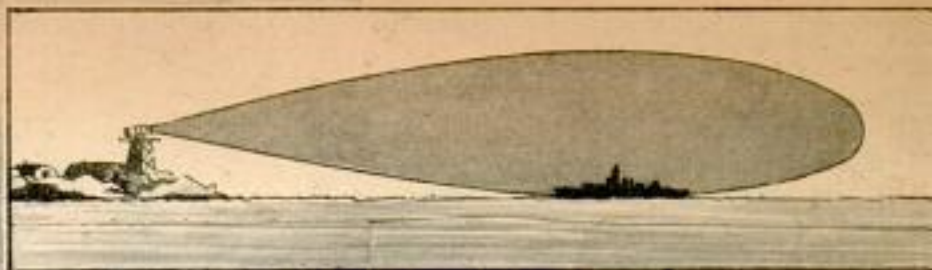
The entire radar instrument is built around the cathode-ray tube which is in effect a two-dimensional voltmeter with a weightless and inertialess pointer. This pointer is normally centered on the screen of the tube, but is deflected in instantaneous response to electrical or magnetic influence. In moving, it leaves a visible line or trace on the cathode-ray tube screen which the trained operator can easily interpret. Some of the information is immediately furnished to the gun directors, if the instru-

Despite heavy clouds, Norman coast appeared like this to radar operators on pre-invasion reconnaissance flights

ment is coupled to the guns, making it possible to have the gun follow a moving target, continually "on target." This is because the equipment furnishes the angle of elevation, altitude, slant range and azimuth, which are factors of gunnery computation.

The slant range is the direct distance between the target and the instrument. It is determined by converting time into distance. Actual calculations of slant range by radar operators are made by having a picture of the main pulse and of the target echo appear on the calibrated screen of a



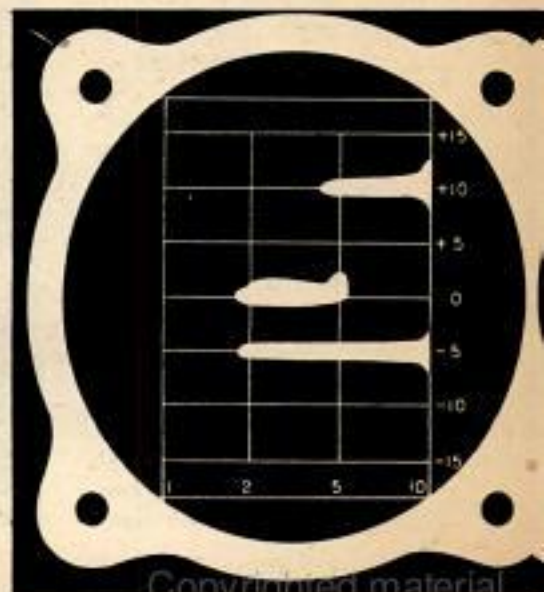
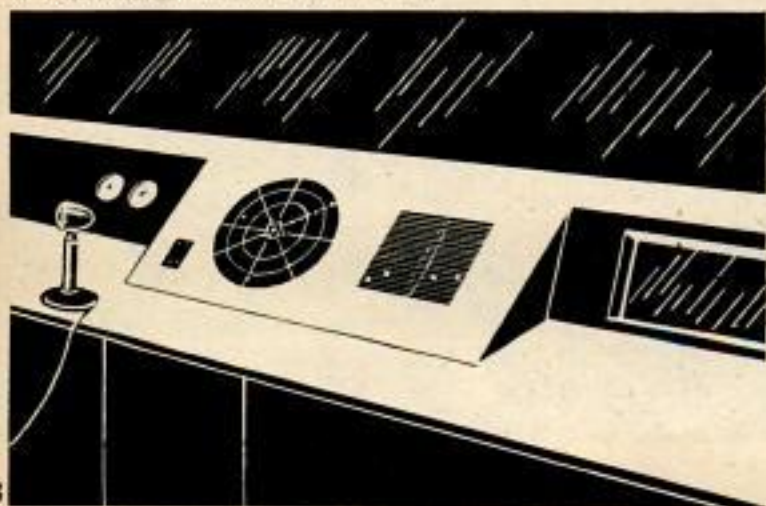


cathode-ray tube. The echo of the main pulse appears at a point along the scale which corresponds to the slant range of the target.

Effort has been made to develop microwave transmitters, since the ability of a set to distinguish two targets close together depends on the sharpness of the radar beam, and also because longer wave lengths require more cumbersome antennae. Current airborne radar sets show how well the matter of microwave transmission has been licked.

Early in the war the potentialities of radar at sea began to be apparent when a formation of cruisers was ordered to steam into an archipelago in the Solomons and bombard enemy shore installations—on the blackest of nights and through waters that had been charted only sketchily. Relying on their radar, the column steamed in formation at 25 knots, cruised confidently through the intricacies of the unfamiliar archipelago to the point to be bombarded, successfully evaded several minesweepers, found their objective and plastered it. Then, still at 25 knots, they turned in the narrow waters and

Radar station on British coast has 185-foot tower. Circle inset shows how "pips" appear on range scope. Below, scanning screen for airport and indicator to warn pilot of other craft
Civil Aeronautics Administration diagrams



steamed out. On their arrival back at base they were able to report that one of the reefs on their crude charts was in error by about six miles. All this was done in zero visibility.

Radar's first critical test came in the Battle of Britain when, despite a shortage of fighter planes and pilots, the British were able to spot each incoming air raid in time to throw fighters against it. Their chain of defensive radar stations was begun four years before. The British had applied a discovery made in 1922 by two scientists, Dr. Albert Hoyt Taylor and Leo C. Young. In an attempt to measure the then relatively new short waves, the two were first annoyed and then excited by the fact that ships moving down the Anacostia River between their transmitter and receiver distorted the radio signals. That discovery was twinned with another experiment in 1925. Knowing that the Kennelly-Heaviside layer, the earth's "electric roof," reflected radio waves, the scientists attempted to determine its height by transmitting upward a very short pulse of radio energy, and then measuring the time it would take the reflected "echo" to return. This pulse ranging was the very basis of modern radar.

But the practical payoff of radar was in its many applications. One is IFF (Identification of Friend or Foe). This

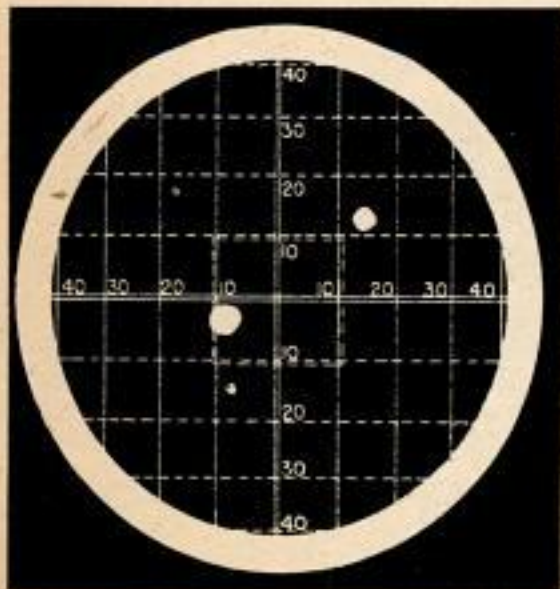
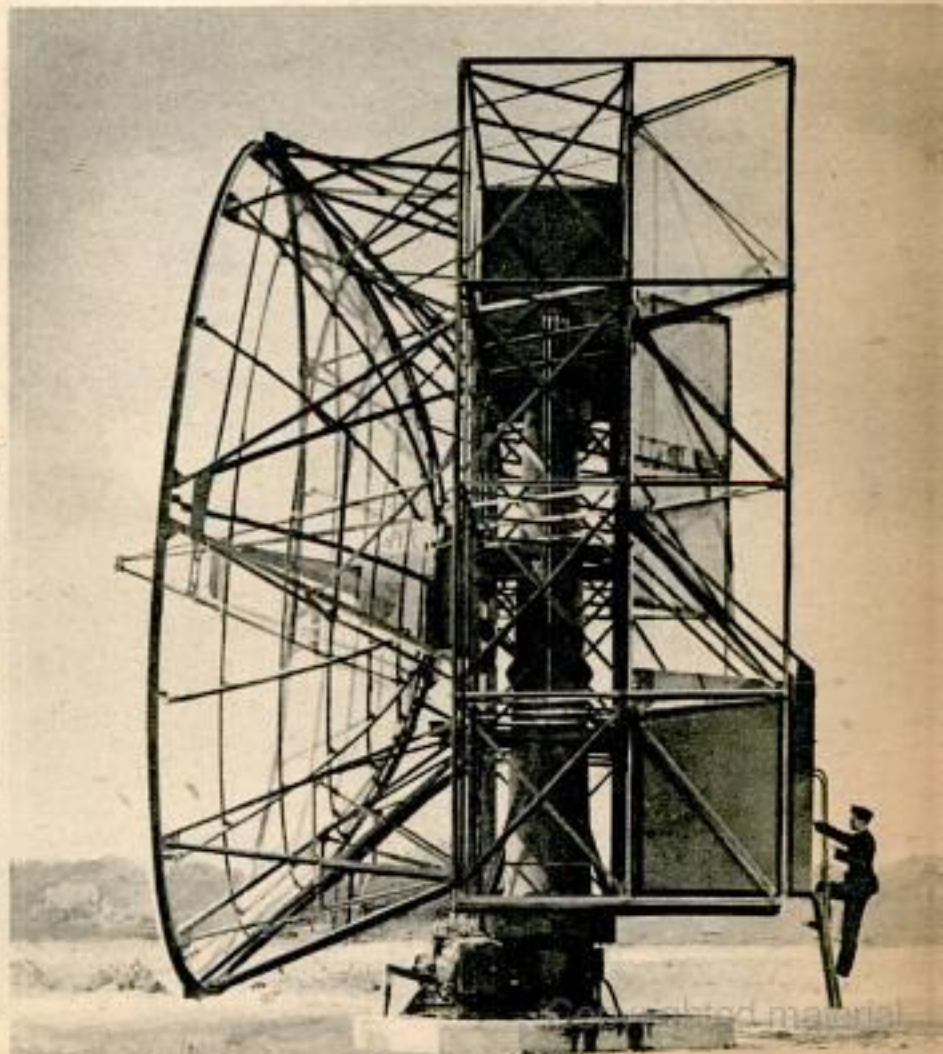
Right, radar set used by British to direct fighter planes to best tactical position. Cabin houses both transmitter and receiver. Below, CAA direction indicator to warn pilots of aircraft near by; size of dots tells distance

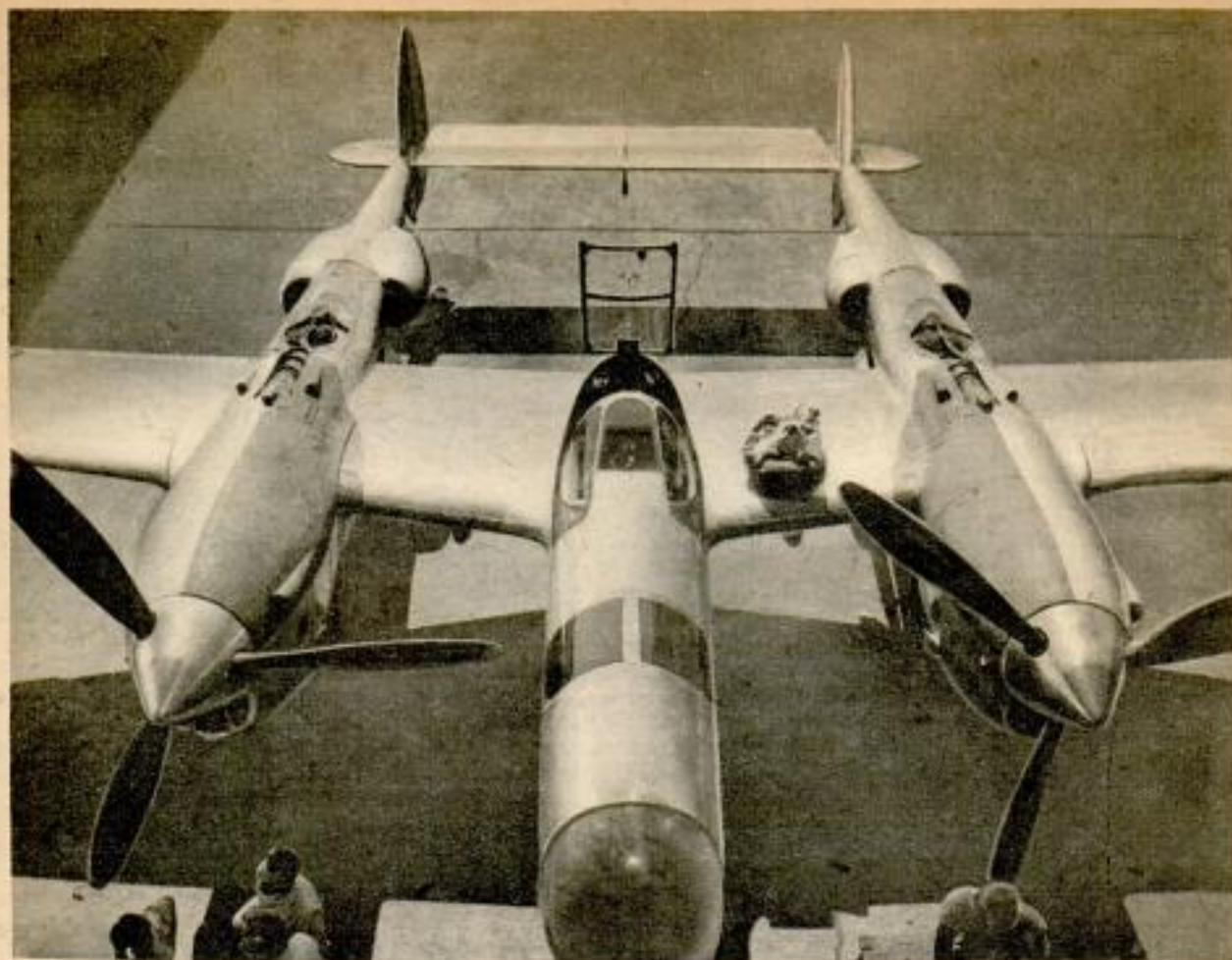


U. S. Navy photo
Radar operator is guided by scope in center of set showing graphlike line and by large disk into which he is peering showing actual scene

was the electronic analogue of the painted insignia on a plane; instead of making its signal to human vision, it made it to the radar. It had a special signal by which a plane could identify itself to a challenger. Today IFF is used not only on aircraft but on every combat ship in the Allied navies.

With surface radar, IFF, and the latest operational information at his side, a CIC





Radar equipment in elongated nose of P-38 Pathfinder guided bomber group to target in fog or darkness

officer can report as follows to a ship's captain, even on the darkest night:

"Several ships—probably five, two large and three in the screen; lead ship bearing 030, range 39,000, showing IFF; course 220 degrees, speed 18 knots, no zigzag; believed to be two CVEs on ferry duty with three cans in screen, as they are approximately three miles west of the supposed position of ferry group."

If such information can be furnished about friendly forces, it can do the same with enemy forces. Then the report above might be changed to:

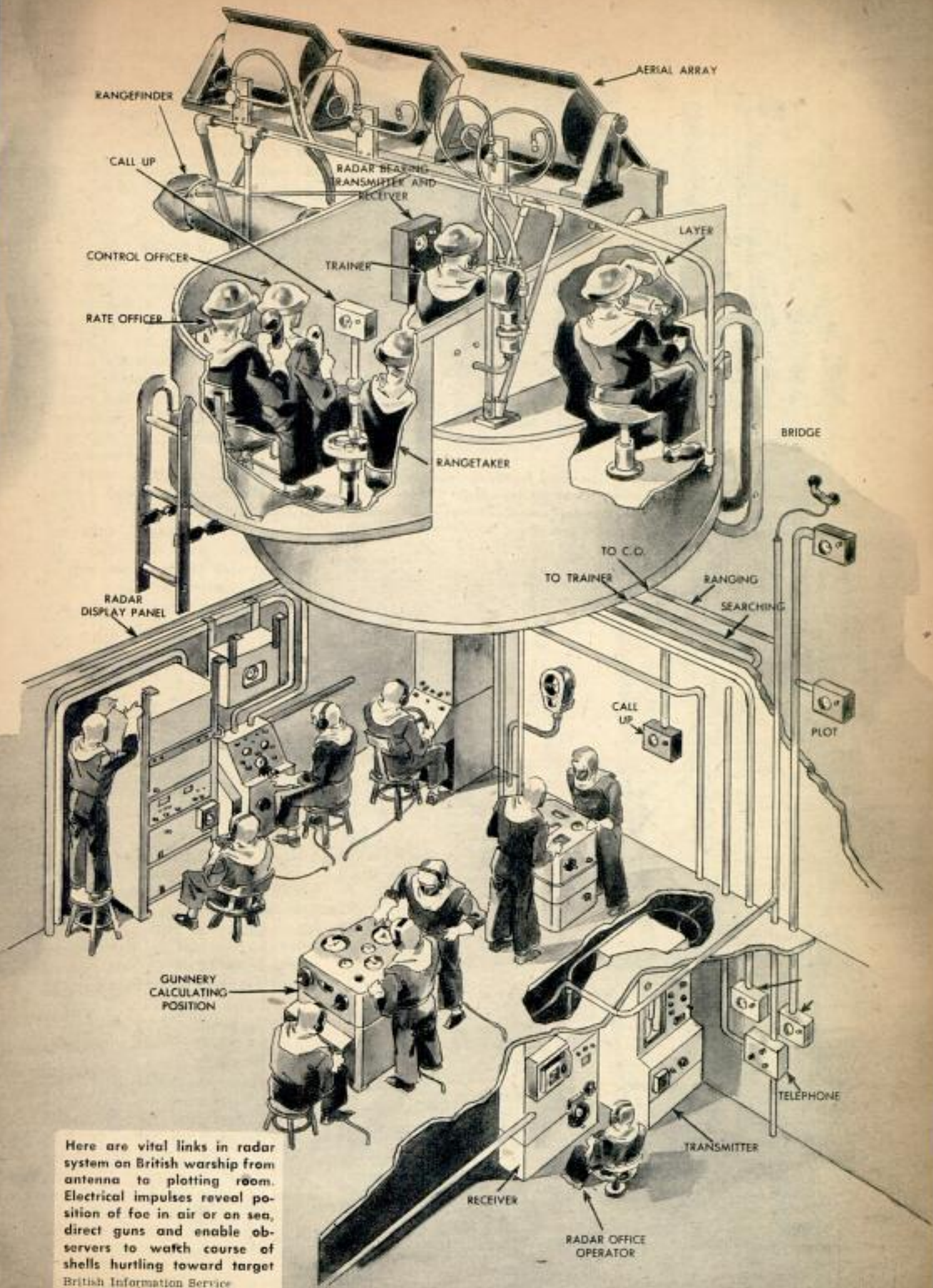
"No IFF; evaluation—enemy; could be task force reported to have sortied from Tokyo Bay, consisting of one BB, one CL and three cans."

At this point, CIC would be feeding information to the gunnery department. The target's bearing and range, course and speed are fed into computers as the huge main battery directors swing swiftly into position. The two forces continue to close. New ranges and range rates automatically reposition the guns. Finally the radar indicates the enemy is within range. Word is given: "Commence firing!" The master salvo key is closed and nine 16-inch shells go hurtling through the night. So sensitive is radar that the operator can "watch" the

shells move across his screen toward the target "pip." Then he sees indication of their splashes and can quickly read off how much correction must be made. Again the guns boom, and this time the salvo appears to land squarely on the lead ship. The "pip" fades from the screen: The ship has been discovered, identified, tracked, fired upon and sunk without being actually seen. This happened many times.

Another phase of radar is BTO (Bombing Through Overcast). Members of the Eighth Air Force, piloting Flying Fortresses against Germany, called this device the "Mickey." Its function was to permit bombing by radar pilotage. Such a set was requested by the Army Air Forces in June, 1943. It was needed mainly to get the bombers off the ground during the bad target-visibility months of winter. One squadron of radar-equipped planes could lead 60 times their number on every raid. Utilizing the dozen planes so equipped, the Army could go out over Germany 10 to 20 times oftener than in the previous winter.

One problem caused by "Mickey" was that it gave the Allied pilots too much confidence and caused them to let down in dead-reckoning navigation. It painted an accurate picture of the terrain below—so, theoretically, comparing this picture with

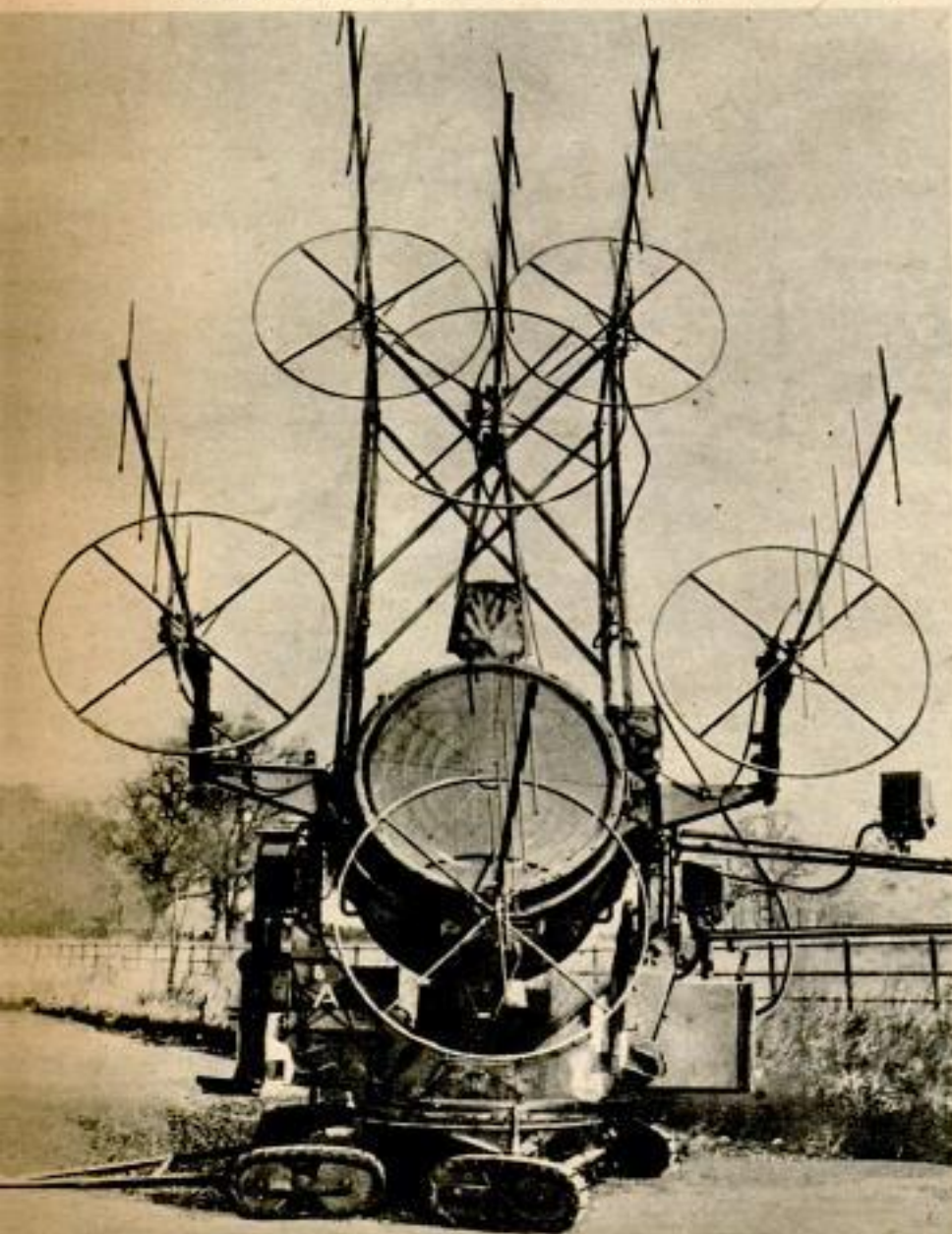


Here are vital links in radar system on British warship from antenna to plotting room. Electrical impulses reveal position of foe in air or on sea, direct guns and enable observers to watch course of shells hurtling toward target
 British Information Service



British official photos

Flying Fortress of RAF Coastal Command has radar devices extending from nose and under wings; these planes sought surfaced subs and convoy stragglers. Below, radar-controlled searchlight helped AA gunners locate Nazi bombers and flying bombs over England



the contours of a map should establish where the plane was. But frequently two different places show almost the same arrangement of towns, rivers, mountains and land patterns. A radar navigation error resulting in our planes bombing Switzerland shows the importance of using dead reckoning.

One last radar device deserves mention: the radar altimeter. Just as the range to an aircraft can be measured from the ground, so the range to the ground can be measured from an aircraft. Crude radar altimeters antedated the war, but the development in radar art has made the present automatic radar altimeter simple, reliable and practical.

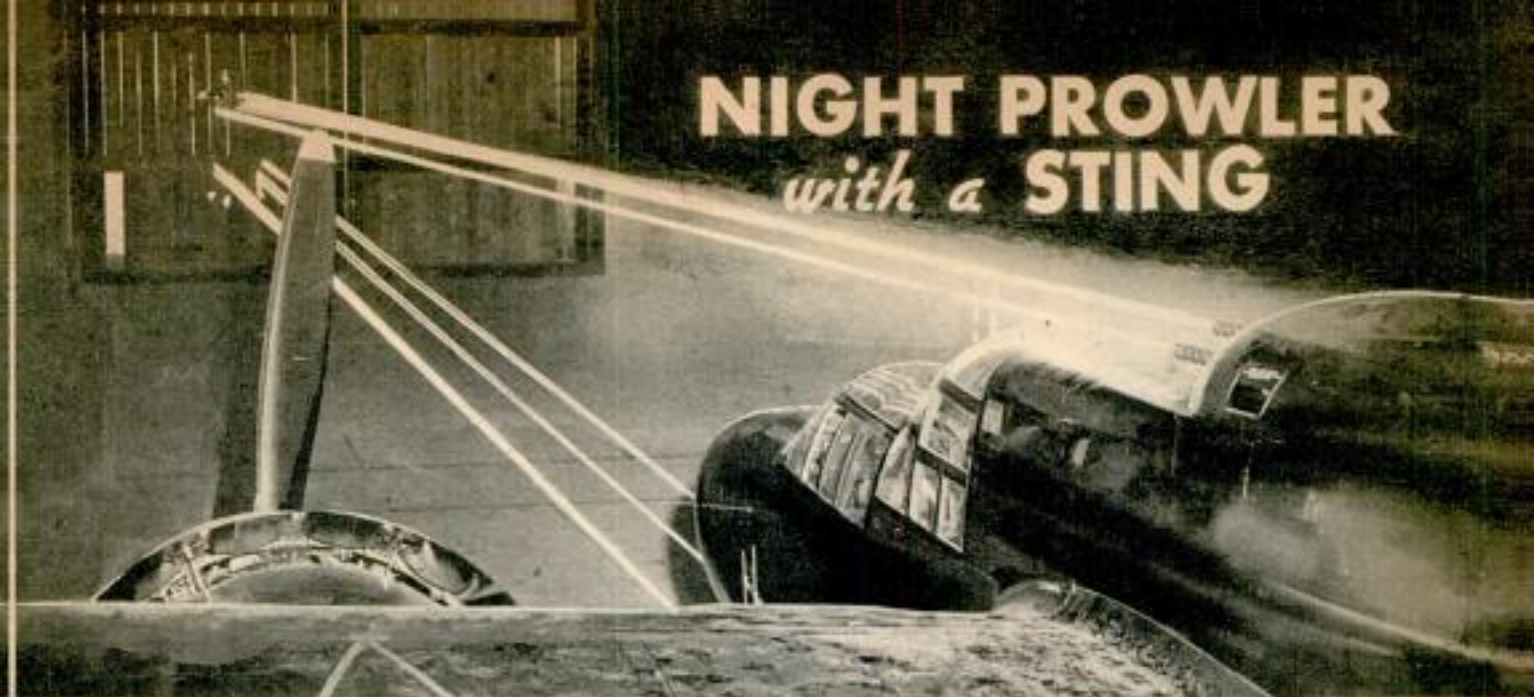
In the opinion of the Joint Board on Scientific Information Policy, there has been some too-optimistic, uninformed speculation about the peacetime uses of radar. It should make air and sea navigation continuous and fool-proof, regardless of night or weather. In its present form, however, it could hardly be considered useful for a locomotive or automobile.

First steps in applying radar to civilian aviation have already been taken by the Civil Aeronautics Administration, using equipment loaned by the Army and Navy.

The biggest influence radar will have after the war is indirect. The tremendous improvement of radar sets has made obsolete many of our prewar ideas about electronics. Many of radar's components are identical with those of a radio or television set or hearing aid. Individual radio communication is even beginning to appear practical, subject to certain limitations.

Altogether, it is fair to say that radar, as radar, will have a mild immediate beneficial effect on all our lives, by making it safer to travel by sea or by air. But the impact on electronics generally of techniques developed during the war because of radar will have profound and far-reaching effects on our daily life.

NIGHT PROWLER *with a* STING



Northrop Aircraft photos

Tracer bullets and shells—5600 a minute from four .50-caliber machine guns and four 20-mm. cannon—rip target as Black Widow P-61 night fighter shows forward sting; converging fire chews up enemy planes



Glossy black paint makes P-61 almost invisible by searchlight. Right, setting guns to skip prop



Below, checking P-61 for combat on compass strip. Note 4 droppable tanks





SCIENCE IS THE UMPIRE

By Paul Gardner

IN DECEMBER 1939, one of the tensest moments in sports history occurred. With 40 seconds to play, the Washington Redskins were on the New York Giants' eight-yard line. Bo Russell had to kick a field goal to overcome the 9 to 7 lead of the Giants. Silent tension, such as only a crowd of 60,000 can exude, filled the atmosphere. Russell tried the kick.

At least \$50,000 for the players as well as hundreds of thousands in wagers rode with the ball. Referee Bill Halloran gauged the desperate attempt with his eye. There was an awful wait. Then Halloran ruled the kick wide. Thousands milled onto the field in protest. A riot was avoided only by magnificent police team work.



Electric uniform for fencing (note "tail") relays signal at every touch. It is used in epee championships. Below, artist's conception of fishing boat using radar to find school of fish



Science, in 1939, had not yet really entered the sports world. Science, within another decade, may make most of the decisions—accurately and incontrovertibly.

In football, an inconspicuous transmitter near the goal posts might flash invisible electric beams which if intercepted would record a goal. Other sports such as baseball, golf, bowling, fencing, track and field events, horse racing and tennis are due for some startling innovations.

The sport of fencing employs a unique electrical scoring device. In the national epee fencing championships special suits are worn with an electrical attachment which signals each touch. A touch may be made anywhere in the epee championships, thus making accurate judgment imperative.

Holcombe Ward, president of the United States Lawn Tennis Association, says tennis leaders are discussing use of the electric eye in tennis. Close decisions often have swayed momentous matches. Bill Tilden tossed scores of optical daggers at inoffensive linemen in his long career. Foot faults, service faults and outs of the future may well be settled by the unerring eye at Wimbledon, Forest Hills and Davis Cup classics.

Golf also will reflect scientific progress. Let us assume that you are at the sixth hole at the country club and you want to notify your wife that you will be late for dinner. A pocket walkie-talkie will connect you through the local telephone exchange.



Strings used by Brooklyn Dodgers for training pitchers to hit target "dead center" may be replaced by electric eye beams after the war



False starts are avoided by metal plates before runner; if hands are taken off, gun cannot be fired. Below, science records a close finish

Western Electric photo



Copyrighted material



Western Electric photo
Two-eyed camera gets set for some speedy action at air races

The next Olympic Games, perhaps in 1948 in Stockholm or London, will employ camera eyes for finishes and many other electric gadgets. The starting device for runners which was tried out successfully in Denmark just before the war will be used widely. Lawson Robertson, coach of many American Olympic teams, has designed a similar device in which all starters

place their hands on metal plates and the gun, electrically attached, will not fire if a man takes his hand off. This will eliminate ludicrous incidents such as took place at Randalls Island when all six sprint finalists were disqualified for two false starts each. Officials had to reinstate everybody to determine the American champion.

Most sports after the war may be governed by an electric eye camera such as is now used in horse racing. At race tracks, the first horse crossing the finish line beam sets off the camera which instantaneously takes a photo of the finish. Any sport utilizing a boundary line can employ such a beam.

High jump or pole vault contests may have invisible beams in place of the crossbar. A bell or other signal will tell indisputably whether or not the athlete made it. Dan Ferris, secretary-treasurer of the Amateur Athletic Union of the United States, declares that a series of beams can be arranged so that a man gets credit for the exact height of his jump should he go higher than the crossbar beam.

Sometimes world records have been taken away from jumpers when it was discovered that the bar sagged in the center. Light beams, of course, do not sag. In addition to the crossbar beam and those above it, there will be a visible light beam which will give the jumper an incentive.

As enthusiastic as Ferris about the application of science to postwar sport is Jack

Left, international chess game played by television. Right, bowler "trips" electronic beam guarding alley



Mara, president of the New York Giants, eastern champions of the National Football League. He well remembers the disturbance at the Giants-Redskins battle of 1939. He also realizes that the electric beam may yet be used to detect offsides, check on whether a team made its first down, and determine if a runner stepped out of bounds on the sidelines.

Elmer Layden, high commissioner of professional football, points out that football is the most difficult and complicated of games to officiate and anything that can make for increased efficiency will be welcome.

Baseball men, on the other hand, have already considered scientific umpiring and believe it would not be practical for their sport. The radio beam could not be applied in judging balls and strikes because the batter would break the beam himself if his hand or his bat were over the plate before the pitch.

Science, however, will invade the baseball world in the form of television. Baseball men are opposed to it because it would cut down the attendance at the ball park, but commercially sponsored television broadcasts are expected to more than cover the loss of attendance revenue.

In the postwar revival of sports, television will play a tremendous role. Everybody in the country will be potential spectators for single events. Boxing already is counting heavily on television. According to Mike Jacobs, the world's leading promoter, the next heavyweight championship fight will gross about \$6,000,000 because television will bring it simultaneously to hundreds of theaters. The present high for a heavyweight championship fight is \$2,600,000.

Jacobs believes that eventually a fight could be staged in a small studio with a handful of officials and spectators present, but with an audience of millions watching the battle by way of television.

And then there's the comfort of the postwar sports fan. Electric mittens, electric shoes and electric coats will be worn. Such garments keep aviators warm on high altitude flights. Why not spectators at football games on freezing days?

Televising a six-day bike race—millions will follow sports through this medium

NBC photo

OCTOBER 1945



Beams above crossbar assure credit for exact height of jump

With radio-telephone devices, football and other sports officials will explain decisions immediately to the entire crowd. The present football semaphore system is understood by few. The spoken word would clarify many knotty situations.

For many who have an understanding of only baseball or football, television will bring the refinements of golf, tennis and

(Continued to page 148)



Copyright



SHEEP CUT GRASS between the steel mat runways at San Bernardino, Calif., field of the Air Technical Service Command. Mowers couldn't be used over mats and grass was fire hazard until 400 sheep arrived



MIDGET SIDEWHEELER is powered by a two-horse-power gasoline engine and is only 14 feet long. Two 30-inch paddle wheels propel craft. It was built by 14-year-old David Bucher at Lake Mohawk, N. J.



INLAID in this table and 10 chairs are more than a million pieces of wood of 46 different varieties. Magnifying glass was used to set some small pieces

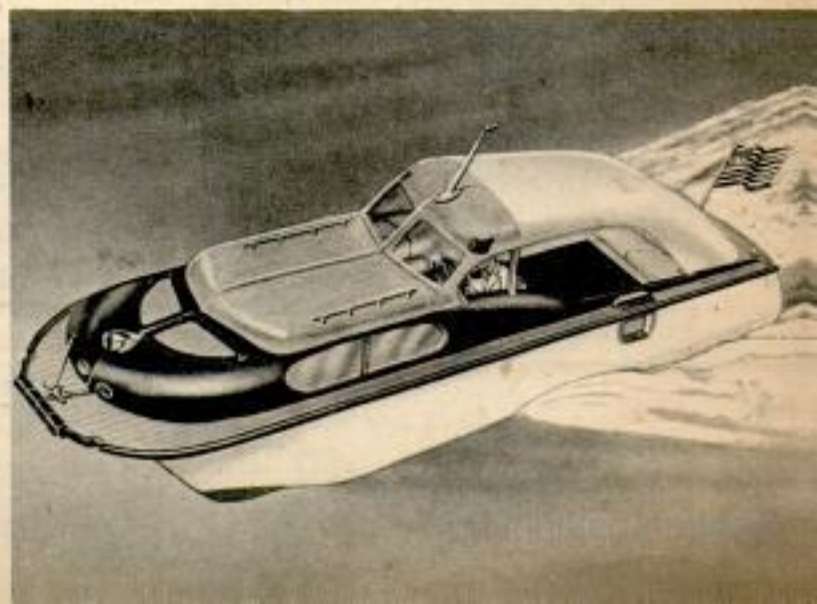


TRUCK SCOOP anchored to frame tosses loads over top of cab into open body. This one-man hydraulic unit is operated from cab by manipulating one lever

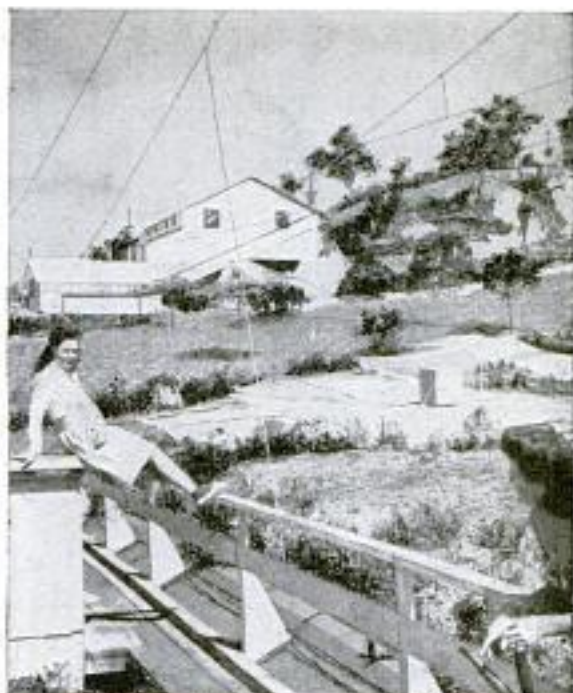
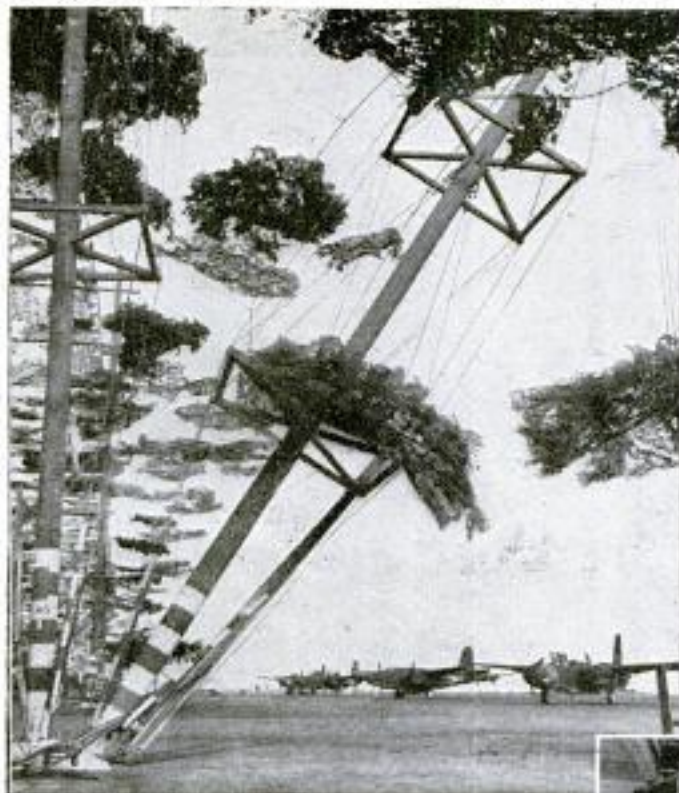
DUMMY TANK made by the Japs was constructed of volcanic ash. They cut cogs in the wheels and used a tree limb as cannon. Yanks found dummy on Iwo Jima



Patrol Industrial Designers Association
PROJECTING DECK like that of an aircraft carrier is featured on cabin cruiser designed by Ray Russell of Detroit. Convertible top is operated by push button



NOW THE LID IS OFF



Workers pause while "gardening" amid fiber glass flowers to add realism to camouflage. Below, boulevard in front of main plant entrance

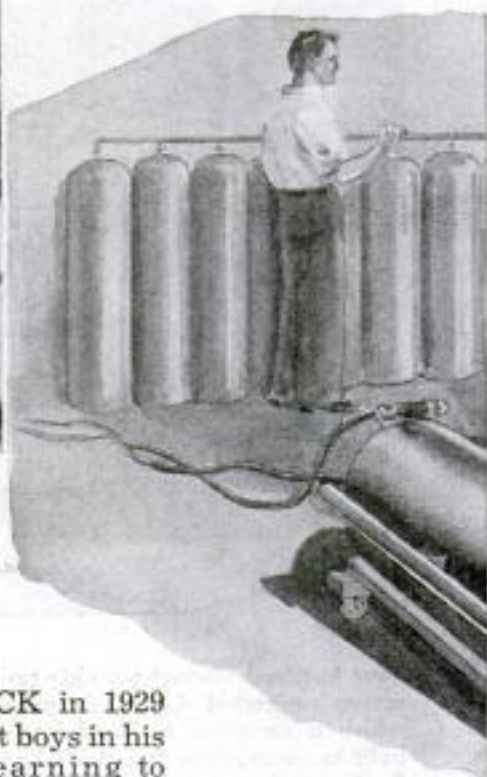
Four hundred 90-foot wooden poles like those above supported 4,489,000-square-foot net on which a complete residential subdivision was built to camouflage Douglas Aircraft's gigantic Santa Monica plant. Net of fiber glass slivers in strands was arranged between two layers of chicken wire and was strung along 1,120,000 feet of cables. Artificial gardens and homes blended perfectly into surrounding real community, as view below shows, and covered the entire plant and automobile parking areas



HIGH PRESSURE

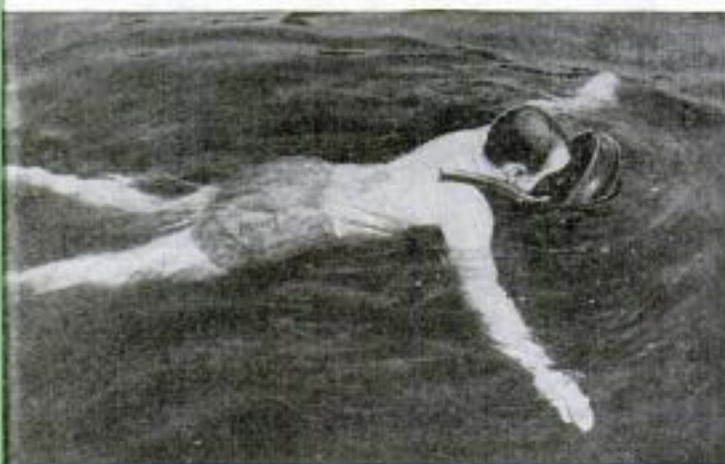


Wearing lightweight suit with helium-oxygen mask of his own design, Jack Browne prepares to emerge from special tank after setting new deep-sea diving record. Below, a revolutionary "lung" developed by the young diver which carries its own supply of oxygen in cylinder



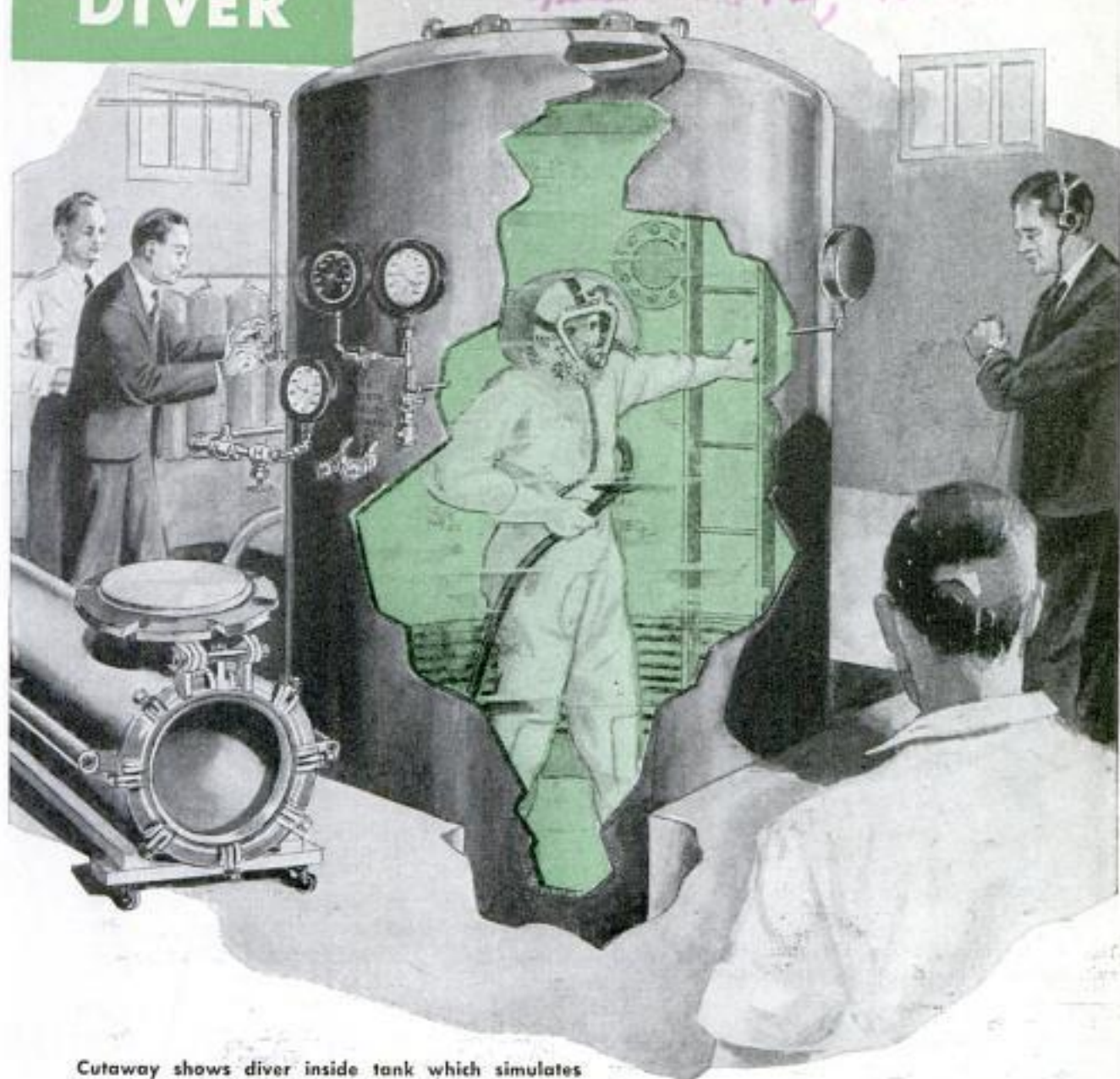
AWAY BACK in 1929 when most boys in his block were learning to swim, Jack Browne of Milwaukee, Wis., was learning to sink. While his neighborhood buddies were experimenting with old inflated inner tubes, Browne was tying weights on his feet for a stroll along the bottom of some nearby pond. A big tin can served as a diving helmet and a piece of discarded garden hose as an air line.

In those days it probably never occurred to the 12-year-old Milwaukeean that a few years later grateful officials of the U. S. Navy would be watching his experiments



Above, swimmer wears inflated rubber "pillow" with breathing tube and window to locate sunken objects

DIVER



Cutaway shows diver inside tank which simulates deep-sea pressure of 550 feet. Cylinders in background supply oxygen and helium. Portable decompression chamber (left) helped diver avoid bends

with the keenest interest. Some of those officials were present recently when Browne, now 28, set a new world record of 550 feet for simulated deep-sea diving. He wore a revolutionary lightweight diving suit with many improvements of his own design.

When Browne perfected an ingenious diving "lung" a few years ago, he says he was thinking of treasure hunts and moss-covered gold bricks. He had no idea how handy it would be for rescue and construction work. This lung, which is only one of Browne's many practical inventions, has been used by our military forces all over the world. It is a favorite with bridge-building engineers, who sometimes not

only have to work under enemy fire but under water as well.

Divers can work for an hour and a half at a depth of 60 feet with the self-contained lung. It consists of a rubber and transparent plastic mask which fits over the face and a vestlike harness that rests on the shoulders. Tubes on either side of the mask connect with an oxygen cylinder on the front and a canister on the back for absorbing carbon dioxide in the breath. A weighted belt is worn with the lung. Post-war uses of this equipment include rescue and recovery work by lifeguards, light salvage work and some water sports such as spear fishing.

Browne insists that the lung is a simple invention and not nearly as important as the new lightweight diving suit which he has developed in cooperation with the



This is the revolutionary 50-pound diving suit. Below, clamp closes the back entrance



Navy. This suit weighs only 50 pounds compared with the standard 250-pound outfit used by deep-sea divers in the past. It was to test this suit that Browne made his simulated dive to 550 feet and incidentally set a new world record.

The suit is made of rubberized fabric with a built-in standard mask. Transparent plastic over the face affords wide visibility. Aside from reduction in weight, the suit's most outstanding feature is a back entrance which eliminates the cumbersome 12-bolt breast plate on ordinary heavy equipment. All the diver has to do is step into the suit and close the "back door" after him with an air tight clamp. Browne has also designed some new footgear to be worn with the suit. The square-toed shoes weigh 20 pounds each and have a wood inner sole for insulation and canvas tops for comfort.

Browne made his record "deep-sea" dive, oddly enough, in a tank containing only eight feet of water. Deep-sea pressure was produced by pumping air from cylinders into the tightly closed tank. This procedure, divers say, is far more dangerous than an actual open water dive. Failure of a valve or porthole when Browne was at 550 feet would have meant almost instant death. At that point the surface of the diver's body was under pressure of 570,000 pounds, or 240 pounds to the square inch, according to Dr. Edgar End, noted authority on air pressure and deep-sea diving. He supervised the test along with Capt. A. R. Behnke of the U. S. Navy Medical Center, Bethesda, Md.

Browne "descended" to 550 feet in only 10 minutes, but it took him seven hours to come up despite the fact that he was breathing a mixture of helium and oxygen. The slow ascent must be made to avoid the painful and sometimes fatal "bends." Browne, like many other deep-sea divers, substitutes helium for nitrogen in the breathing mixture.

Under high pressure the body absorbs in the blood and tissues a considerable amount of nitrogen. Helium is less soluble. When the pressure is removed, the nitrogen or helium goes out of

"Escape vest" carries 15-minute supply of oxygen. It was designed for escape from damaged vessel or "ditched" plane



solution in the form of gas bubbles. Helium bubbles are much smaller than those formed by nitrogen, lessening the danger and shortening the time of ascent.

When Browne first went under water in the tank he was breathing 55 percent oxygen and 45 percent helium. When he passed the 500-foot mark, breaking the record set by a Navy diver in 1938, he was breathing 87 percent helium and only 13 percent oxygen.

Browne was in telephone communication with observers outside the tank at all times. As the amount of helium was increased, his voice gradually changed into a metallic echo. On the way up, the amount of helium was reduced until he was breathing pure oxygen at 60 feet.

Four and a half hours after he entered the tank, the hatch was opened and Browne was whisked into a portable decompression chamber (which he also invented). This portable unit was placed on a truck and taken to a hospital equipped with a decompression chamber. Browne stepped out of this chamber two hours later.

"I guess this proves that a man can live at a depth of 550 feet in a diving suit," he said, "and perform practical work that far down. I think I could have gone down another hundred feet. The next thing I want to do is try this suit out in the open sea."

The portable decompression chamber

(Continued to page 152)

Right, diver holds search board which has plastic window for hunting sunken items. Below, board in use



On street corner in New York, a Navy diver gives deep-sea demonstration in glass-walled tank to help sell bonds. Chief petty officer is talking to the diver by phone



Carl Pool
1010 Magnolia St.
Los Angeles, Calif.

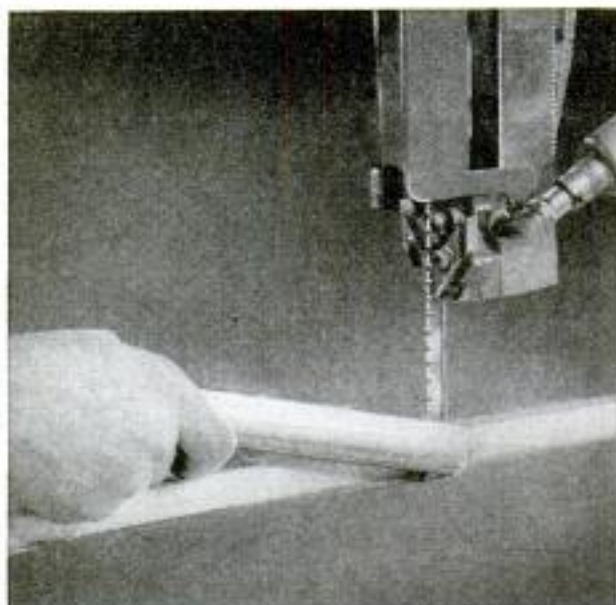
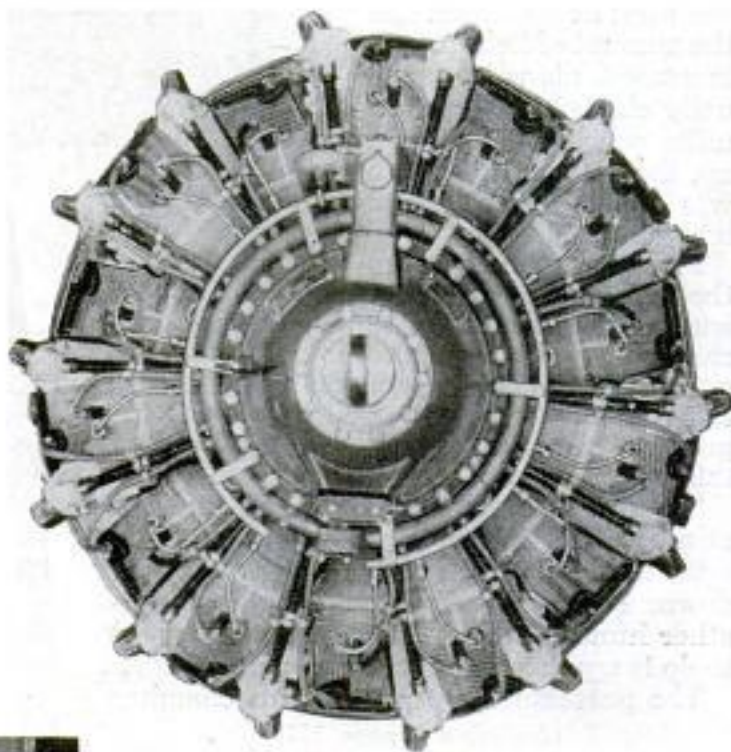


Amateur Prospector Carries Assay Lab In Portable Case

Encountering an interesting rock, Carl Pool, West Coast amateur prospector, doesn't wait to have it assayed. His portable laboratory made from a candy salesman's display case provides a chemical analysis on the spot. Ten collapsible trays in two tiers swing outward when opened to give easy access to alcohol burner, blowpipe, mortar and pestle, glassware and reagents which permit dozens of tests without the necessity for a return trip. When folded the equipment fits snugly into the case.

"Eavesdropper" Warns Of Engine Defects

Aircraft engine defects are revealed either before or during flight with a detonation indicator developed by a manufacturer of precision flight instruments. This sensitive device consists of a detonation pickup unit and harness attached to the cylinder walls. It observes changes in the frequency of vibrations and is connected through an amplifier to an indicator on the instrument board which flashes a warning. The indicator picks up defects which cannot ordinarily be detected unless the engine is taken apart. The indicator also reveals whether the quality of fuel being used is best for a particular engine.

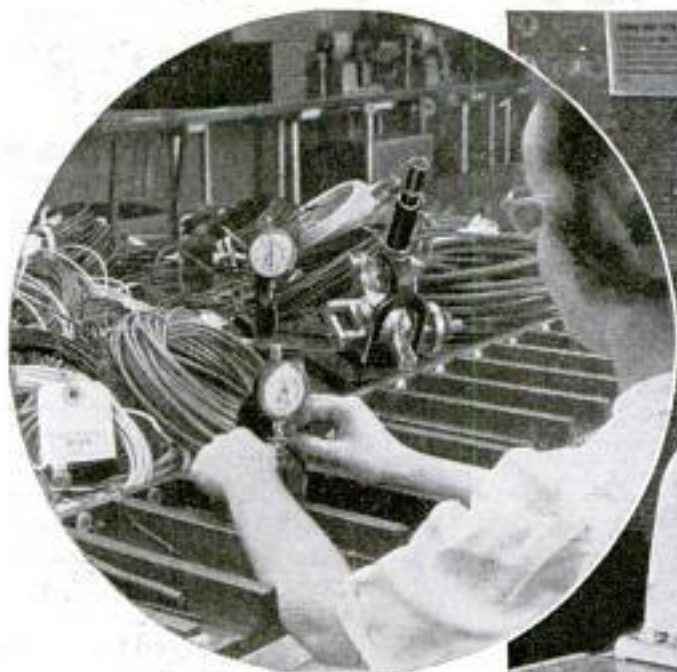


Oiling Stick for Band Saw Blade Is Held Against Moving Teeth

Band saw blades can be oiled while in motion with a lubricating stick which is pushed against the teeth. The stick, which is six inches long and one inch in diameter, makes cutting faster when used on a metal cutting saw and prevents the formation of metal chips that clog and break teeth. The lubricant prevents pitch from collecting on the blade of a wood cutting saw.

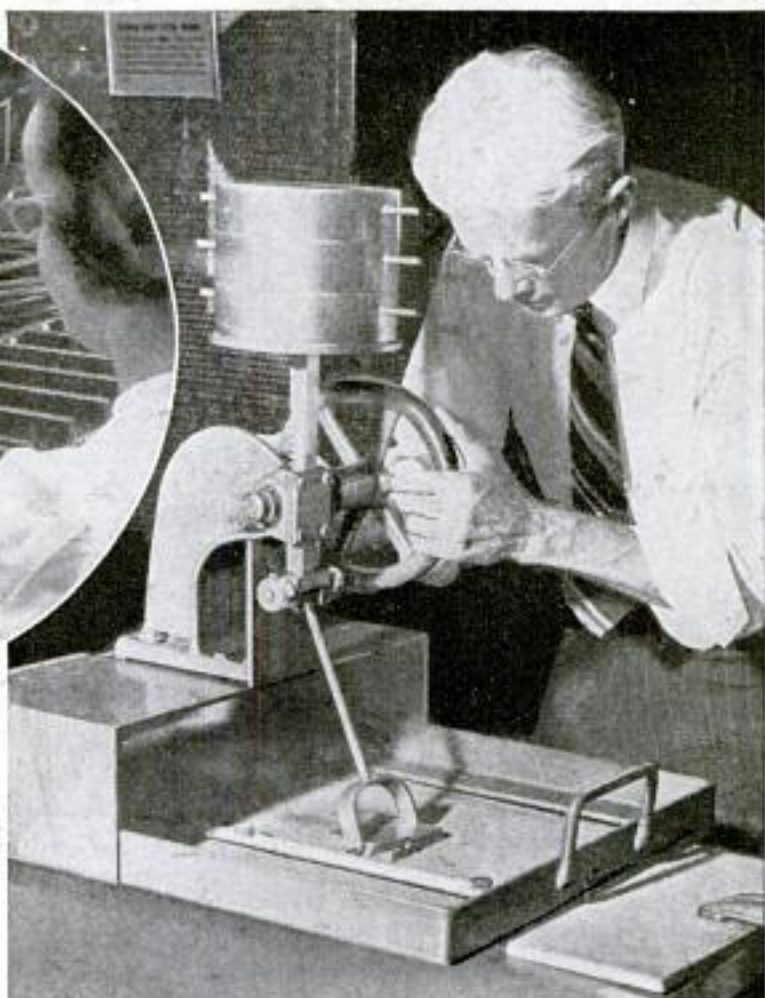
☐ The government's milkweed floss collection campaign in 1944 yielded approximately 1,650,000 pounds of floss, sufficient to meet government needs, and there will be no collection program this year.

Proving Ground for Synthetic Product Safety



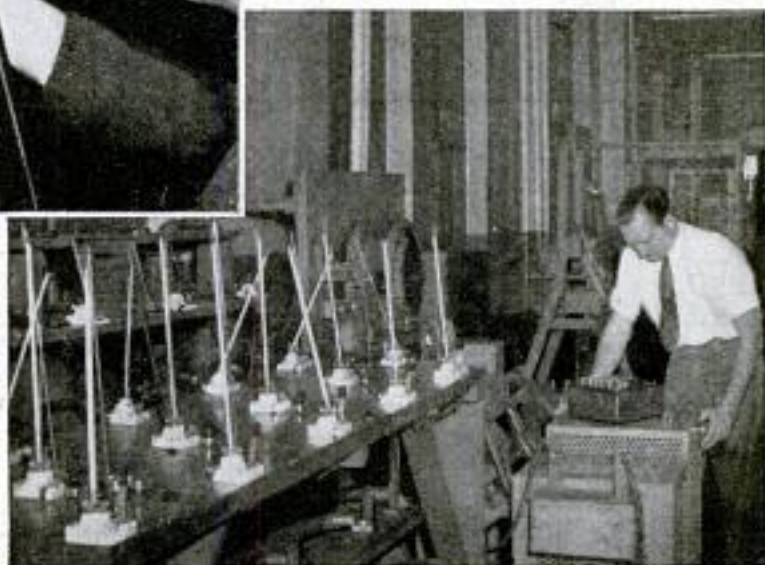
Underwriters' Laboratories photos

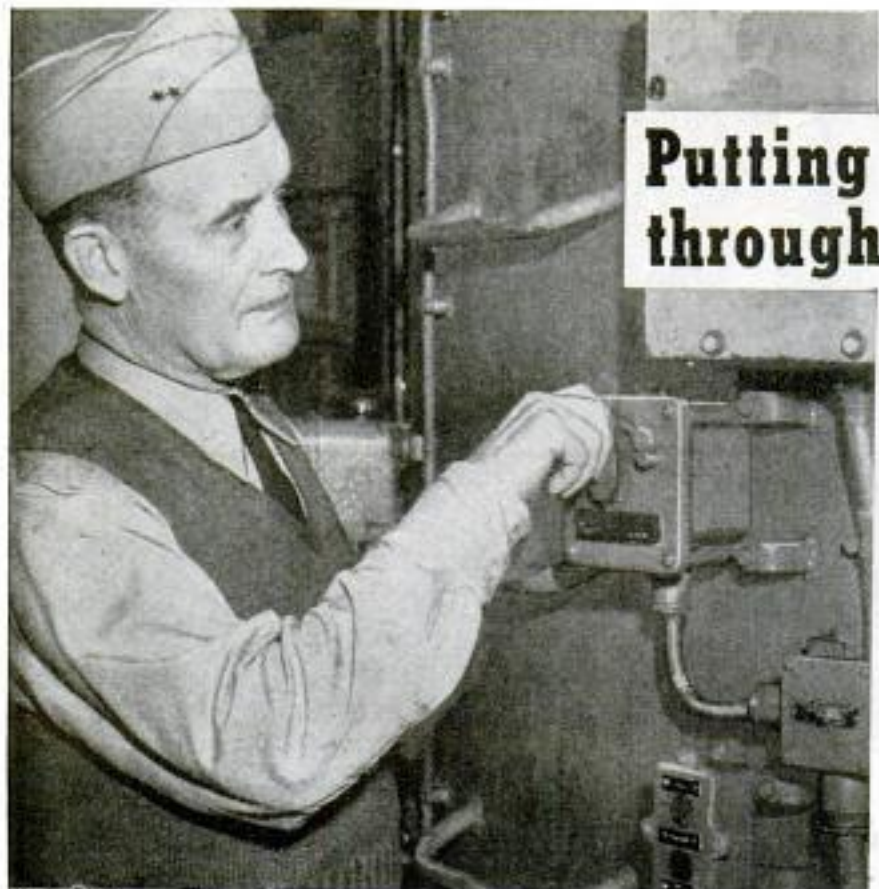
New methods of testing to learn safety and efficiency stem from the rapid rise in products made of plastics and synthetics. Reading in thousandths to half-thousandths of an inch, sensitive dial above gauges thermoplastic insulation and synthetic rubber used for wires and appliance cords. Companion tests indicate flexibility, brittleness and resistance



Simulating conditions produced by shoes on a person running or walking, apparatus above tests materials to make floor surfaces safe. It measures the coefficient of friction under practical conditions. Left, accurate photographic records of split-second operation of systems used for burglary detection are made possible by cathode ray oscillograph, beat frequency generator and various noise meters

In the Underwriters' Laboratories, Inc., engineers see that plug fuses blow out rapidly on over-current loads that cause fire hazards in buildings. Fuses are calibrated accurately and tested, right, for heat-resistance on new equipment. Some of the fuses, utilizing cold molded plastic cases, now have cellulose acetate plastic windows which replace mica for certain ratings. Safety of design will rate high in postwar products





Navy photo
Admiral Noyes tries out general alarm system from bridge of new cruiser

Putting **WARSHIPS** through their paces

By Leigh Noyes

Rear Admiral USN

(President of the Board of
Inspection and Survey)

especially those concerning small vessels, are conducted by local boards.

The rigid inspection procedure of the Navy, developed over many years, has played no small part in the remarkable performance of our Fleet. Ships which we built to steam 50,000 miles between overhauls have traveled more than 200,000 miles.

LAST year the Navy commissioned 42,248 of the finest vessels that have ever put to sea. It is the job of the Board of Inspection and Survey to make sure that these vessels, from the largest battleship to the smallest landing craft, are mechanically perfect before they are commissioned.

It is probably safe to say that no decade in the 68-year history of the board has witnessed as many acceptance trials as were held during the fiscal year 1944. I speak from the experience of 60,000 miles of travel—on land—during that 12-month period, visiting shipyards on the east and west coasts, the Great Lakes and the Gulf.

The vessels commissioned during 1944 consisted of 678 combatant ships, 32,814 landing craft, 355 auxiliaries, 954 patrol and mine craft, 6887 small boats and 560 district craft. The combatant ships included battleships, aircraft carriers, cruisers, destroyers, destroyer escorts and submarines. Ordnance items for this period included 63,000 gun assemblies of 20-mm. caliber and larger and more than 500 million rounds of anti-aircraft ammunition.

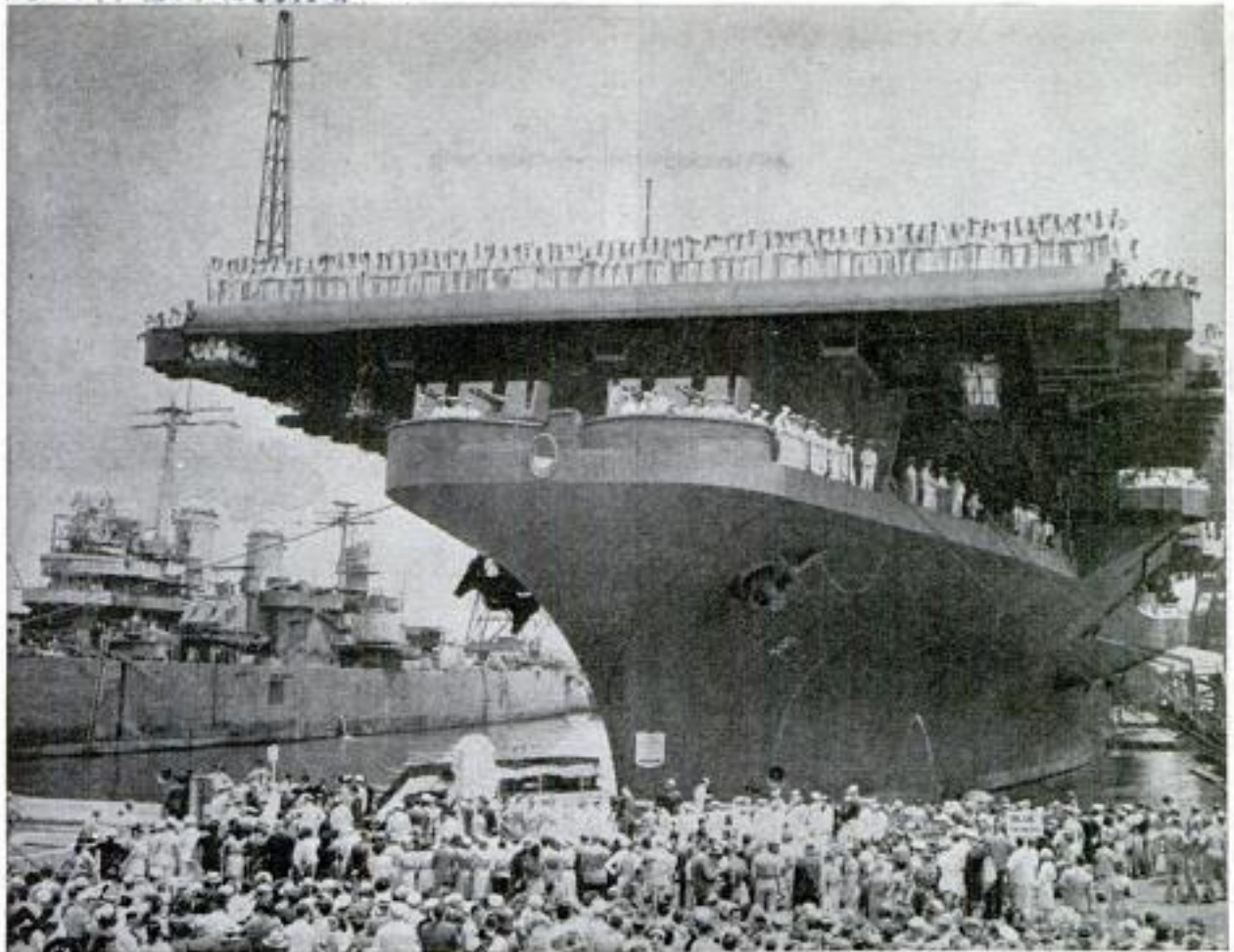
The three chief functions of the Board of Inspection and Survey are (1) to hold acceptance trials for new and converted vessels; (2) to hold service trials for commissioned vessels to determine economy of operation, speed and maneuverability and (3) to survey and appraise damaged or obsolete craft. Many of the trials and surveys,

Nothing escapes the eyes of the naval inspectors from the main engines to an apparently insignificant nail hole in a bulkhead. Recently, when inspecting a converted ship for watertight integrity, it was found that screws had been improperly placed in a bulkhead to hold a bulletin board. In accordance with naval standards, all holes in bulkheads have to be welded or stopped up in such a manner that they cannot be blown out under pressure.

To illustrate the work of the board, let us "follow through" on the inspection that preceded the commissioning of a new aircraft carrier.

This flat-top was launched last December and the preliminary dock trial was held in March. The dock trial, held by the contractor, is to try out the main engine, and during this trial the ship is secured with heavy lines. The acceptance trial, conducted by the board, was held early in April.

The route for inspection is laid out for each deck. The ammunition hoists are carefully tested; airplane elevators and the bomb and torpedo elevators are operated and checked with full loads; the anchors are dropped and hove in and the time noted. Ordnance experts test out the battery with its directors and many fire control appliances. The steering gear is tried out from various control stations. Usually, part of the trial is conducted at



Before commissioning of this 27,500-ton aircraft carrier, sharp-eyed Navy inspectors tested every part

the dock and part with the ship under way for a full power test of all main engines.

The Diesel emergency equipment, which can carry on if the boilers are hit by a torpedo, is also given a grueling test. The rudder must be "put over" with the ship backing. Even the ship's laundry, which can accommodate 2000 men, is inspected. Incidentally, the laundries on our Navy's modern ships are a far cry from the days when all enlisted personnel had to wash their clothes in buckets.

After all the tests have been completed and found satisfactory, a general inspection of the ship is held. This includes all electrical radio and sound devices, many of which are of a highly secret nature.

At all times the inspectors are on the alert for such things as hot bearings, defective gears, improper temperature ranges that result in overheating, and any excessive or unusual noises. In all types of ships the noise level must be held to a minimum.

An important part of the work of the board at the present time is survey and appraisal of damaged or obsolete craft. No vessel, however, is marked for scrap or sale if any possible use can be found for it. An LST which was too badly damaged to be used in battle again is serving as an ad-

vanced base barracks ship in the Pacific. There are dozens of cases like this.

When small boats, such as landing craft, are damaged, they are disposed of by a local survey group aboard ship. A question frequently asked by prospective or former small boat owners is: Will many of these small craft be for sale now that the war is over? Thousands of these vessels will be disposed of, but one should bear in mind that the engines were built for efficiency from a military standpoint and not for economy of operation.

However, during the war years, the Navy's prime concern was not how to dispose of vessels, large or small, but how to acquire more. Our \$15,404,600,000 procurement program for 1945 had as its goal some 206 combatant vessels, 223 patrol craft, 56 mine craft, 694 auxiliaries, 657 district craft and 22,560 landing craft.

As the board has pursued its duties of inspection, playing its part in building up the most powerful navy in history, we have kept in mind the words of Secretary of the Navy James Forrestal:

"The greater our strength, the sooner our victory."

Japan's surrender proved how right he was.

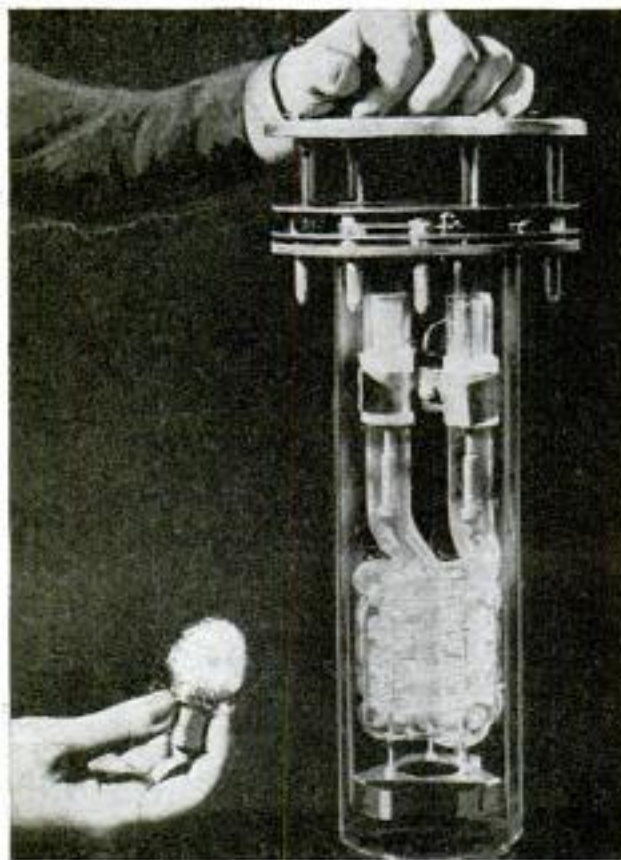
Russell Mfg. Co.
 Oak & Mineral Sts.
 Platteville, Wis.



WATER-COOLED, this chair makes it easy to relax in 108-degree temperatures. Water flows continuously through back and seat, keeping occupant comfortable



BULL MASK with slits in peepers keeps 1000-pound bull from seeing when his head is raised, prevents him from charging his owner who invented the mask

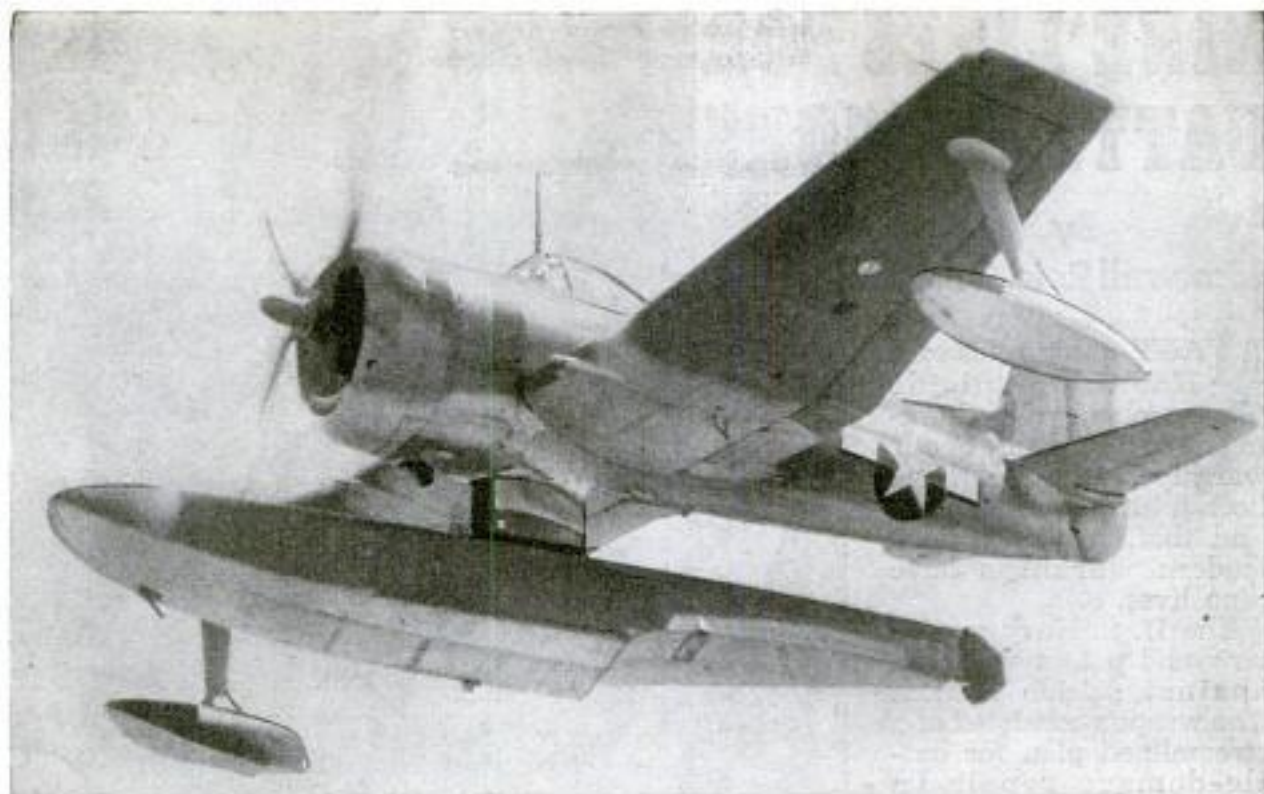


FLYING FLASH, the supertube shown compared with a photographer's flash bulb, shoots brilliant flashes earthward with machine-gun rapidity from reconnaissance planes. It lights ground two miles below



SELEVISION, a device embodying television principles and used for commodity buying and selling, reflects bids made by buyers or sellers in many cities on its white panel from "Quojector," machine at right

Electric Co.
 Lamp & Paint
 Nelson

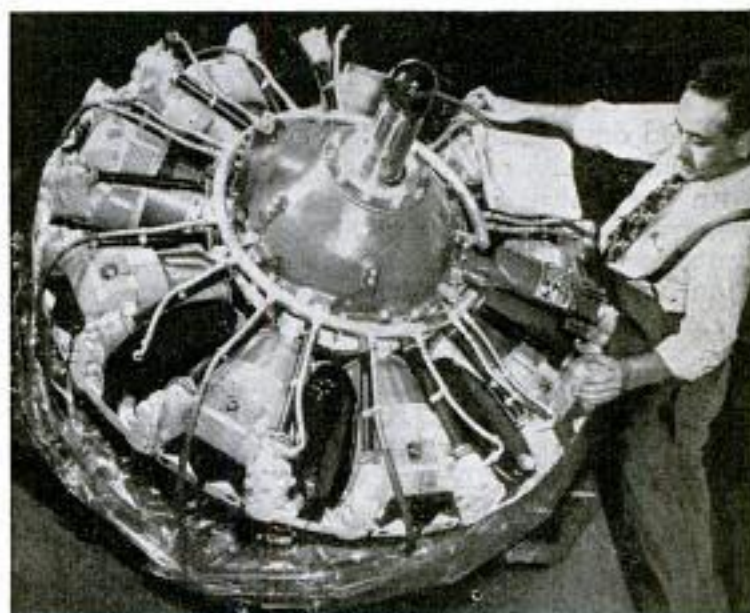


'Hot' Navy Seahawk Has Bombs in Float

In aviation parlance, "hot" is the word for a Navy scout plane that flies faster and higher than any previous model. It is the Curtiss SC-1 Seahawk, a single-place, single-float, low-wing craft powered with a nine-cylinder Wright Cyclone engine. This engine develops more than 1200 horsepower and is said to generate more power per pound than any other engine of its type. The Seahawk has nearly three times the horsepower of the Kingfisher which was also used for scouting, spotting and air-sea rescue operations. Despite its increased speed, the Seahawk has a low landing speed. The new seaplane not only boasts more potent firepower but if necessary can carry bombs in the main float which is equipped with bomb bay doors. Auxiliary fuel tanks can be carried in the float on long missions. When used for rescue work a bunk is installed behind the pilot's seat. The Seahawk can be launched by catapult, and with its folding wings occupies a minimum of deck space.

During the last decade (1935-1944), 100,000 persons have burned to death in the U. S.

Single-float Curtiss Seahawk is Navy's fastest scout plane. Below, Seahawk's nine-cylinder 1200-horsepower Wright engine



Phosphorescent Tape Glows in Darkness

Applied like adhesive plaster, a phosphorescent plastic tape displays a glossy surface in daylight and a blue-green glow at night. Sandwiched between the white adhesive and a plastic protective film, the phosphorescent pigment stores light and gives it off in the darkness. The moisture-resistant tape can be printed for use in all types of markings.



NINE LIVES FOR BATTLEWAGONS

By
Maxwell Reid Grant

MANY a Jap pilot of a Kamikaze suicide plane probably died thinking he had sunk one of our warships. It would have been a bit discouraging to find that, like cats, most modern warships have nine lives.

The U. S. Navy used a new and potent weapon against suicide attacks. The weapon consisted of a streamlined plan for battle-damage repair in which engineers and craftsmen worked like surgical teams to build substitutes for damaged sections and have them ready for replacement before a crippled craft reached drydock.

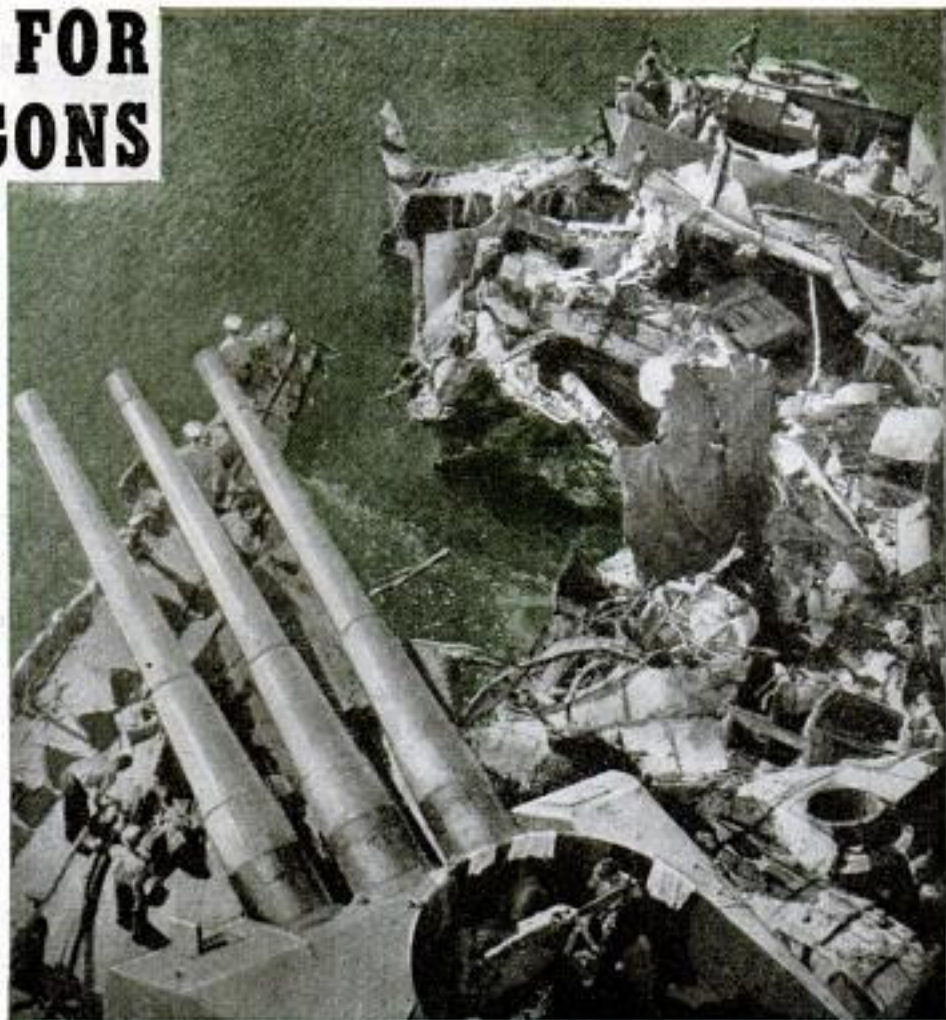
Salvage units operating with the fleet at Okinawa repaired battle damage to 823 ships. The units saved ships and cargoes worth more than half a billion dollars in battle areas.

Here's how the new system worked:

A wounded destroyer turns back on orders from the task force commander. Major repairs must be made. Below decks, photographers already are taking closeups of the battered hulk. Armed with these pho-

tographs and with detailed sketches, the ship's executive officer and a junior engineer take off in a Navy plane for the United States.

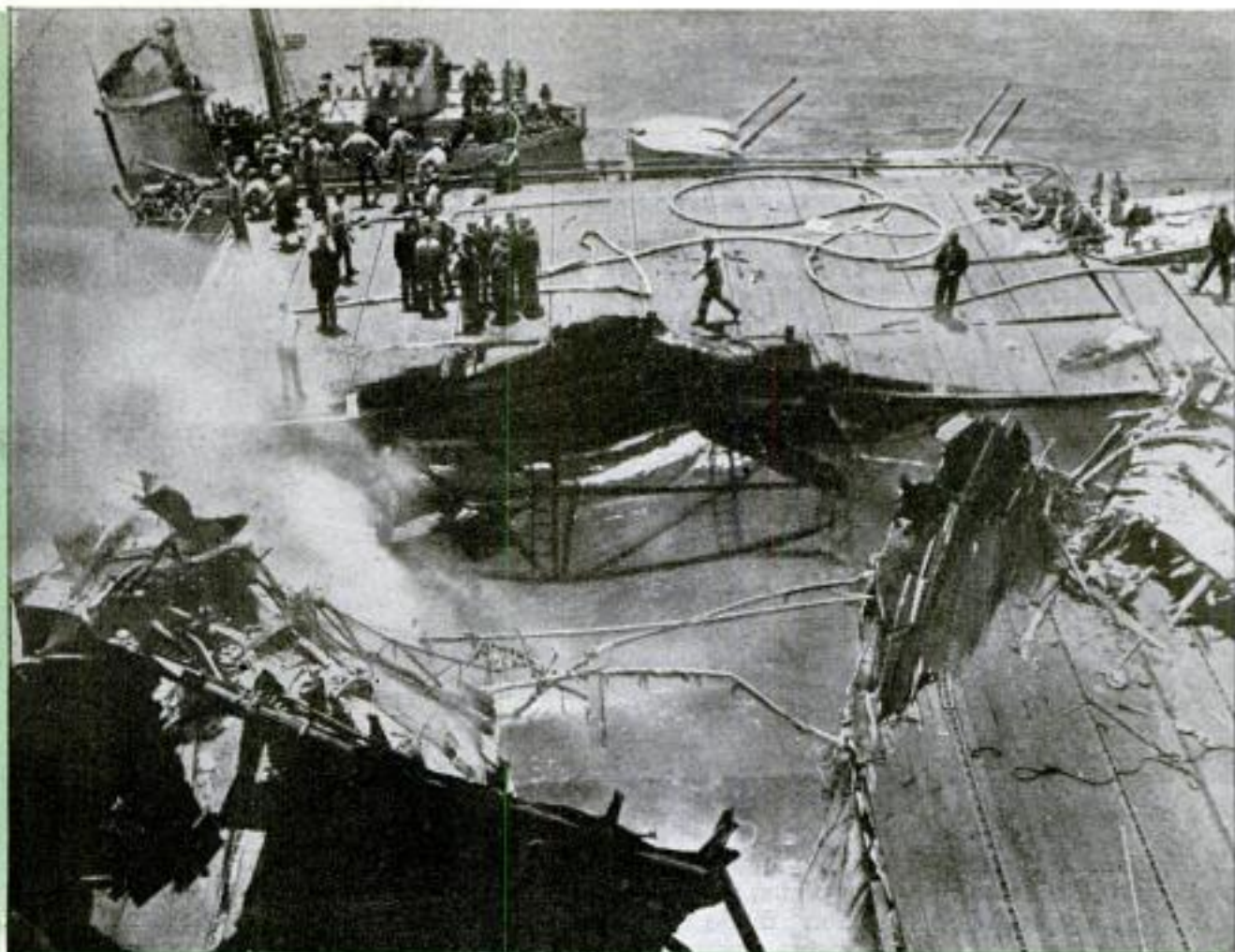
Meanwhile, the Navy's Bureau of Ships in Washington receives a coded radio message: "Destroyer XY seriously damaged by torpedo from suicide plane. Hole is between frames Number 28 and 35, extending



Making repairs on this severely damaged cruiser is all in the day's work

Rigging shop makes bow fenders, below left. Microfilm in right foreground holds all the plans in background





Hit by two Jap suicide planes, carrier Bunker Hill, above, got safely to Puget Sound Navy Yard for repair

from deck to 10 feet below water line. Four compartments flooded."

Down in the vaults where plans of all our fighting ships are stored, a reel of movie film is slipped into a projector. It is a microfilm copy of the destroyer's original blueprints, reduced from dozens of bulky bundles to a roll that can be concealed in

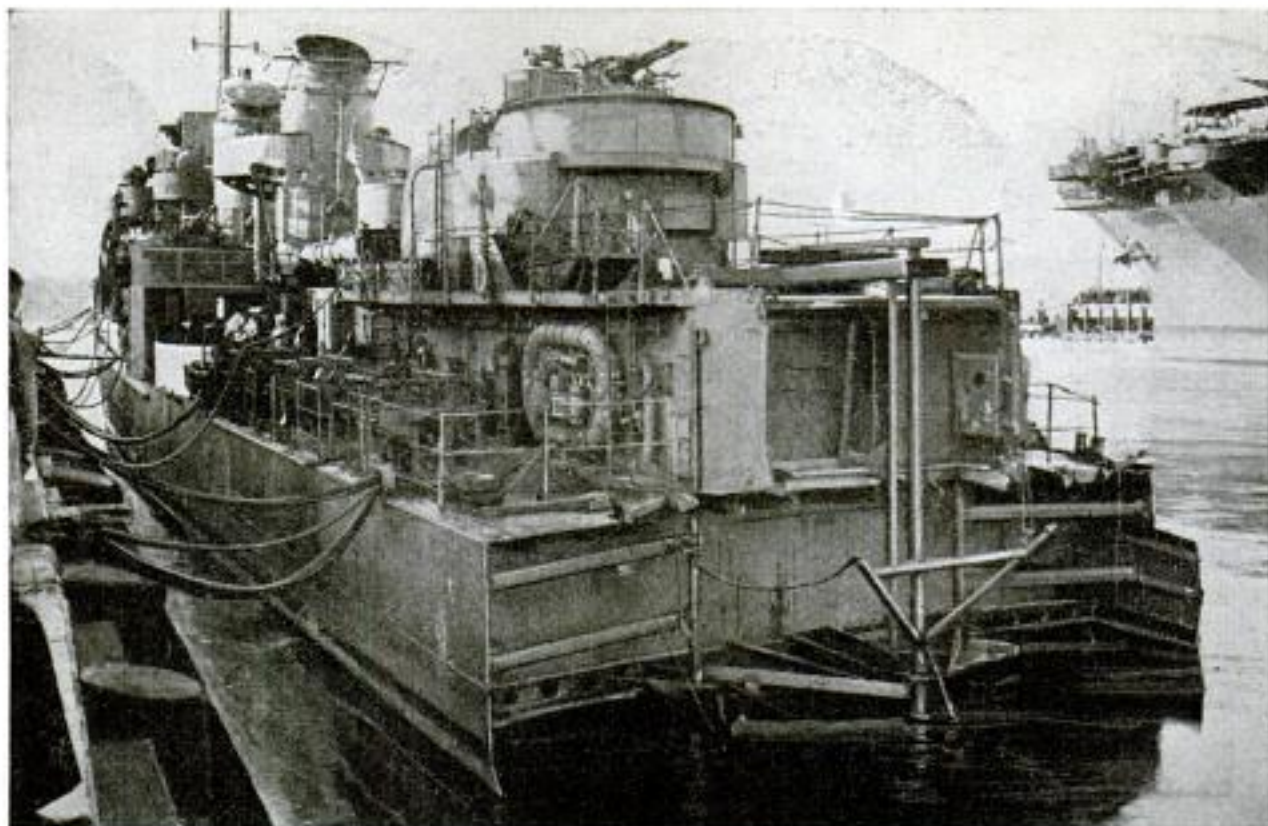
Divers had to remove powder from magazines of warship as water covered them after a sneak attack by the Japanese



one's palm. Moments later, plans of the damaged sections have been blown up to life size on enlarging paper, ready to be flown west.

Studying a timetable and a master chart of work plans for all the nation's repair yards, Navy officers "spot" the destroyer's job of surgery for a West Coast drydock and give it an "availability" of 30 days, estimated time for repairs. Out through a network of Navy communications flow orders to start procurement for needed equipment. Next day, when the two advance officers step ashore from their plane, they and the yard's production heads confer over the photos of the damage and the original "blueprints," and outline the job to be done. By next morning, a steel skeleton is taking shape in the fabricating department. Big as three boxcars, it is an oversize section somewhat longer than the original damaged compartments.

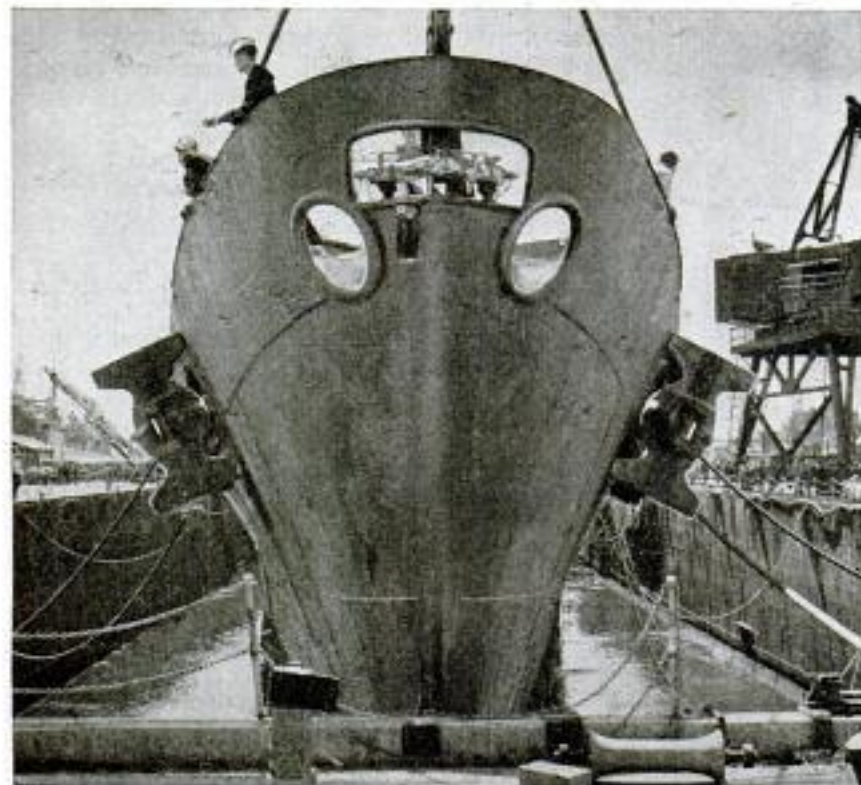
Two weeks later the crippled destroyer limps into the big drydock. Welders immediately cut away the edges of the gaping hole and remove the emergency plates which wall off



Mine in Alaskan waters blew the stern off this destroyer. She was towed to a West Coast yard for a new one

the flooded compartments. The big new section is lifted into place, its plates dovetailing nicely with the "incision" made in the ship's side. Repair experts swarm aboard, weld the section into place, install decks and bulkheads, then begin to connect up the intricate maze of electrical wiring, pressure tubing, and controls for naviga-

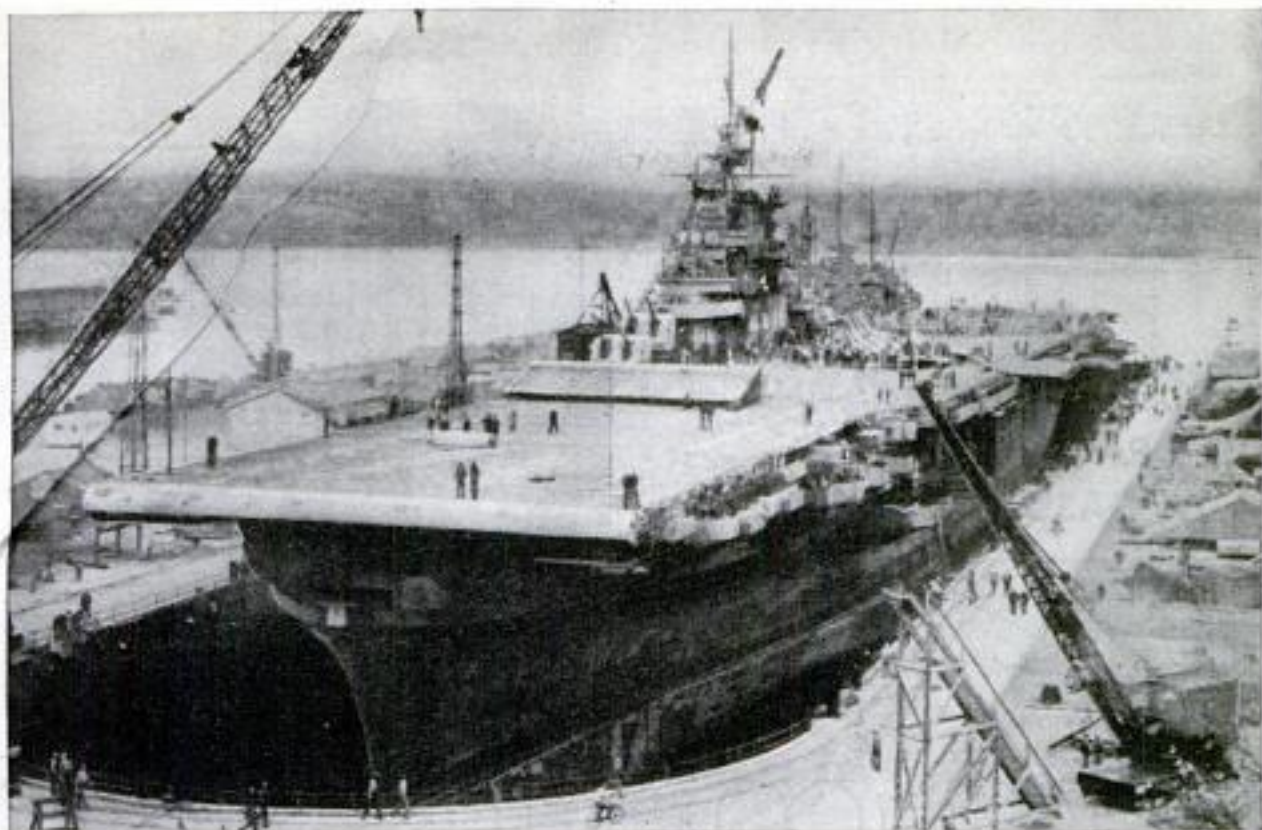
Cruiser settles evenly on keel blocks at big Navy drydock on West Coast



tion, fire, and other instruments. Fully 10 days before such an "operation" could have been completed in the old days, the "patient" is discharged and is on her way back to the battle area.

By such rapid-fire means, the Navy rushed fighting craft back into action. Thousands of skilled craftsmen—boiler-makers, electricians, ordinance workers, welders—formed the shipyard army assigned to repairing seriously damaged ships. Many of these ships were put aside for postwar repair. At San Francisco, repair work has increased six-fold. As many as 120 ships were undergoing repair at one time recently in its 30-odd yards and 150 subcontracting plants. Los Angeles area yards began to expand long before the battle for Leyte Gulf.

Microfilm speeded up repair work at the Fleet's advance bases, too, for shortage of air cargo space often delayed delivery of a major ship's bulky blueprints to remote spots. A battleship requires a big drydock



Carrier Bunker Hill, whose wreckage you saw on page 61, as she reached Puget Sound yard for "surgery"

for major repairs and its blueprints fill a freight car. Microfilmed plans of a "baby flat-top" total about one cubic foot, but the original blueprints would fill a nine by 12-foot room.

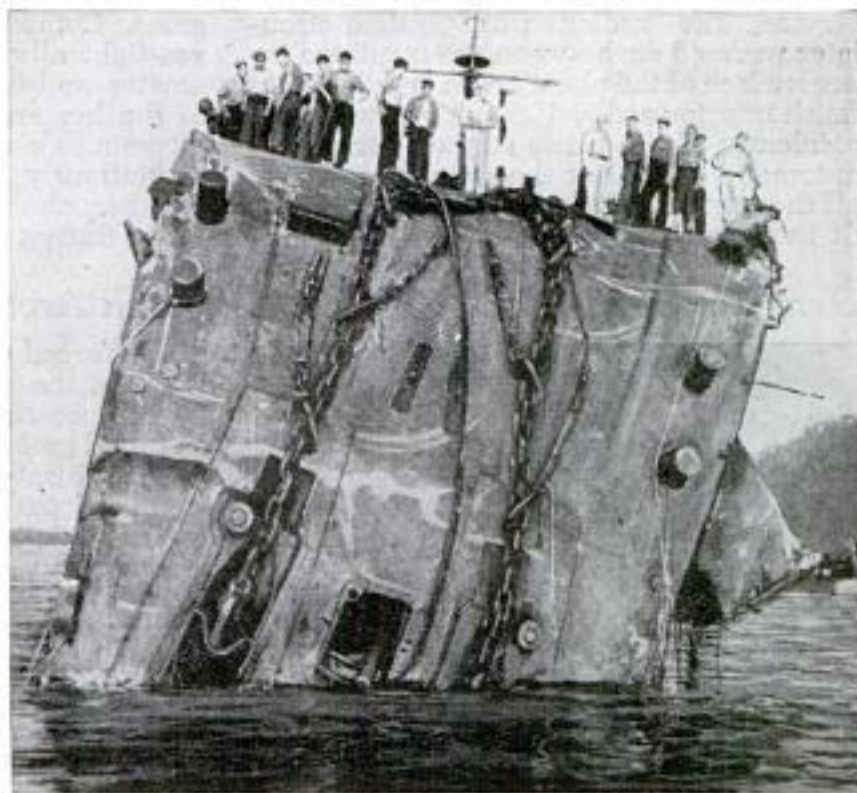
The escort carrier Kalinin Bay put in at U. S. Naval Drydocks at Terminal Island, near Los Angeles, with 25 holes in her skin. Thanks to microfilmed blueprints flown from Washington, she rejoined the Fleet six weeks sooner than ordinarily.

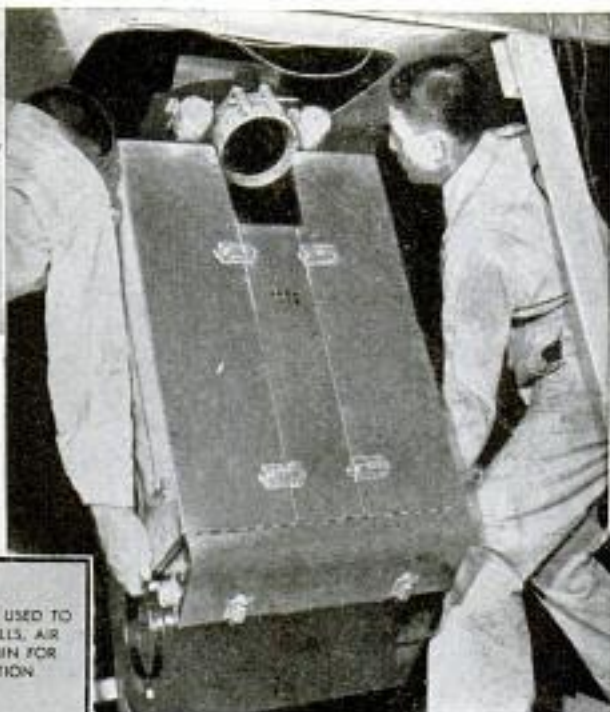
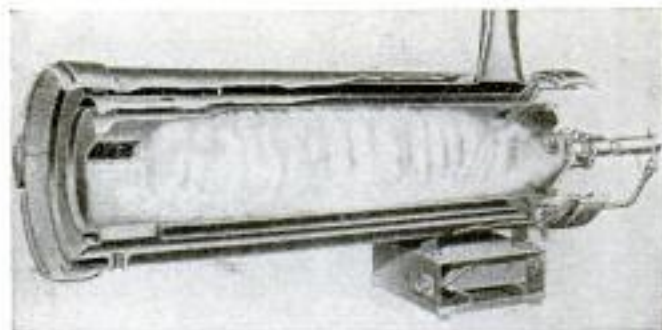
Off Leyte, at the height of the battle between Nippon's large battleship force and the little American escort carriers, a Japanese bomb struck the aircraft carrier Suwannee. Temporary repairs enabled the Suwannee to help turn back the superior force of the Japanese. But next day, two more Jap bombs destroyed the carrier's forward elevator and started bad fires on the hangar and flight decks. The carrier had to head for home. Photographs and descriptions of the damage were flown immediately to Puget Sound Navy Yard at Bremerton, Wash.

When the carrier arrived, so much of the new equipment was ready that at least four weeks were saved in repair and overhaul time. Some 55 miles of cable and enough pipe to carry a stream of water seven miles were installed in the ship for the reconditioning. Painters applied 42 tons of paint

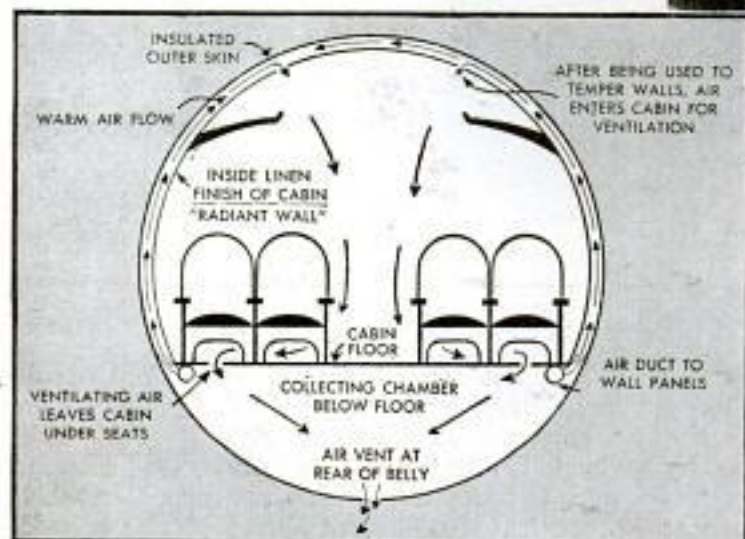
(Continued to page 154)

Foredeck collapsed over torpedo hole, but cruiser Honolulu sailed home





RADIANT PLANE HEATING USES PACKAGED UNITS WITH GASOLINE AS FUEL

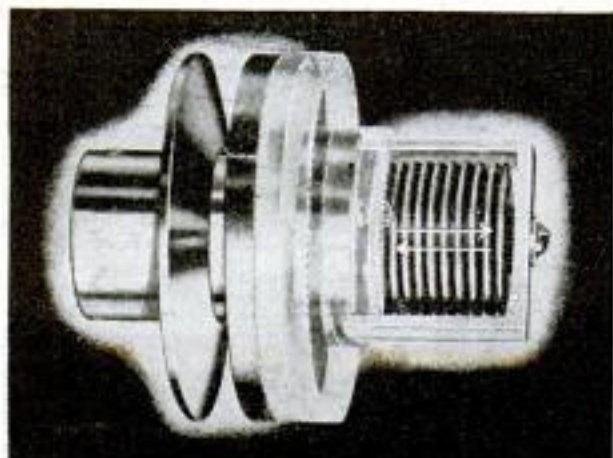


Radiant heating is applied to aircraft in packaged combustion type units installed in TWA Stratoliners released from military service. The "radiant wall" system circulates warmed air between the insulated inner surface of the plane's skin and the linen finish interior walls. Heaters operate independently of the plane engine, permitting automatic control of the warm air on and off the ground. The twin heating packages fit into the belly of the plane through a

quick access panel. Each includes an aircraft heater of 100,000 BTU capacity, thermostatic controls, fuel pumps, ventilating air blower, dampers and other automatic devices. A heater package can be removed and replaced by another in a matter of minutes. One heater is normally enough to warm the plane. In operation, the two units

are cycled on and off continuously. Surface temperature of the radiant walls never exceeds the design temperature of 90 degrees. Combustion occurs in a cylindrical gas-tight alloy steel shell, 8 inches in diameter and 36 inches long, in the center of the heater, with gasoline sprayed into incoming air and the mixture ignited by a continuously firing spark plug. In warm weather, the device keeps cool air circulating during flight.

Heat Controls Speed of Blower to Banish Arctic Blast and Save Fuel



In a forced warm air heating system, the speed of the blower fan can be controlled by furnace temperature with a thermally operated speed-changing pulley. This eliminates a blast of cold air when the system is turned on and the hot over-run at the end of a heating cycle. A thermostatic bellows expands with the heat to shift the unit into high gear. This consists of forcing pulley sheaves to close, changing the position of the unit's V-belt to a larger driving circumference. As the temperature drops, the operation is reversed. A single-speed fractional horsepower motor can be used with this fuel-saving unit.

serrated edges of the wheel, its motion guided machinery which raised or lowered the sand box in the water, thus flushing the tides into the "delta," or drawing them back.

One question had to be answered—would the invading salt water make the transmitted water too brackish for irrigation use? So the water in the tidal chamber had to represent invading salt water, but it could not actually be salt water, because the salt deposits might build up in the channels and alter the hydraulic balance of the model. So they colored the "salt" water blue, and trained a spectrophotometer—which reads colors—on samples taken from the model at many points. For "blueness" they read "saltiness."

Studying both the ways in which they had simulated Nature and the ways in which the model's limitations forced them to deviate from her, the engineers spent many months working with the model to make sure it really represented, on a tiny scale, what happens in the real delta. Questions such as this came up: Surface tension of water could make no difference in the real delta, but, on the model scale, could it cause the water to behave differently? The answer is "no" but it took months, and many experiments in altering the tension in the model, to find out.



Micrometer measures stretch of one of a thousand bolts holding case of Grand Coulee 150,000 hp. hydro-turbine

After more than a year the model had undergone every conceivable check for accuracy. Then the engineers ran off thousands of tidal cycles at the rate of one every 90 seconds, a month's tides in 45 minutes, correlated their data, and had their answer: Natural channels could be used, with minor improvements by dredging. The bureau could safely save \$24,000,000.

Water discharge of proposed Bridge Canyon Dam, to be tallest concrete dam at 736 feet, is studied in model





Saw-toothed wheel above in tide machine forms profile of tides in San Joaquin Delta and enabled engineers to learn if fresh water could be transferred across delta model at right. Wheel controls lifting and lowering of sandfilled box in trough of water, simulating tides. Below, 8000-ft. belt conveyor for earth-fill dam



Such problems are tossed continually at the engineers of the bureau's eight laboratories in Denver, all under R. F. Blanks, chief of the division of engineering and geological control and research. The group of laboratories covers hydraulics, earth materials, microscopic investigations, machinery and metals testing, concrete and concrete materials, chemistry, paint, photoelastic studies, and special engineering investigations.

In constructing huge Boulder Dam, how could millions of tons of "setting" concrete be cooled off quicker than the hundreds of years Nature would take? Special



refrigerating pipes through the huge mass, 570 miles of them, and special low-temperature cements evolved in the laboratory solved that one.

Then there was the long apron of the Grand Coulee. In designing a huge dam which discharges thousands of tons of water each second, the water must be delivered to the channel below as smoothly as possible, or it may eat back under the toe of the structure—as witness the caverns under the lip of Niagara. Original plans called for a long apron. Laboratory studies showed it was possible to substitute what the engineers call a "bucket" instead, at a saving of \$4,750,000.

The bureau has bought nearly \$100,000,000 worth of cement. It tests cement all the time. It has de-

A Billion Dollars' Worth of Dams

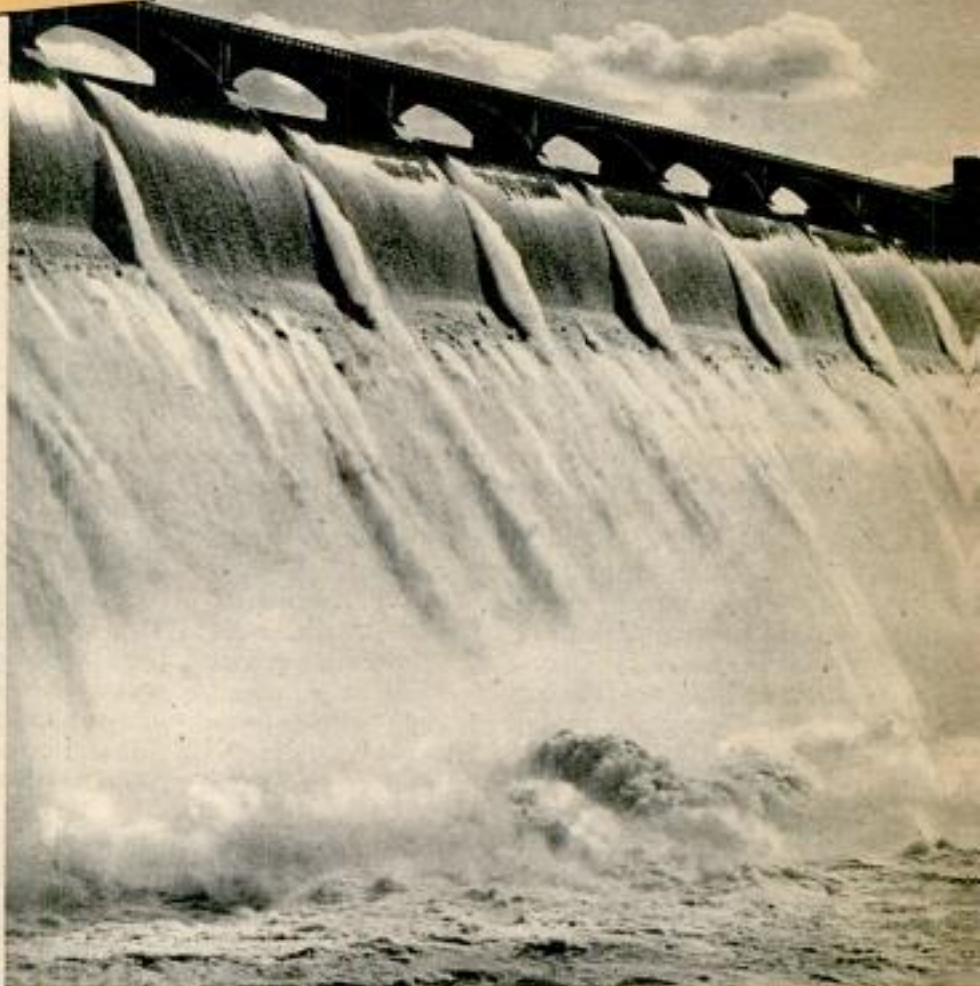
are built first in miniature
by ingenious U. S. engineers
whose tamperings with nature
sometimes have strange effects

By Roscoe Fleming

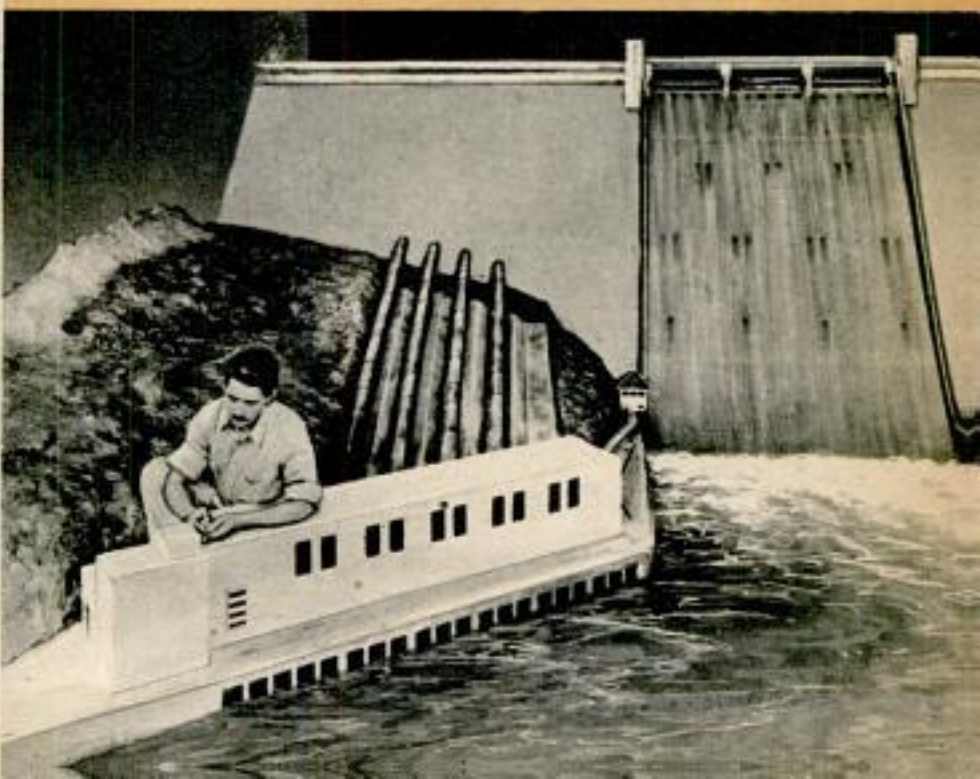
ENGINEERS in the Denver laboratories of the U. S. Bureau of Reclamation—which in its 43 years of existence has built and operates a billion dollars' worth of dams and irrigation works—are constantly facing once-in-a-lifetime problems involving mighty forces and masses of Nature and how to bend them to the service of man. Often it takes more time and ingenuity to set up the machinery, controls and conditions exactly right, than it does later to run off the problem itself.

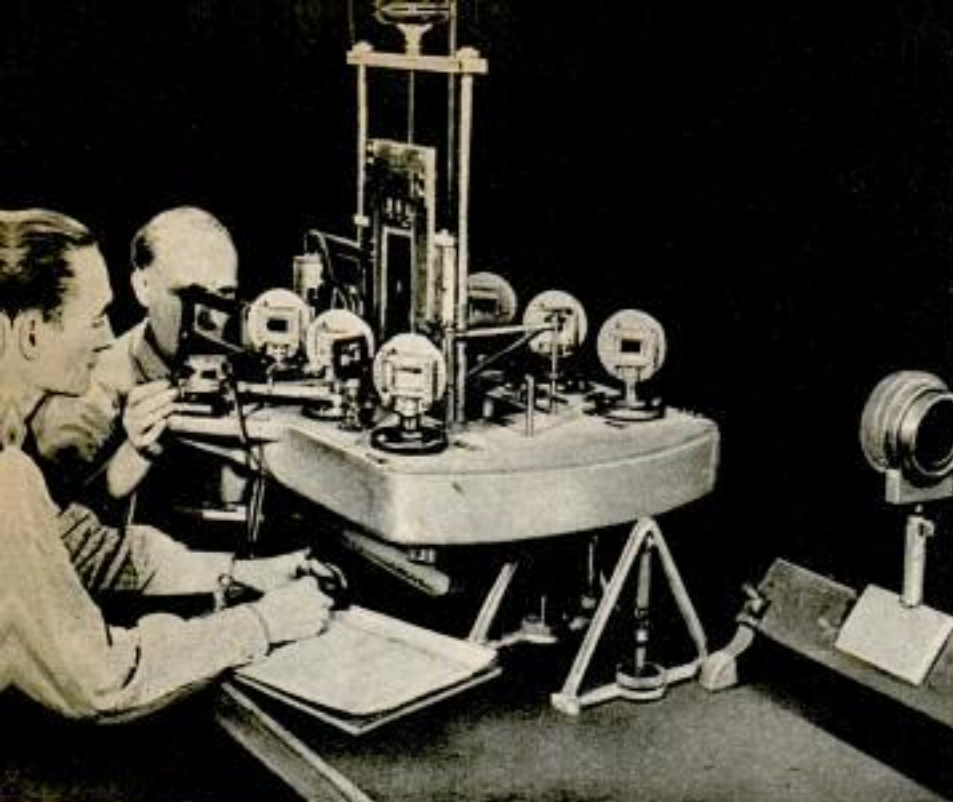
For example, within a few weeks the engineers simulated more California coastal tide cycles in an artificial delta than Nature had created since man settled there. This was done in the hydraulic laboratory, which always displays something interesting, such as a model for a dam of 1950 to be even bigger than Boulder. To create the delta, the laboratory floor was covered with a huge, delicately modeled relief map of concrete. Many parts of this map had to be accurate to the one-thousandth of an inch.

The artificial delta was part of the planning for the vast \$300,000,000 Central Valley Project in California, which the bureau is building to provide new livelihood and prosperity for hundreds of thousands of people. Essentially, it is designed to move water from the northern end of the great valley



Laboratory shaved \$4,750,000 from cost of Grand Coulee Dam, above. Shasta Dam mockup below preceded real thing by years





Engineers use photoelastic interferometer equipment in measuring stresses of model representing gallery of a planned gravity dam

to the hot, arid southern end, where it will grow lush crops.

The Sacramento River, from the north, and the San Joaquin, from the south, meet above San Francisco Bay, and thence crawl sluggishly to the bay through a hundred interlacing channels in a 2000-mile-square delta. Could some of these channels be used to transfer billions of gallons of water

deeper water.

Then they had to build a tide machine to reproduce the tide cycle of the upper bay. This was perhaps the most ingenious thing they worked out. The rim of a huge wheel was saw-toothed, in the pattern of the tides of a typical month. Below it in a miniature tidal channel was a huge weight, a box filled with sand. As a cam traveled the

from the northern mountains into the San Joaquin Valley, or would a new canal have to be built across the delta on high ground? The first project would cost \$8,000,000, the second \$32,000,000, and water-users and taxpayers would foot the bill. Experts said the natural channels could be used, but the Denver laboratories were called in for a double-check.

First, the engineers had to lay out the delta channels in concrete. In the space available, a foot of the model horizontally had to represent 4800 feet of the real delta. But vertically, the scale had to be changed to one to 100, since a 50-foot natural depth, let us say, comes out at one-eighth inch when reduced 4800 times, a mere wet smear of no value in studying the behavior of

Dorr clarifier units act as huge brooms in desilting basin, keep silt from flowing into All-American Canal

U. S. Bureau of Reclamation photos





Workmen caulk spillway seams of Shasta Dam. Pipes 15 feet in diameter, upper right, supply generator units

vised ways of making a concrete surface nearly as smooth as velvet, so that water glides along with little friction.

Originally bureau dams were built with an especially rich concrete mixture on the upstream face, to make them as water-tight as possible. Tests proved this unnecessary. And at Shasta Dam there was thought to be no satisfactory gravel nearby. The laboratories came up with the answer—special treatment of an aggregate so near that the gravel could travel to the dam by conveyor. This saved \$1,385,000.

In the concrete laboratory a huge press that can exert 4,000,000 pounds of pressure crunches concrete cores into fragments as engineers measure stresses and strains. Here also cycle after cycle of freezing and thawing, wetting and drying, test ability of concrete to "take it."

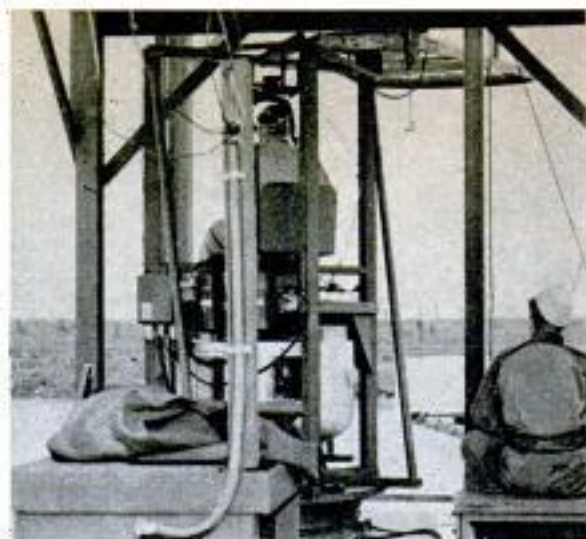
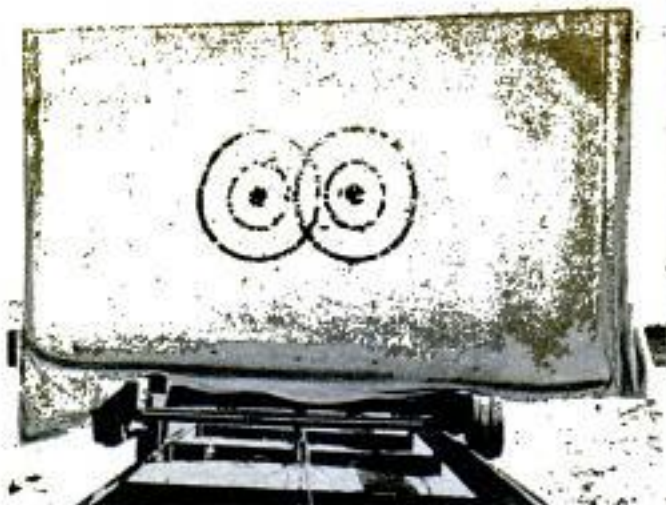
In a room beyond, an engineer may be fitting a

wooden model of a 108,000-kilowatt generator, in a tiny powerhouse like a doll's house, to check the design of a power plant of 1960. But new dams such as the contemplated Bridge Canyon Dam just below the Grand Canyon National Park, higher than Boulder, will have the powerhouses buried deep within the dam structure itself, for economy of design and for protection against possible bombing.

(Continued to page 148)

Elasticity of concrete gets a test in a 4,000,000-pound hydraulic compression device

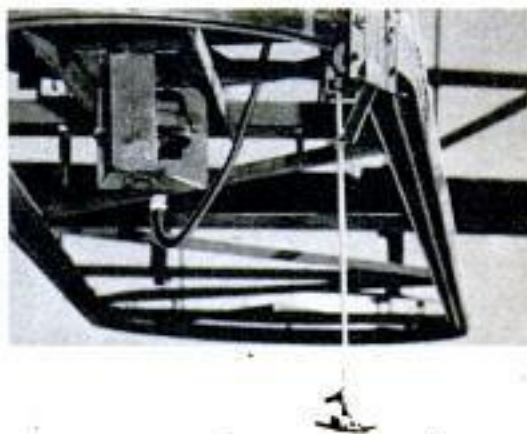




Bull's-eyes—one for each turret gun—are perforated by bullets as gunner (right) sights at plane below

Twin Bull's-Eyes Record Hits

Aerial gunners fire live .50-caliber machine gun bullets in an electric trainer at Avon Park Air Field, Fla. Built to train bomber crews, the new trainer has a platform with gun positions duplicating those on a Flying Fortress. A ball turret gunner, for example, is trained in that position on the platform. The gunner aims at a miniature plane suspended from an oval track. This target flies toward and away from him, simulating the movements of an attacking fighter. When the gunner fires, the bullets from his two machine guns crash into a target with twin bull's-eyes—one for each gun—located on a track 50 feet away.



Plant Broadcaster in Single Unit Has Built-In Phonograph

Packaged into one compact unit, a plant music broadcasting and paging system now available requires only 22 inches of floor space. Servicing up to 100,000 square feet of a plant with 20 to 40 loudspeakers, the combined unit is intended to broadcast music to plant workers, make routine announcements, and locate key workers by paging. It has a built-in phonograph that provides continuous music for a half hour, automatically playing ten 12-inch or twelve 10-inch records. During paging, the music volume is lowered, but not entirely discontinued.

Sulfa 'Bandage' Poured on Burns

Sulfagel, a new liquid sulfa "bandage" for burns, forms a germ-tight, transparent coating that lets the physician watch healing progress without exposing the burned area, the *Journal of the American Pharmaceutical Association* discloses. Pharmacists tried 64 formulas before finding the best combination, which is essentially sulfadiazine, a form of gelatin and water.

FLYING COMMAND POST



Two of Mercury crew operate radio station, above, as officer in background uses land line telephone. Right, member of crew during a test of the radio equipment

H EART of a flying command post from which the Southeast Asia Command headed by Admiral Lord Louis Mountbatten conducted the successful Burma campaign of 1944-45 was a complete radio station installed in the Mercury, a C-47 cargo plane. The standard U. S. Signal Corps transmitter and receiver was the first such equipment to be permanently housed in aircraft for use on the ground, says the Army Air Forces, which outfitted the plane and supplied a crew from Wright Field, Dayton, Ohio. As soon as the C-47 had landed at an advanced airfield or other point on the front, power plants were turned on and radio operators began sending messages to forward units and receiving information on progress of the fighting. Using the installation, Lord Mountbatten maintained communications with combat commanders more than 1500 miles away during the campaign. In addition to technical apparatus, complete living facilities were carried in the flying command post, including gas stoves for preparing food and cots on which the personnel could sleep.

Starting up power plant, which was connected to tail of plane



Mercury operators install a set in a jeep for local use, above. Below, working on plane aerial and ground



Saved by the Silk

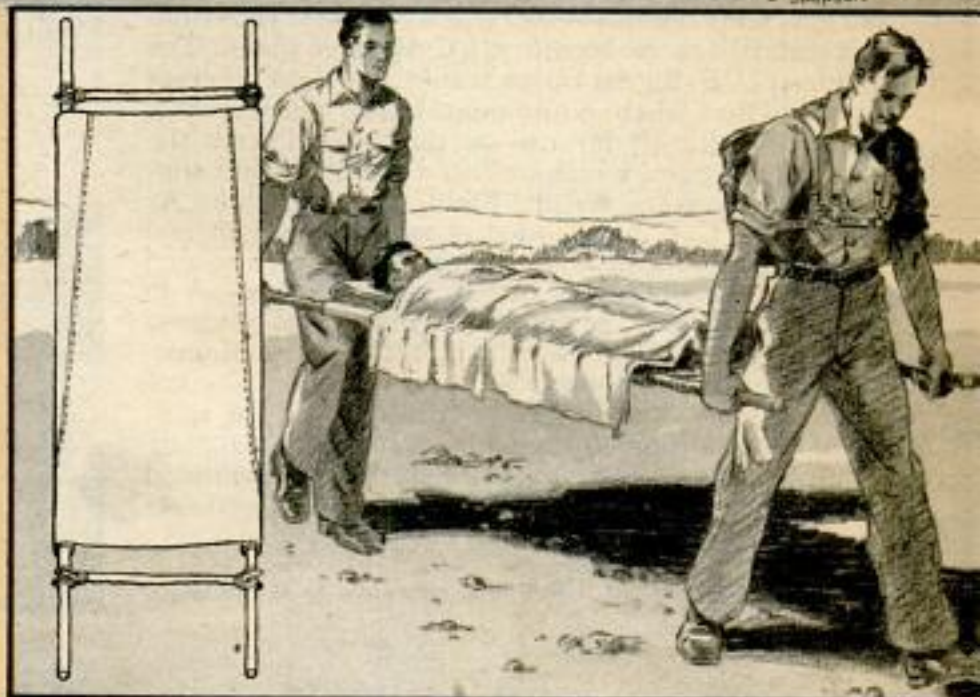
Parachutes have saved many lives even when the flyers haven't had to bail out and yank the rip-cord. The chute itself is one of the greatest survival aids an airman can have. Among emergency uses developed and tested by the AAF's Tactical Center at Orlando, Fla., are travel packs, signals, shelter, clothing, hunting and fishing equipment and innumerable devices to give first-aid



SUN PROTECTION



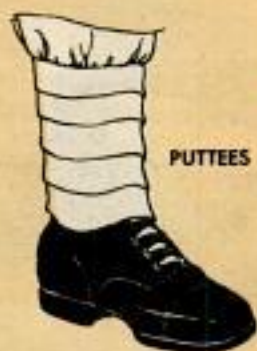
SANDAL



With a rectangle of chute cloth about 3 panels wide and 6 feet long, a simple litter is improvised. Cloth is rolled tightly on stout poles



RAFT SAIL



PUTTEES



SHADE HAT

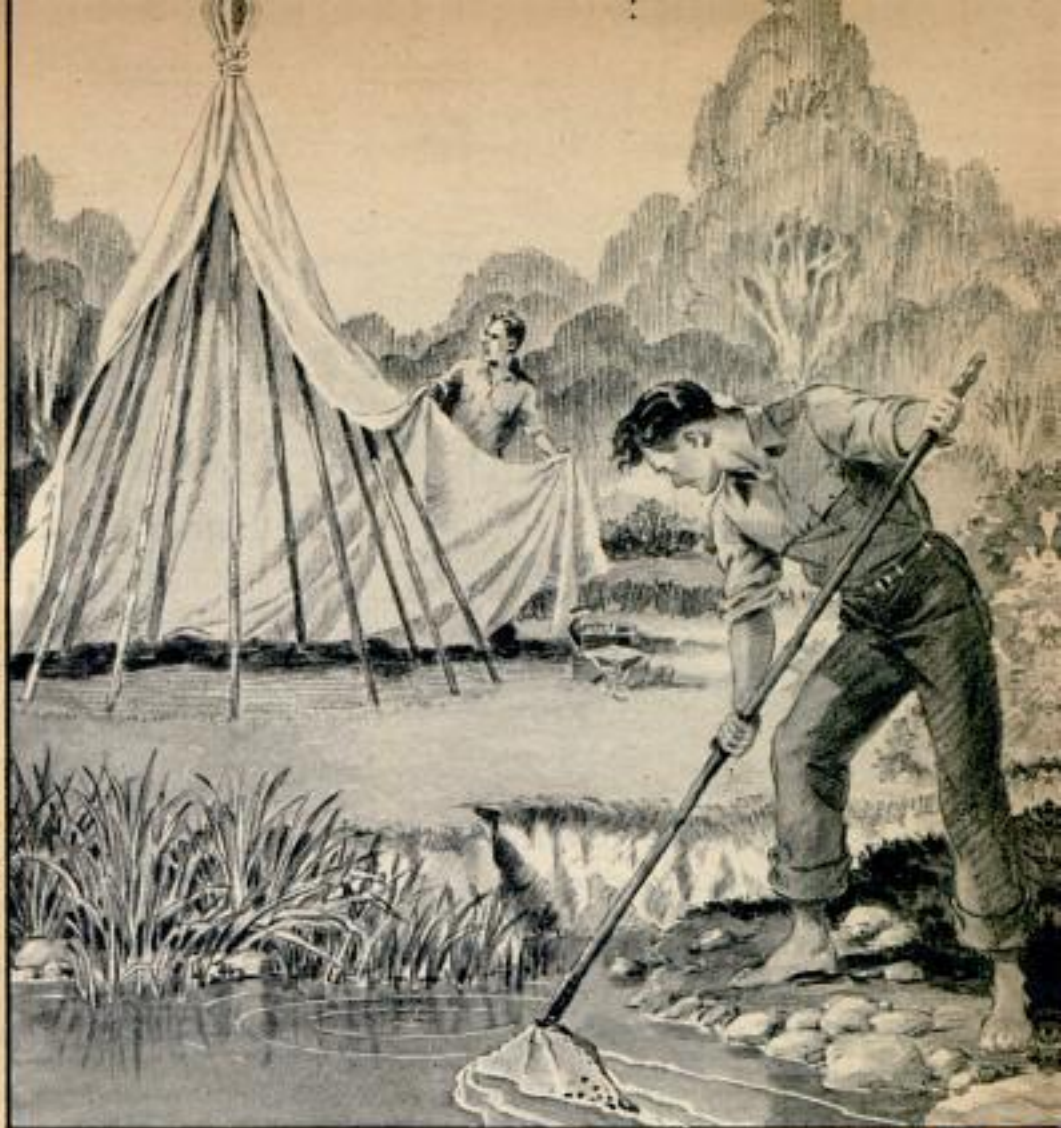
TRAVEL PACK
AND SPLINT



BED
ROLL



FISHING
SEINE



Pole paratepee and hand net for fishing, above, provide shelter and food. Paratepee takes 11 poles about 14 feet long, allows 3 men to sleep comfortably. Fire can be built inside. Frame of hand net is made from heavy wire of pack frame. Below is shelter using shroudline for ridgepole. Spread-out chute is ground marker. Small pieces also serve as signals



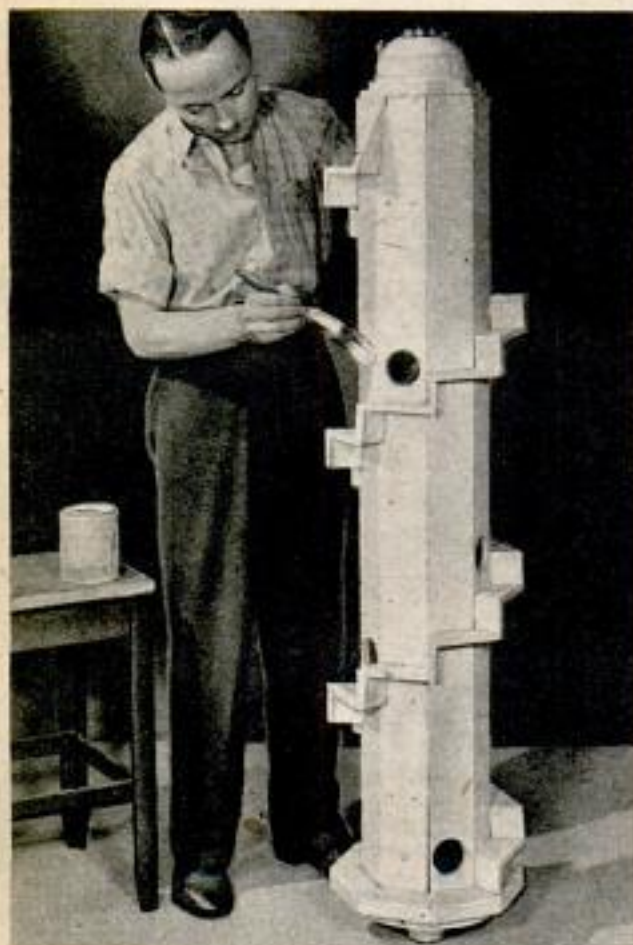


Golf Ball Harvester Thousands of golf balls are picked up in a few minutes at a practice driving range near Los Angeles with an ingenious "harvester" attached to a motorcycle. It consists of a series of thin wooden disks placed close enough together to pick up a golf ball. As the disks rotate, wooden tongues disengage the balls and they fall back into a collecting trough.

Russians Report Restoring Life to 12 of 51 Fatally Wounded Soldiers

Supplying oxygen direct to the lungs by a pulmotor and injecting blood into a vein and an arm artery in the direction of the heart has restored life to 12 of 51 fatally wounded Red Army soldiers, according to an article in the American Review of Soviet Medicine. The method furnishes nourishment to the heart muscle, the article declares. A private declared dead was giv-

en the treatment three and a half minutes later by a specially trained group of doctors; in about a minute his heart started to beat, and after three minutes breathing began, according to the Review. The soldier regained consciousness in an hour, and is reported alive and well today after 18 months, under observation at the All-Union Institute.



Eight-Room Martin "Penthouse" Is Built Like a Tower

When many martins fly north next spring they will find their postwar housing problem already solved. A new house which is built like a tower has been designed by a Minneapolis business executive. It has eight compartments and a winding stair which circles the tower. The martin tower requires no special tools to build.

Vibrator for Hydraulic Press

Any number of repeated pressure strokes can be applied automatically by the ram of a hydraulic bench press using a newly developed vibratory hydraulic pressure principle. Pressure on a hand or foot control lever causes the ram to descend from its full upstroke limit and make short, repeated automatic full pressure strokes until the operator releases the control lever. Pressures can be preset for any degree between 1600 and 8000 pounds. With an automatic cycling device, the ram makes any preset number of uniform pressure strokes. The vibratory principle adapts the hydraulic press for high-speed stamping, forming, forging, riveting, broaching, trimming and kindred processes.



Life Jackets Run Obstacle Course In Circular Testing Tank

Buoyancy and wearing qualities of life jackets get a rigorous test in a circular tank fitted with an obstacle course, developed by the Coast Guard Research and Development Division from an idea suggested by A. F. G. Lucas of the National Academy of Science. Five jackets, fitted on dummies and suspended from steel arms, can run through the tank in one test. A three-horsepower electric motor drives the jackets around the obstacle course at three speeds, running, swimming, and walking, operating much like a merry-go-round. The jackets, containing fillers of kapok, fibrous glass and treated cotton, are removed from the tank at intervals of 15 minutes, weighed to determine loss of buoyancy, and examined for other signs of deterioration.

Life jackets running through obstacle course, above left. Sailor, above right, prepares a jacket for testing. Right, weighing jacket for buoyancy loss



Dial Adjusts Cooker's Pressure

Pressure can be adjusted instantly to 5, 10 or 15 pounds by turning a dial knob on the cover of a cooker. The desired pressure is maintained throughout the cooking without change. The cover has a long handle to lock it against a gasket seal and to help remove the hot cover. Big enough to hold four quarts, the cooker also can be used for pressure canning.

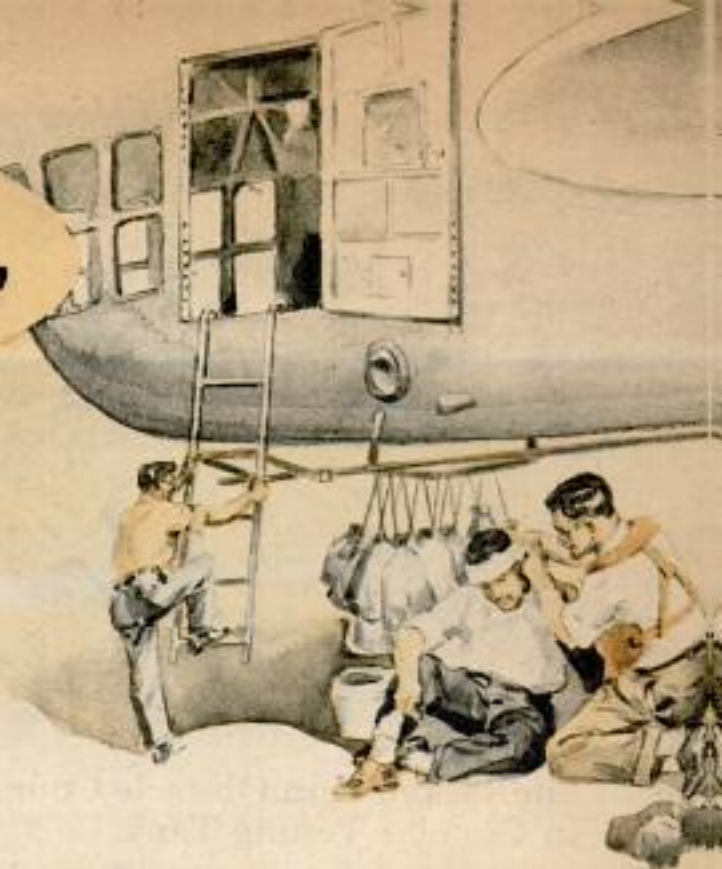
IT TAKES 25 TONS of blueprint paper to construct a battleship. It takes seven pounds of kraft paper, three pounds of book paper, for each Signal Corps radio set. It takes your help in saving waste paper, for paper is still a No. 1 War Material Shortage!

"IT'S IMPOSSIBLE BUT WE'LL TRY IT!"

PART 2



For desert rescue with a blimp, Rear Admiral Rosendahl pins the DFC on Lieut. Peter Culbertson. Below, Marine flyer rescued at sea is removed from airship



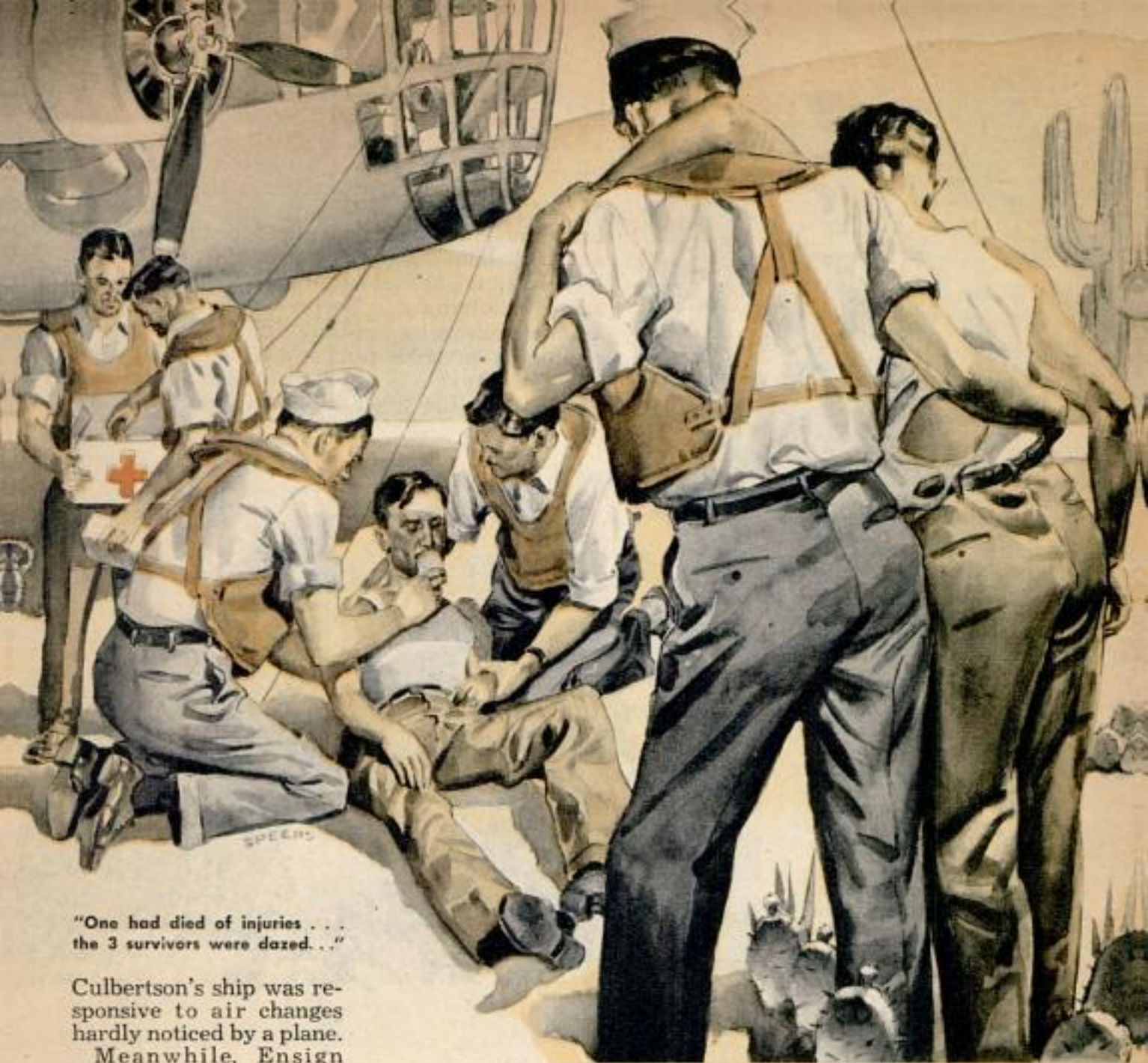
By Thomas E. Stimson, Jr.

TO ATTEMPT the impossible—the rescue by airship of two Navy flyers, one of them injured, who had parachuted into the blistering sands of Imperial Valley in California—there could have been no better choice than Lieutenant Peter Culbertson, USN, of Blimp Squadron X.

Receiving a call for help from Holtville, about 20 miles from where the flyers had hit the silk, and from which rescue parties tried in vain to penetrate the desert heat, the coast blimp station said: "It's impossible, but we'll try it." And Culbertson, hero of legendary blimp exploits, was assigned to command the rescue airship and a picked crew. Ensigns Herman K. Calahan and Alfred J. Hoffman were chosen as pilots; John Ralph Caver and Herbert W. Wilson, chief machinist's mates; Leonard N. Craig, Jr., airship rigger; Ollie Webb, aviation machinist's mate, and William N. Crow, pharmacist's mate.

They flew a standard K airship, 257 feet long, inflated with 500,000 cubic feet of helium. Aerial patrol operations since early in the war proved this type to be rugged and reliable. Nonrigid, it has no internal supporting structure.

Culbertson headed for San Gorgonio Pass, a pilot's headache that cuts through the mountains near Palm Springs. The prevailing westerly wind from the ocean drives into it, speeds up, and then boils with turbulence when it meets the hot light air of the desert. Flying is rough in the pass for even a heavy airplane and



"One had died of injuries . . .
the 3 survivors were dazed . . ."

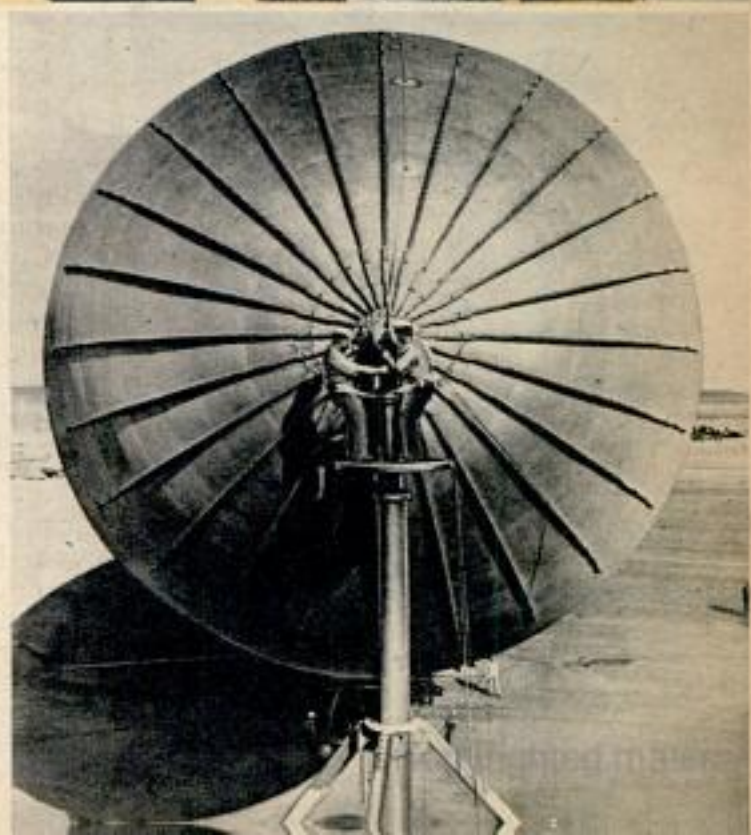
Culbertson's ship was responsive to air changes hardly noticed by a plane.

Meanwhile, Ensign Clement G. Williams and Ensign Ivan J. MacMahon, experienced ground officers, left the air station by airplane for Holtville. They would organize a ground party to handle the ship if Culbertson decided to land at the Holtville field.

In San Gorgonio Pass the blimp sped along with a tail wind that brought its speed up to 100 knots. It yawed wildly from side to side in the rough air and thermal currents boosted it straight up at a 2000-foot per minute rate. Culbertson blistered his hands on the control wheel as he fought to prevent the elevatorlike ascents. Meanwhile he had valved helium until he had transformed his ship from lighter-than-air to heavier-than-air.

An airship is a composite machine, part balloon and part airplane. Its basic lift is provided by the gas that distends its enve-

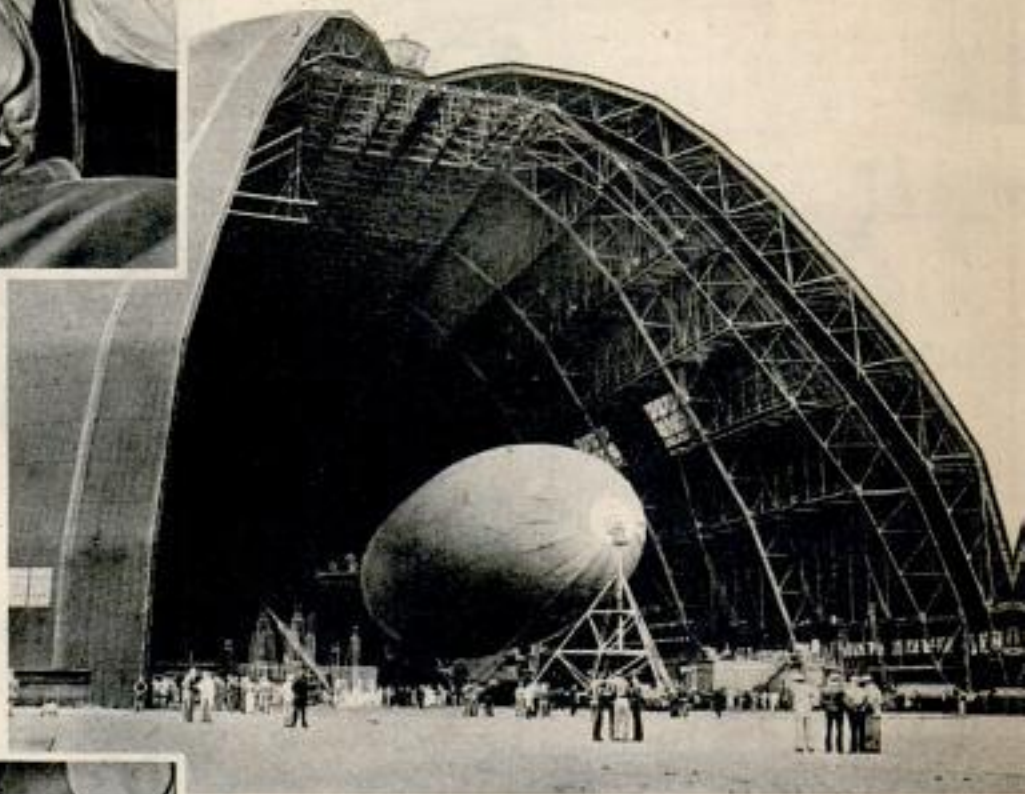
Ground crew fastens airship's nose to mobile mast





Wearing Mae West life preserver, airship's pilot grasps rudder control wheel while getting a report by intercom phone from aft lookout in cabin

New M-1 blimp, right, is largest nonrigid airship. It's composed of 3 connecting units. Electric stove heats coffee for crew, below



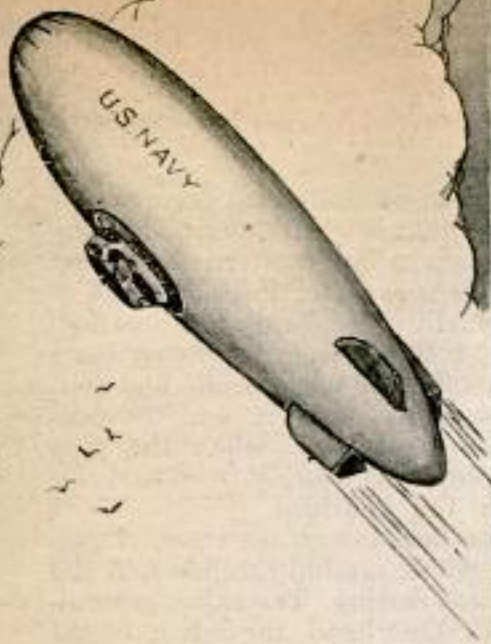
lope and it obtains additional lift from dynamic forces when driven ahead by its engines. Thus an airship frequently takes up a load that it could not lift by buoyancy alone. In that condition it depends on its engines for remaining aloft.

That was the situation in the pass. The airship had climbed to an altitude of reduced air pressure and its helium gas was expanding. A child's balloon, released, ascends until it bursts from expansion of its internal gas. Such a catastrophe is avoided in an airship by releasing part of the gas when its internal-pressure reaches a certain point. This allows the airship to fly safely at high altitude but also reduces the ship's lifting capacity. Culbert-

son's ship was 3000 pounds heavier when he emerged from the pass. He flew over the date palm groves of Indio, skirted the Salton Sea and arrived over Holtville.

From there a Navy plane, its pilot talking by radio, escorted him on the last lap. Over the sand dunes the plane dipped and pointed out the spot. Culbertson moved in, going down to 400 feet for a close look. One Navy flyer was sitting on the sand, supporting the other on his lap. Two Navy men who had persisted in a rescue attempt on foot were just arriving, 100 yards away.

It was now 5 p.m., but the temperature had dropped only a few degrees from a probable 131. The "hot stove" effect from the torrid ground made the airship hard to control. Instead of gently rolling dunes the terrain consisted of large sand hills with steep wind-drifted sides. Only one spot, half a mile away, appeared at all suitable for a landing. Culbertson decided to drift down to the pair who were moving and ask them to bring the others to that location.



Mechanics on catwalk service engine and supports. Drawing shows how skipper proved an airship can climb

First he had to lighten ship. Gasoline consumption since leaving the pass had reduced the weight somewhat but the ship was still hundreds of pounds too heavy for a slow landing. He moved away, jettisoned fuel, and brought the ship nearly into equilibrium with the air. The ship nosed down, touching its landing wheel on top of a mound over which the two men were plodding. Culbertson shouted and one of them turned with an incurious stare, then moved on. Neither man seemed to grasp the fact that an airship was practically forming a roof over their heads. They were just about out on their feet.

Culbertson gunned the engines and climbed away. There appeared only one solution, a controlled crash landing. He told the crew he would try to make a hard spot landing, with the possibility of damaging the cabin. It was worth the chance.

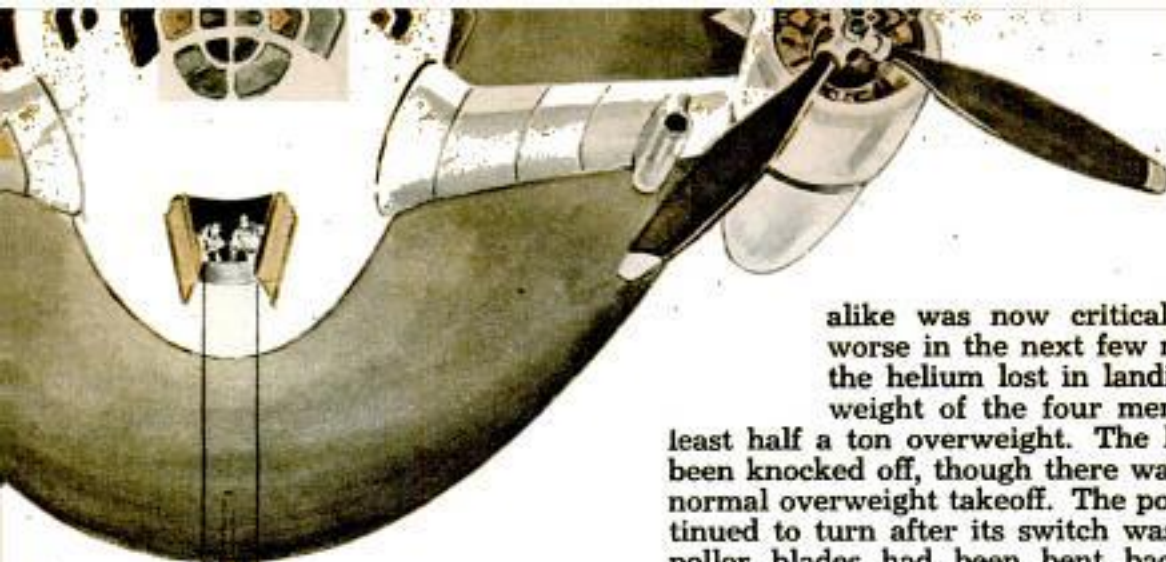
On the home field blimp is fastened to mobile mast

He killed the starboard engine on the approach, headed across a valley toward a ridge, and killed the other engine. The forward end of the cabin plowed into the dirt, scooping it up until Culbertson and Calahan, at the controls in the forward lookout, got their shoes full of sand. The airship stopped and helium was valved to hold it there.

Meanwhile, the four men on the ground had joined company. Two became aware of the blimp and staggered to it. They were too weak to step up into the cabin without help. Crew members went to the remaining pair and led one back, carrying the other. Pharmacist's Mate Crow found that the latter had died of his injuries and the heat only a short time before. The three survivors were dazed, as if in the twilight stage of anaesthesia.

The situation of rescued and rescuers





alike was now critical and became far worse in the next few minutes. Counting the helium lost in landing and the added weight of the four men, the ship was at least half a ton overweight. The landing wheel had been knocked off, though there was no runway for a normal overweight takeoff. The port engine had continued to turn after its switch was cut and the propeller blades had been bent back when the ship crashed. High test gasoline was leaking from fuel line connections loosened in the smashup.

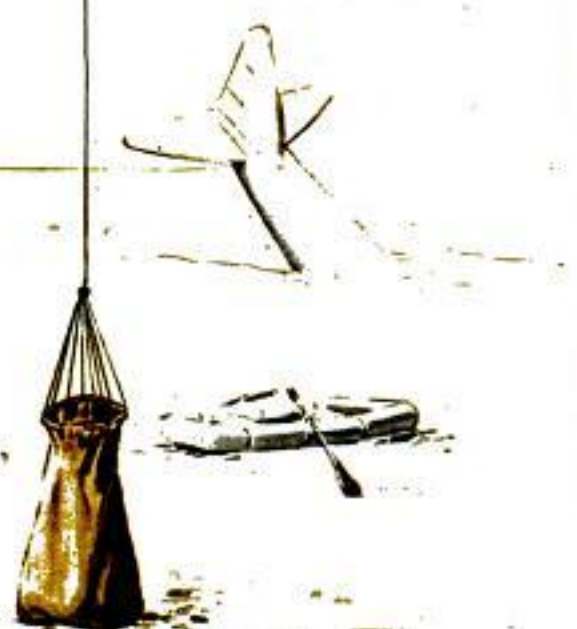
While Culbertson was considering these factors and the rescued men were receiving first aid in the cabin, the whole airship lurched and slid slowly from the prominence on which it was resting. The cabin grounded in the bottom of the adjoining ravine. Overhead, the fabric of the envelope rested on the side of the hill, rubbing against the slope as it swayed in the hot air. The big airship, almost the size of a destroyer, was now in an apparently hopeless position.

His crew looked sick and Culbertson realized that they—and himself—needed action, at once. "Fellows, there's a lot of junk on this ship I never did like. Now's our chance to get rid of it. Come on, let's lighten ship!" Stocky, with the powerful arms of a wrestler, he ripped the metal cabin door from its hinges and pitched it away. Two men laughed and bent over the galley range. Out it went. Chairs, life jackets, overhead sleeping bunks, smoke flares, the emergency rubber life raft, everything that was loose or could be loosened was thrown out on the sand.

Culbertson had a plan that might work. He knew that the ship was sturdy enough to take the beating he was going to give it. First the port engine was cranked but it failed to start. The starboard engine, however, started at once, and Culbertson gave it full power. The ship



How lifesaving gear of blimp works is shown in drawing at left. Line with life ring passes through cabin, has bags of sand as counterbalance. Right, blimp spots crash victim, drops food and raft



dragged itself along the ravine sluggishly, hit hard and bent back the tips of the thrashing propeller, then bounced up into the air. It drove ahead, hit again, and made a final bounce, clearing the rise in front of it with two feet to spare. Culbertson nosed down again at once to get the long tail over the same obstacle.

The rest is anticlimactic. The airship proceeded to Holtville on one set of bent propeller blades, discharged the people and the body it had picked up, and refueled. Propellers were taken from two airplanes to replace both sets of bent blades and the port engine was restored to use. Still heavy and without its taxi wheel, the ship was heaved up into the air by the ground crew at the command "Up Ship!" and began its all-night return trip to the coast.

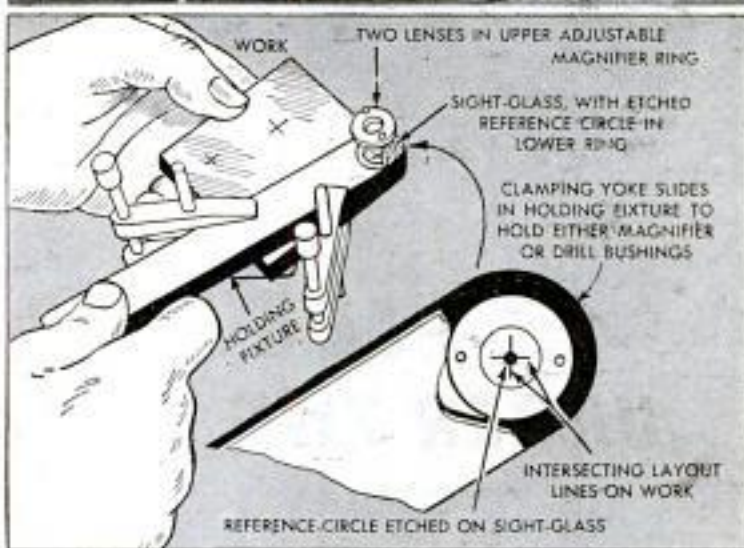
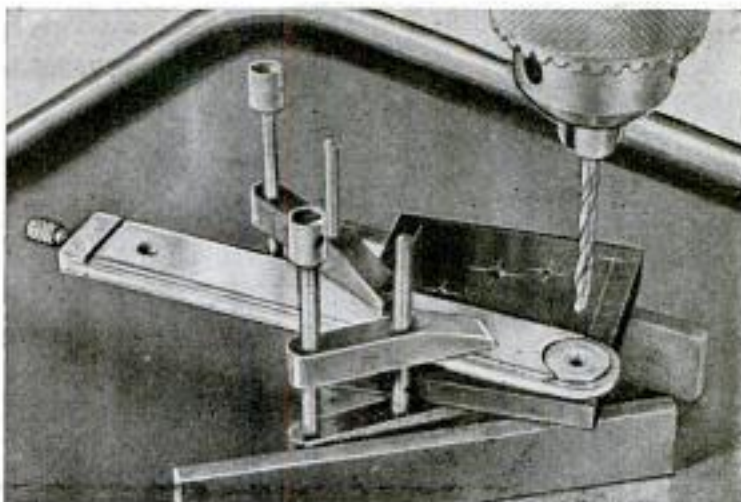
Culbertson got a medal for the desert rescue but a week later things were back to normal. This time he frightened some passengers, heavier-than-air pilots, half out of their wits. There had been some supercilious remarks about rates of climb of airplanes versus airships. And someone had patted the side of the cabin. "Nice old sausage. Good old blimpsey."

Ace waited until he was 150 feet off the ground, just high enough to avoid bumping his tail. Then he wound the elevator wheel all the way back and held it there, pointing the ship's nose practically straight up. The passengers were tumbled backward to the rear of the cabin, just the spot they wanted anyway, because that's where they had left their chutes. Now they were fighting to get them on. Any plane pilot knows that you can't point an aircraft's nose straight up, close to the ground, at slow speed, and walk away from the wreck. Ace is still chuckling over their reaction in his airship.

He got his Air Medal for a rescue in May 1944, under circumstances opposite to those of the desert rescue. He was on ordinary patrol offshore. The day was cold and blustery, with a heavy sea and a 30-knot wind. Culbertson's radio operator picked up a message that two aircraft had collided at sea about 100 miles away.

Ace headed toward the area and went down low. It wasn't long un-

"Bombsight" For Centering Drill Is Accurate to .001 Inch



Holes can be drilled swiftly and accurately with an optical center locator which saves time in construction of tools and dies. After work has been laid out carefully, a compound magnifier is clamped over the holding fixture and moved slowly over the intersecting layout lines. When the reference circle etched on the sight glass is centered exactly over the layout lines, the holding fixture is clamped to the work. The magnifier then is removed and the correct drill bushing substituted. Holes can be located and drilled easily within tolerances of .001 inch.

til a lookout sighted a patch of marker dye in the water, with a man in a life raft in the middle of the patch. Some distance away a PBY flying boat also was conducting a search.

Today, all blimps are rigged for air-sea rescues. The lifesaving gear consists of a sea anchor to moor the airship to the ocean, and a large life ring secured to the end of a line. Several bags of sand form a counterweight at the other end and the line passes through the cabin. With these devices an airship can pick people up without difficulty under any condition of wind or sea.

But no airship carried this gear 18 months ago.

(Continued to page 150)



Fleet Admiral Nimitz reviews Royal Marines on British ship

the Jap-held Sakashima Islands while American soldiers and marines poured ashore in the attack on Okinawa. The second chance came in July when the Royal Navy teamed up with the powerful U. S. Third Fleet under Admiral Halsey to work over the Japanese home islands.

Both operations were missions of honor and revenge. Prime Minister Churchill had pledged the full weight of British strength to help destroy Japan, and every man-jack in the task force was eager to avenge the disastrous sinking of the battleships *Repulse* and *Prince of Wales* off Malaya shortly after Pearl Harbor.

Queen of the seas for 300 years, the Royal Navy has always been known in Anglo-American naval circles as the "senior partner." In its first Pacific operation against the Japs, it found itself inferior in numbers and experience to the colossal U. S. Pacific Fleet which had been locked in com-

FLEET UNDER TWO FLAGS

THE JAPS are said to love fireworks, but they didn't care much for the show put on by Admiral Halsey's mighty Third Fleet last July. Steel mills and factories were blasted by 16-inch naval gunfire, railroad ferries and ships were sunk by torpedoes, and grounded aircraft and hangars were wrecked by more than 1000 carrier planes.

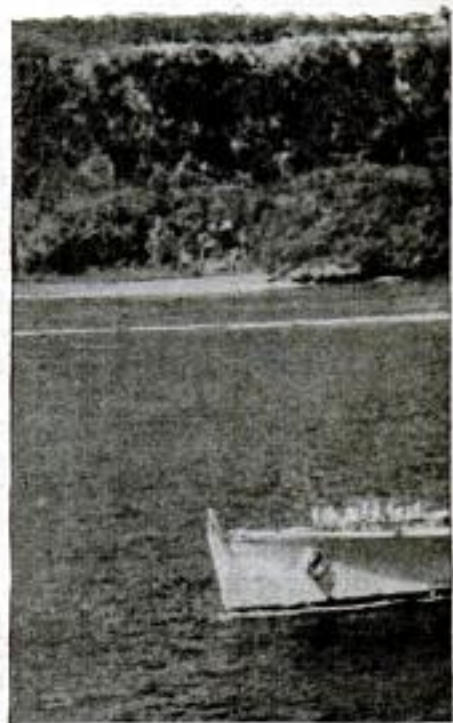
It was even worse when the Navy announced that the British Pacific Fleet had participated in the raid upon Japan's "sacred soil" with a sizable force of carriers, battleships, cruisers and destroyers.

In a nutshell it meant that the world's No. 1 and No. 2 navies had pooled strength to hammer land and sea targets of the treacherous nation which once had possessed the world's No. 3 navy.

Earlier in the year, when it was first announced that the British Fleet was going into action in the Pacific, the Jap radio taunted the Royal Navy, calling it "more of a liability than an asset. . ."

Hard-bitten British officers and seamen from the country that produced Lord Nelson said nothing as they prepared their ships at Australian bases. They knew they'd get their chance later.

The first chance came in March when a British task force sailed out from a secret United States base and pounded



bat with Jap sea and air power for many months. It is true that elements of the British Fleet had fought the Japs around Singapore and the Dutch East Indies in the early part of the war while the British East Indies Fleet had battled the Nips from Ceylon to Java. But last spring marked the first time that a British task force had gone after the Japs in Western Pacific waters.

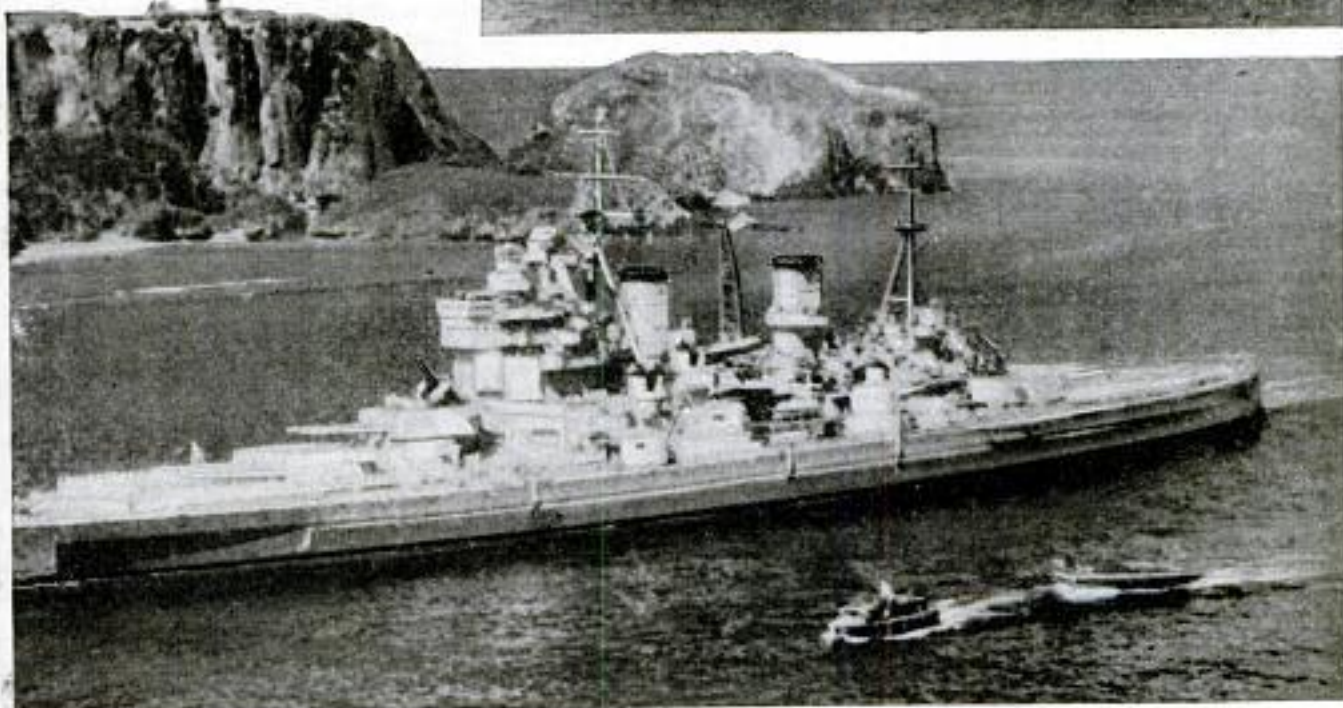
The British Pacific Fleet was a formidable outfit by any standards. It included such mighty battleships as the King George V and such aircraft carriers as the Illustrious, the Victorious and the Indomitable. Its strength in smaller warships was no less impressive—including such cruisers as HMS Black Prince, HM Canadian ship Aganda and HM New Zealand ship Gambia, and such destroyers as Troubridge, Tenacious and Termagant. It was a well-balanced and hard-hitting outfit.

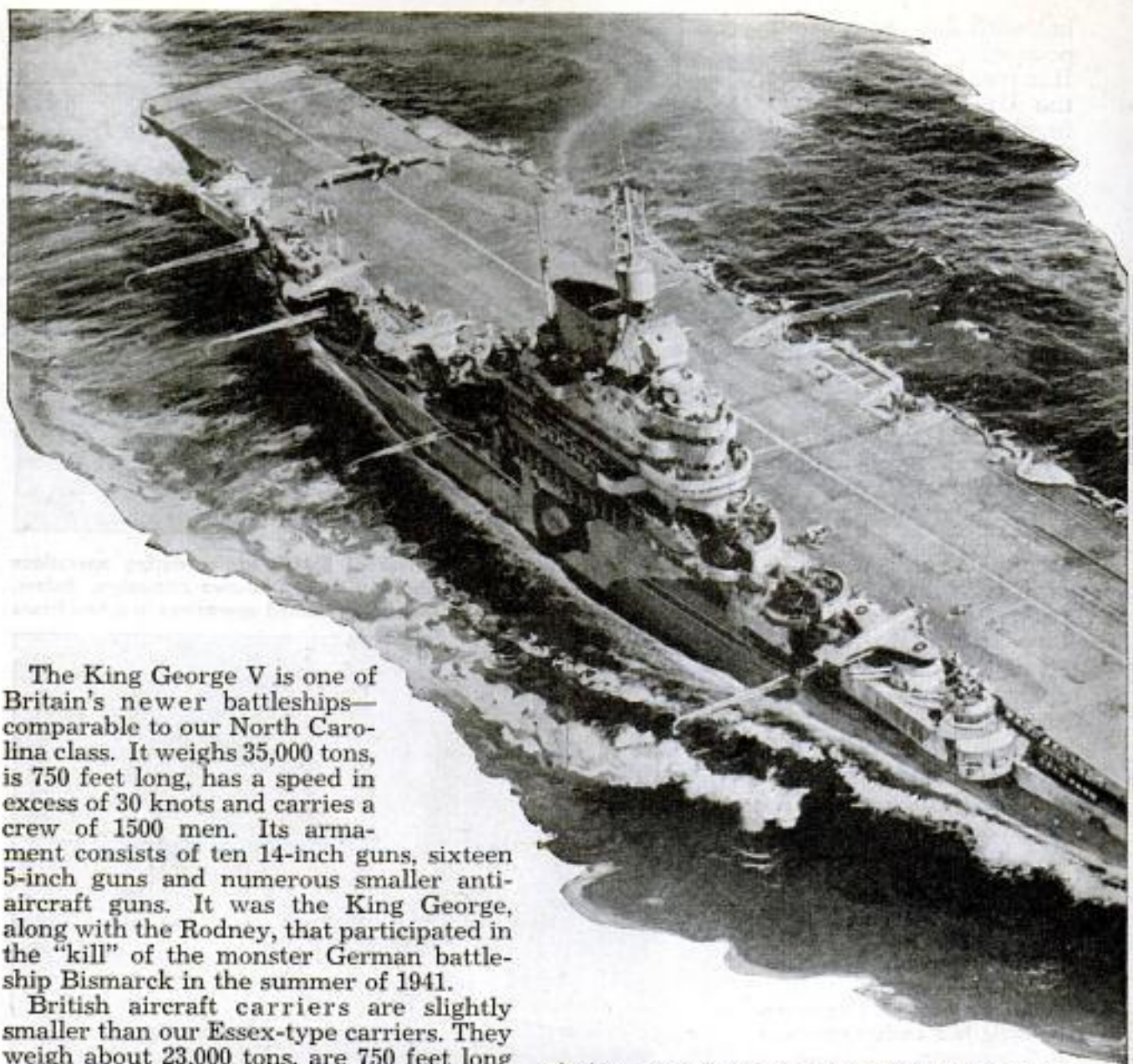
HMS King George V steams majestically into harbor at Guam U. S. Navy photo



British official photos

Jap suicide plane crashes on deck of British carrier during operations against Sakashima Islands supporting U. S. Okinawa campaign. Below, another carrier hit in same action. Both resumed operations in a few hours





The King George V is one of Britain's newer battleships—comparable to our North Carolina class. It weighs 35,000 tons, is 750 feet long, has a speed in excess of 30 knots and carries a crew of 1500 men. Its armament consists of ten 14-inch guns, sixteen 5-inch guns and numerous smaller anti-aircraft guns. It was the King George, along with the Rodney, that participated in the "kill" of the monster German battleship Bismarck in the summer of 1941.

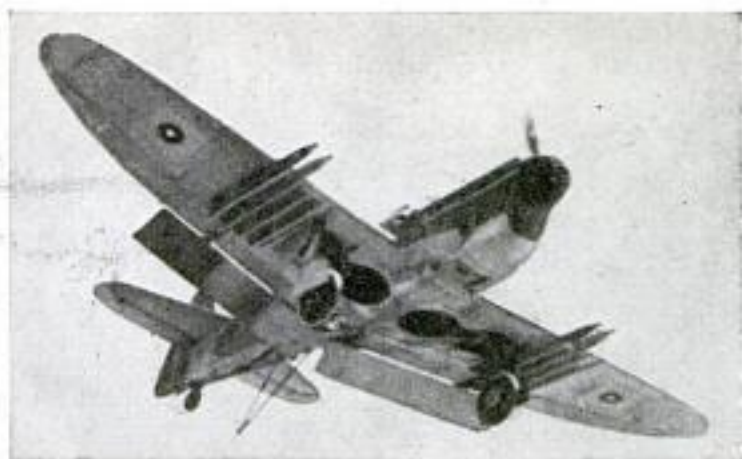
British aircraft carriers are slightly smaller than our Essex-type carriers. They weigh about 23,000 tons, are 750 feet long and carry approximately 70 planes. The Illustrious joined the British Fleet in 1940

The bow view above of HMS Indomitable was made from one of her planes. Below, British fleet train delivering supplies. Cruiser (center) is taking on fuel



and participated in the victory over the Italian Fleet at Taranto in November of that year. Planes from the Victorious helped to cripple the Bismarck in the North Sea. The Indomitable set out for Ceylon early in March 1942, and arrived just in time to beat off an attack by 100 Jap planes.

The crews aboard these ships are also veterans and come from all parts of the British Empire.



Rocket-carrying Firefly also has four cannon. It can fold wings back (below) to occupy small deck space



There are battleship officers from England, Wales and Scotland, flyers from Canada and South Africa, cruiser men from Australia and destroyer men from New Zealand. One ship even carries a lookout whose green turban wound tightly around his head marks him as a Sikh from India.

En route to battle, war correspondents and United States liaison officers were intrigued with the ancient seagoing custom of serving lime juice every morning at 11 and were delighted to discover the reason why British sailors are known the world over as "limeys."

Food was typically British: sausages, tea, toast and marmalade for breakfast; cold mutton and cheese for lunch; steak and kidney pie, mashed potatoes, brussel sprouts and currant tart for dinner. And of course there was always afternoon tea with bread, butter and raspberry jam.

During off-duty hours, officers played

shove half-penny, an old English pub game, or read copies of the London Illustrated. Enlisted men spun yarns, tossed darts or quoits, and played tombola, the only gambling game allowed in the British Navy.

But as the British task force approached its assigned target, a tenseness spread through the ships. Pilots of the combat air patrol kept a sharper lookout for any signs of Jap planes or ships; plotting room operations became more precise; "battle messing" was put into effect and men were served at their gun and lookout posts instead of in the mess hall.

The first operations against the Japs would be a test and every British sailor—from admiral to apprentice seaman—was aware of it. It was a test not only of courage and skill in battle, but an acid comparison between the "senior partner" and the veteran, battle-tough U. S. Pacific Fleet.



British Seafire is carrier-borne version of the famous Spitfire

There were those who had scoffed at the Royal Navy when it was first announced that it was on its way to the Pacific. These critics said: "The British fleet is too slow to operate with the fast carrier task forces of the U. S. Navy; their guns fire different caliber ammunition; they've had no experience refueling at sea or operating from bases for protracted lengths of time; their communications systems are different from what the Americans use; they aren't fa-

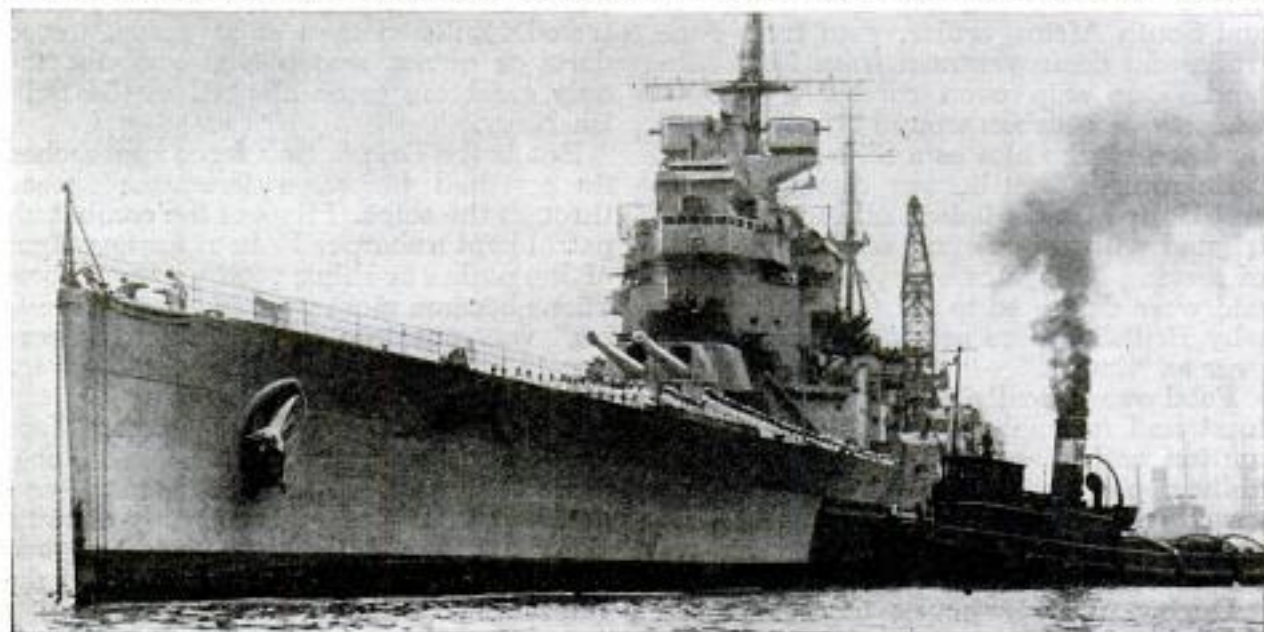
miliar with modern battle tactics evolved in the great war of distances in the Pacific."

What the critics didn't know was this: (1) The British ships were operating as a separate task force, (2) the British Pacific Fleet had organized its own fleet train to supply ammunition, fuel, food and other items, (3) the British had adopted United States fleet communications systems and had stationed U. S. Navy communications experts aboard so there would be no mix-ups, and (4) the British had adopted U. S. Pacific Fleet battle-tested formations.

The British Pacific Fleet task force had been assigned the job of neutralizing the Sakashima Islands—a handful of small islands about half way between Okinawa and Formosa. The Japs had a cluster of air fields there that could be used to stage planes up to Okinawa. If the British could keep this southern sea flank protected, it would allow the U. S. Pacific Fleet to give air cover to the Okinawa landing operations and to hit Kyushu fields to the north.

On March 26-27 the British task force threw its first strike at Sakashima. Fully loaded fighters, bombers and torpedo planes roared off the decks of the carriers to pound Jap aircraft and installations. The sudden appearance of the British ships, which had been a closely guarded secret, must have caught the Japs by surprise because there was little or no opposition. Approximately 20 Jap planes were destroyed on the ground, several small

HMS Howe, flagship of the British Pacific Fleet, carried 300 extra men to help man antiaircraft weapons



coastal vessels were damaged and the town of Ohama was left in flames. A second strike was made on March 31, again with little or no opposition.

The Japs struck back on Easter Sunday, April 1, about 7 in the morning while officers and men were finishing breakfast and preparing for church services. A green and brown Jap Zero came roaring out of the sun and machine-gun bullets hissed in the water alongside the flagship. At once antiaircraft guns began to clatter and the Zero was shot down in flames. Four others were shot down during the day without doing much damage to the task force. Each side had hit the other and had drawn blood—the British getting by far the best of the encounter.

British ships continued to throw air strikes at the Sakashima Islands, keeping the airfield torn up and planes inoperational so that they could not harass the landings on Okinawa. Royal Navy planes hit Sakashima four times in April and six times in May, shooting 31 planes out of the air and destroying or damaging 24 on the ground. Warehouses and barracks were bombed, small ships were sunk, locomotives and railroad tracks were blasted and troop-carrying trucks were strafed.

In such air strikes, the British used five types of first-line aircraft. Three were American-built—the trusty Avenger torpedo plane and the Hellcat and Corsair fighter-bombers, all of which have waged a lot of war against the Japs. Two were English-built—the Seafire fighter and the Firefly, a reconnaissance-fighter.

The Seafire is a carrier-borne version of the famous Spitfire which saved England in the German air attacks of 1941. It is powered by a Rolls Royce Merlin engine of 1470 horsepower, has two 20-millimeter cannon and four machine guns. Its wings fold at the tips as well as at the roots and its appearance has earned it the nickname of "praying mantis." It has an impressive combat record.

The Firefly is the most heavily armed fighter in service with the British Fleet, its armament consisting of four 20-millimeter cannon and rockets. During assaults or air strikes it can "blot out" antiaircraft positions and strong points. Equipped for high-speed reconnaissance, it carries aerial cameras. It has been used in strikes against German shipping off the coast of Norway and against the Japs in the Indian ocean.

In its Pacific baptism, the British fleet didn't rely upon planes alone. On May 4, heavy units of the task force, including battleships and cruisers, ran close inshore to bombard airfields at Hirara and Nobara on Miyako Island in the Sakashima group.

(Continued to page 156)



"Shine Stick" Invented by a skier who got the idea from applying hard wax to his skis, a four-inch "shine stick" gives a high polish to shoes. The stick fits in a pocket of a shine cloth which rolls into a compact outfit with a snap-fastened leather cover.

HONORABLE DISCHARGE EMBLEM



"THIS STANDS FOR HONORABLE SERVICE TO OUR COUNTRY"

Radio-Telephones for Autos Operate Like Walkie-Talkies



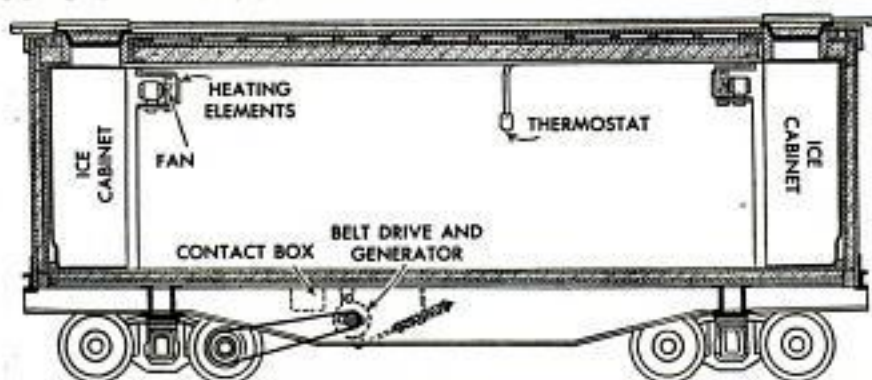
Automobile drivers could have the same two-way telephone service given homes with the mobile radio-telephone system planned by the American Telephone and Telegraph Company. The motorists would use a telephone exactly like the home handset, but operating on the walkie-talkie principle. It would be set normally for receiving and he would have to press a button to talk. His call would go by radio to special exchanges, where it would be transmitted over regular lines to the number called. Under present federal radio law, the user of the radiophone would have to obtain an operator's radio license, but the Federal Communications Commission has indicated a mere reading of the regulations at postoffices will be sufficient for users of such systems. Installations are planned for 13 cities when men and materials are available. A. T. & T. also is considering a commercial highway mobile service.

Just as easy to use as home phones will be the telephone planned for postwar drivers

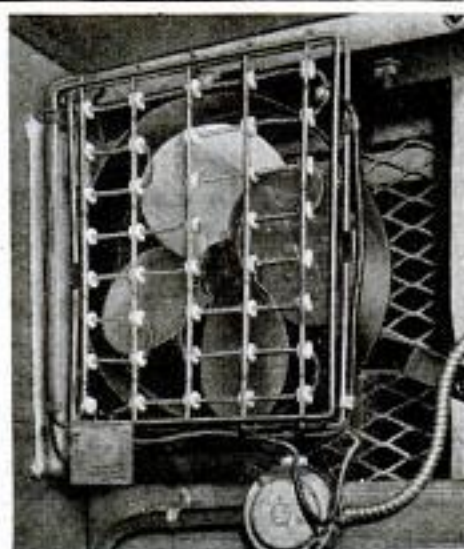
Electric Refrigerators on Rails Cut Perishable Food Losses

Constant temperature to reduce losses in transportation of perishable foods is provided by an electrical refrigeration system for railroad cars. Heart of the system are two heater and fan units, each a foot and a half square, placed at opposite corners of the car. For cooling, ice is placed in cabinets at each end of the car and cool air is kept circulating by the fan, which displaces 1000 cubic feet of air per minute. A single re-icing is required instead of the four or five necessary for conventional refrigerator cars on a four or five-day trip. The heating element replaces charcoal, coke or alcohol heaters during the winter and is rated at 2250 watts. Two heaters in a car are ample for any kind of weather. Power for the system is provided by a 110-volt, five-kilowatt generator riding on the axle assembly. Thermostatic controls which can't be changed by jarring keep the temperature steady.

☐ The 105-millimeter shell container can be readily adapted for temporary splints for broken arms, the U. S. Army Medical Department advises.



Heating elements of refrigeration system are in front of fan

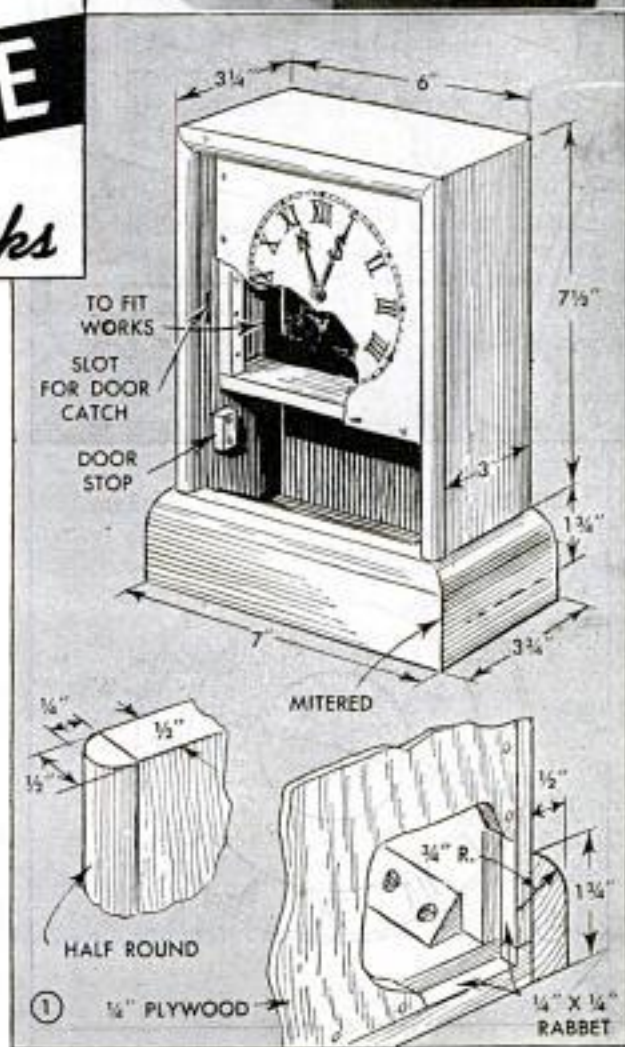


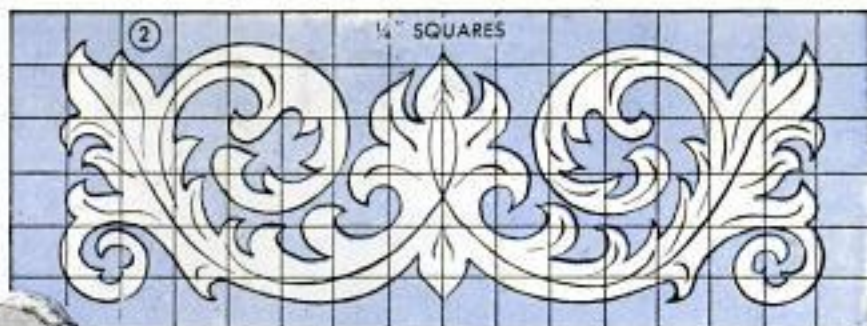
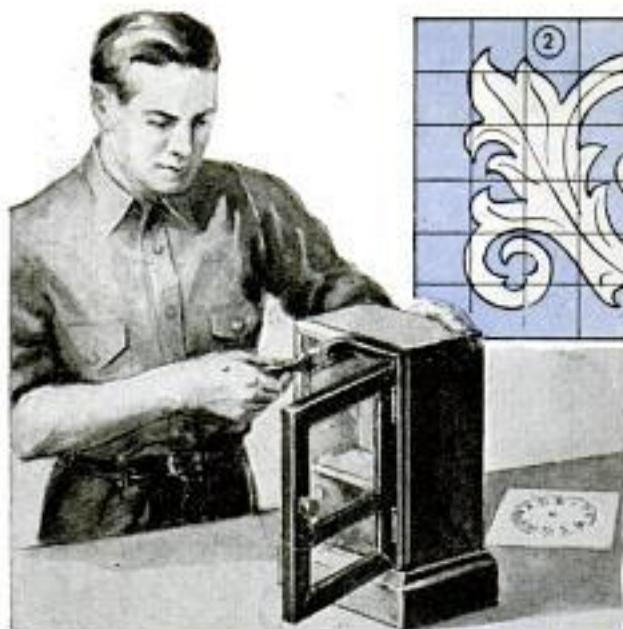


18th Century CLOCK CASE *has electric works*

YOU can adapt a small electric clock to harmonize with period furnishings by removing the works and putting them in a case like this one, which will look well on a mantelpiece or table. Or the works of an alarm clock may be used if desired. Wood for the case should match other furnishings in the room where it is to be used. For instance, in a paneled room, such as a library, pine is a good choice. If the clock is to be used in the living room, hardwood is preferable.

The case is assembled as shown in Fig. 1. Notice that the sides are butted against the bottom, where they are held by screws and a triangular cleat. Top edges of the sides, and ends of the top piece, however, should be mitered and glued, then secured by a similar cleat. All pieces are rabbeted so that the back panel, of $\frac{1}{4}$ -in. plywood, will seat flush with the edges. On the bottom and top pieces, the rabbet is routed out to leave the ends intact, the small remaining fillet being chiseled square, so that there



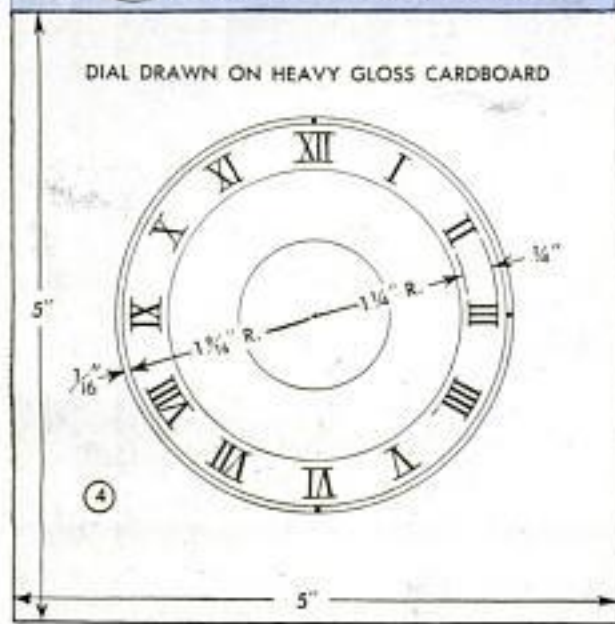
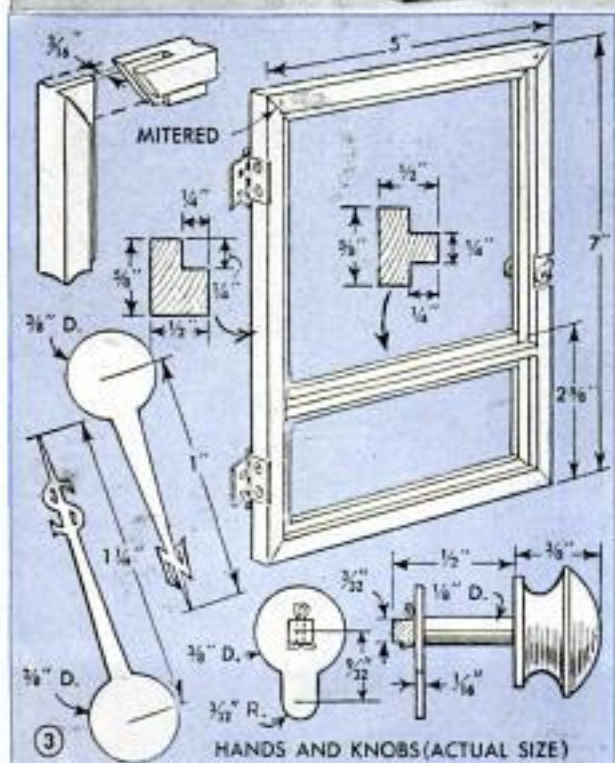


will be no gap at the corners after the back panel is screwed in place. Then wide molding is nailed along the sides and front to cover the joints, and half-round molding is bradded on the front edges, after which the nail holes are filled. As a frame for the works, cleats are nailed in the case, and a door stop is placed in line with and below the frame to space a door.

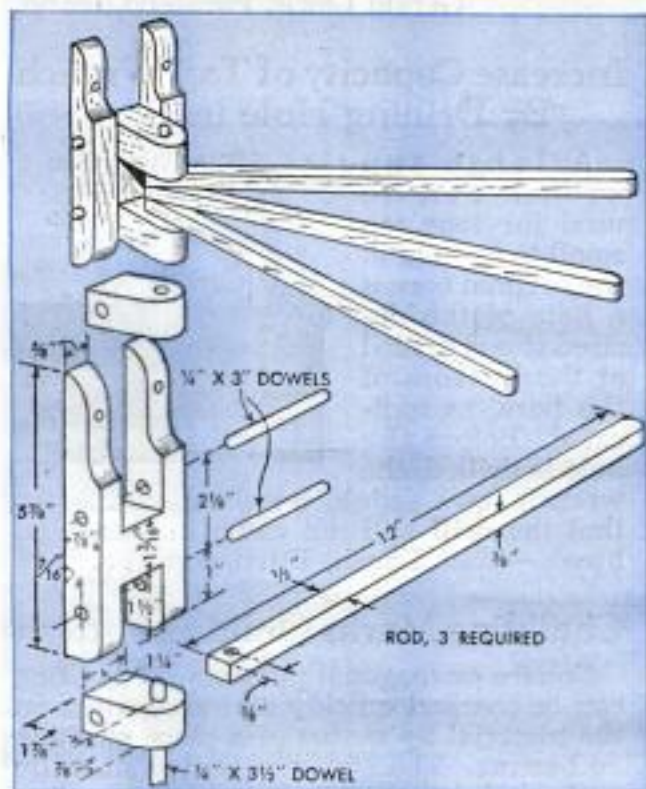
The door frame is shown in Fig. 3. Members are rabbeted as indicated in the sectional details to take pieces of glass, and the corners are mitered and joined by tongues and grooves as shown in the upper detail. Then a hole is drilled for a knob shaft, and the edge of the frame is recessed for a catch, which can be cut from thin sheet metal to the dimensions shown in the lower right-hand details. The shaft is a short length of metal rod, one end of which is filed to fit a square hole in the catch and drilled to take a cotter pin. A wooden knob then is forced over the rod. The door frame is mounted in the case by hinges and a slot is sawed to engage the catch, Fig. 1.

You may want to remove the face and hands of your clock and substitute others more in harmony with the period design of the case. The hands shown in the left-hand corner of Fig. 3 are appropriate, and a suitable dial, with Roman numerals, can be made as shown in Fig. 4. It is inked onto a square of stiff, glossy cardboard and antiqued by staining it with weak coffee, which gives it a slightly yellow cast. The hands are sawed from brass or other light sheet metal.

Now pieces of glass are installed in the door frame and held in place by strips of molding. The upper piece can be left clear, or flower designs can be painted in the corners to harmonize with the lower panel, on which a scrolled design should be applied in gold-bronze paint. Any ornate pattern will be appropriate for the lower panel, the one shown in Fig. 2 being merely a suggestion. It can be drawn on the rear surface of the glass with a stub pen, which will serve better than a brush for tracing the fine lines. When the gold paint is thoroughly dry, the entire surface is coated with flat black paint, after which a coat of varnish is applied to protect the paint.



Wooden Towel Rack Folds Flat Against Wall



With three swinging arms, this easy-to-make rack provides plenty of room for hanging towels, and when not in use the arms fold out of the way against a wall. It consists of an H-shaped back piece in which two brackets are held by short lengths of dowel to support the arms. Front edges of the legs, or upright members of the back piece, are jigsawed to a curve as

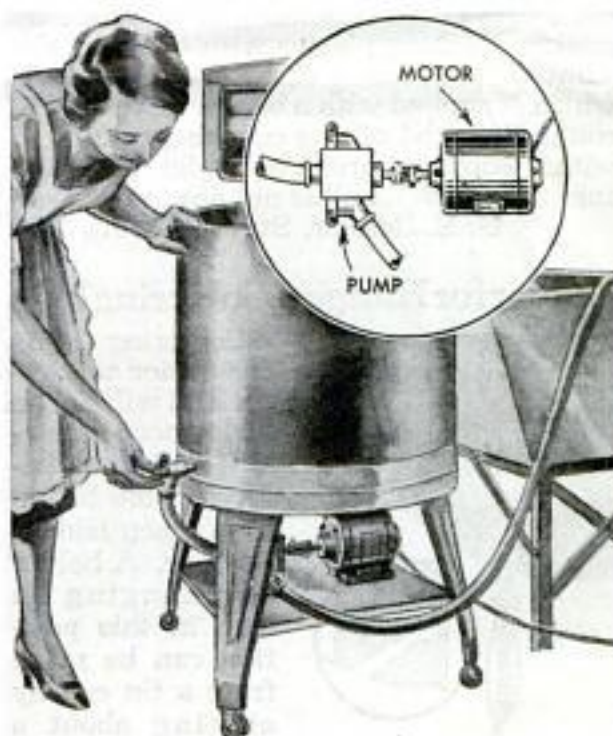
shown. Holes are drilled for screws which attach the rack to a wall. Before the pieces are assembled, they should be carefully sanded to remove splinters, which may catch in cloths hung on the arms. The rack can be painted a bright color to harmonize with kitchen accessories or it can be enameled white to match bathroom fixtures.

Lewis Torrent, Muskegon, Mich.

Water Emptied Quickly From Washing Machine by Pump

Washing machines that have only a drain plug in the tub for emptying water can be equipped with a small motor and centrifugal pump which will withdraw the water quickly and empty it into an adjacent sink. Such an installation will be especially helpful in cases where there is no floor drain into which the water can be emptied. Only a small motor of $\frac{1}{20}$ or $\frac{1}{25}$ hp. is needed. This is mounted on a platform bolted to the washing machine legs, and the pump is coupled to it by a length of flexible tubing such as is used for auto service station air hoses. The intake side of the pump is connected by a piece of rubber hose to the tub outlet, an ordinary sink-faucet connector being used; a longer piece of hose fitted to the pump outlet carries the water away.—James B. Scott, Springfield, Mass.

☛ When washing walls with cleaning powder and soapy water, add enough flour to make a paste so that the mixture will cling to the wall and dissolve the dirt.



Apron to Hold Toilet Articles Is Handy When Traveling

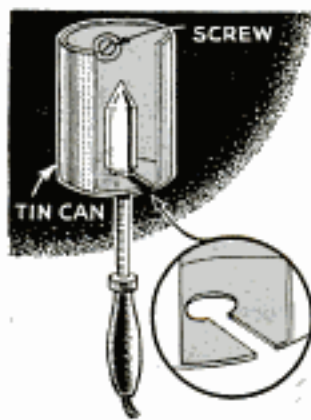


Ladies who travel considerably will find that an apron with several pockets can be used as a handy kit for holding toilet articles such as combs, brushes, face powder, hairpins and small mirrors. An ordinary apron can be adapted to this purpose by sewing the pockets lengthwise to form several compartments of various sizes to accommodate these items. When not in use, the apron can be rolled up to enclose the toilet articles and stored with other luggage.—M. L. Piatt, Alameda, Cal.

Mixture for Finishing Cabinets Made From Plaster and Paint

A paint that is especially effective for radio and other cabinets can be made by mixing patching plaster with ordinary flat paint to produce a fairly thick mixture, which is applied with a brush. A variety of rough-textured effects can be worked out with a stippling brush or knife. The mixture covers well and is not apt to flake off.
G. E. Ressler, Stevens Point, Wis.

Holder for Hanging Soldering Iron



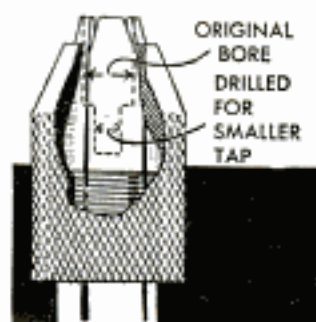
Soldering irons are easier to handle and will heat a little more quickly if hung vertically with the bit up than when laid on the side. A holder for hanging an iron in this position can be made from a tin can by cutting about a

third of its side away and notching the bottom to take the shaft, as shown.

Gerald Lewis, Pocatello, Idaho.

Increase Capacity of Tap Wrench By Drilling Hole in Bore

A large tap wrench can be used for taps too small to be held in the original bore if a hole of the desired size is drilled at the bottom of the bore, as indicated. Before the hole is drilled, the wrench jaws should be closed tightly so that the drill will not catch in them and break.—Matt Laush, Pittsburgh, Pa.



Chalkline Marks Quilting Pattern

Square or diagonal patterns for quilting can be marked quickly and accurately on the material by means of a piece of chalk and string. The string is coated liberally with chalk, then is held taut in position over the material and snapped against the cloth. This transfers a chalk line to the cloth and the mark will remain until it is rubbed off by brushing.

Wesley V. Korman, Mitchell, Neb.

Flag Hung Indoors Is Draped Over Wire Frame



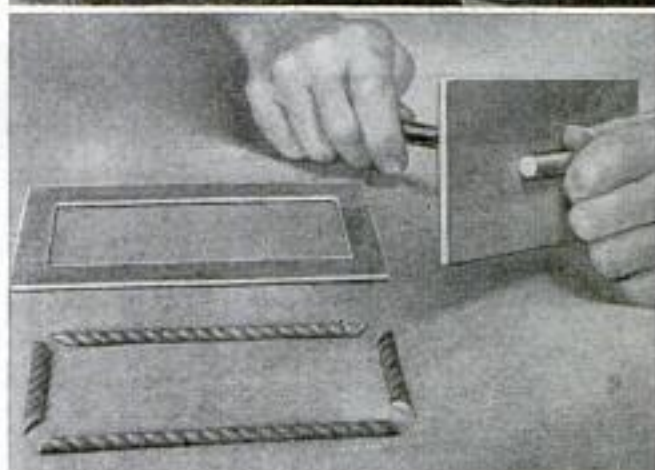
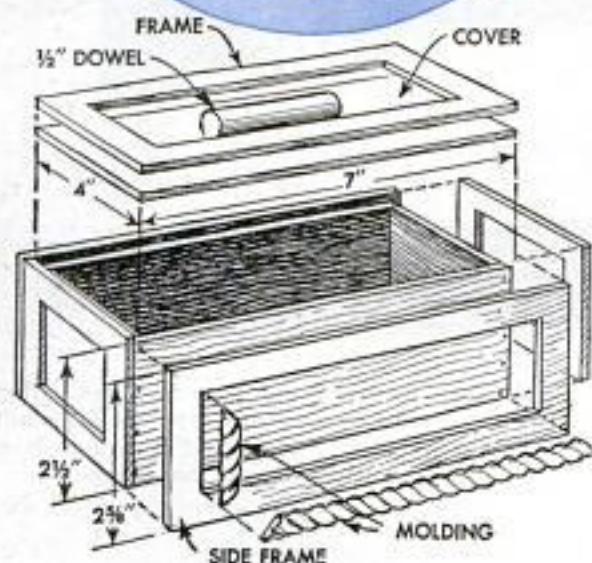
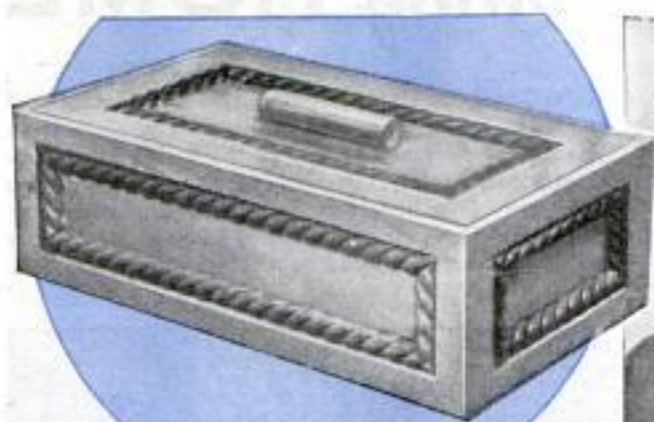
Flags hung on standards for indoor display can be draped gracefully if their folds are supported on two wire frames. These are cut from two coat hangers as indicated. Eyes are formed in the ends of the wire to take wood screws which are driven into the flagstaff.

The frames should be placed on the staff so that their tips extend down to the top of the lowest stripe.

Help Yourself by Helping Others

Many readers want to know just how you solved some of those everyday problems in your home, work or hobby because they're having the same troubles. So why not send us a sketch, photo, or both, and brief descriptions? We pay promptly for all articles accepted. Address Homecraft Editor, Popular Mechanics, 200 E. Ontario, Chicago 11.

New "Face" Overlaid on Old Box for Chessmen

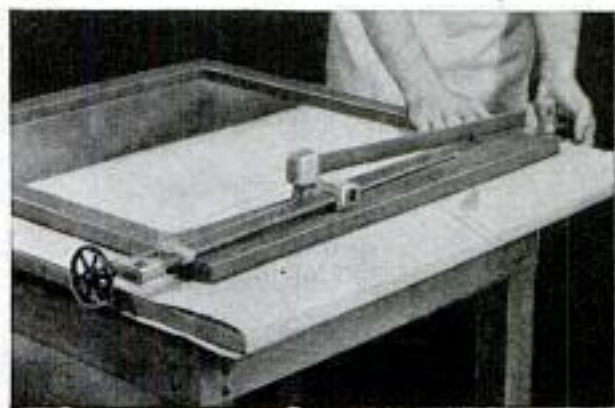


You can give your chessman box a rich, hand-carved appearance by overlaying sides and top with frames of thin wood in which strips of decorative molding are glued. Or you can make a new one by using a box of suitable size, such as a cigar box from which the lettering has been sanded. Cut the frames to fit the ends, sides and top of the box, making them wide enough to project about $\frac{1}{8}$ to $\frac{1}{4}$ in. above the top edges of the box. When glued in place the projecting edges will form rab-

bets into which the cover fits. Then miter pieces of molding and glue them along the inner edges of the frames. For a handle, fasten a short length of dowel to the cover with small screws driven from the underside. Finish the completed box with a coat of shellac diluted with alcohol; when dry, rub with fine steel wool and wax.—Chas. and Bertram Brownold, Woodmere, N. Y.

Short Bar Clamps Coupled Together to Span Wide Work

When gluing work that is too wide for your clamps, you can couple them together as shown, to make one clamp long enough to span the work. Another useful method of doing the job is to bolt two short clamps end to end after removing one of the tail-pieces and reversing the other. Or, instead of using two short clamps for this setup, one long clamp can be sawed off to shorten it to any convenient working length for ordinary use, and the piece cut off can be saved for rebolting to the clamp when needed for occasional long work.

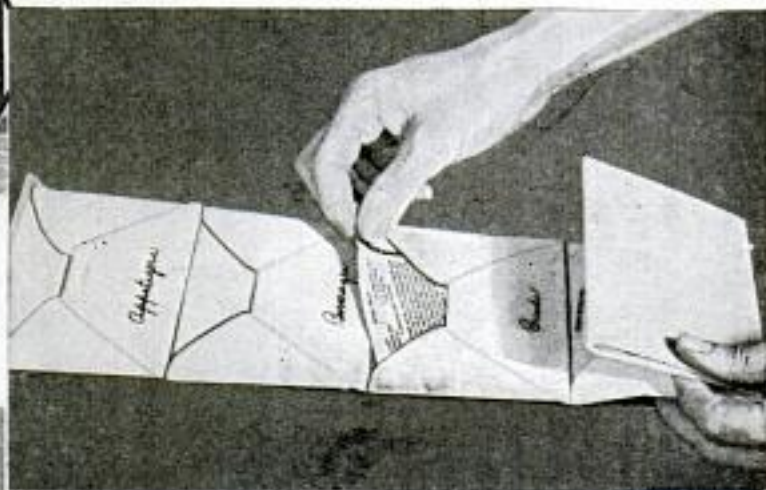


Solving HOME

Left: Spools of thread always will be at hand and easy to select if set on nails that project from cleats, which are screwed to the inside of a cabinet door. Below: Several envelopes of uniform size provide a handy file for recipes or other clippings cut from magazines and newspapers, if the flap of one is glued to the front of another



An old mesh handbag is an excellent substitute for a metal pan cleaner or pot scourer as shown below. It will last a long time and can be cleaned easily

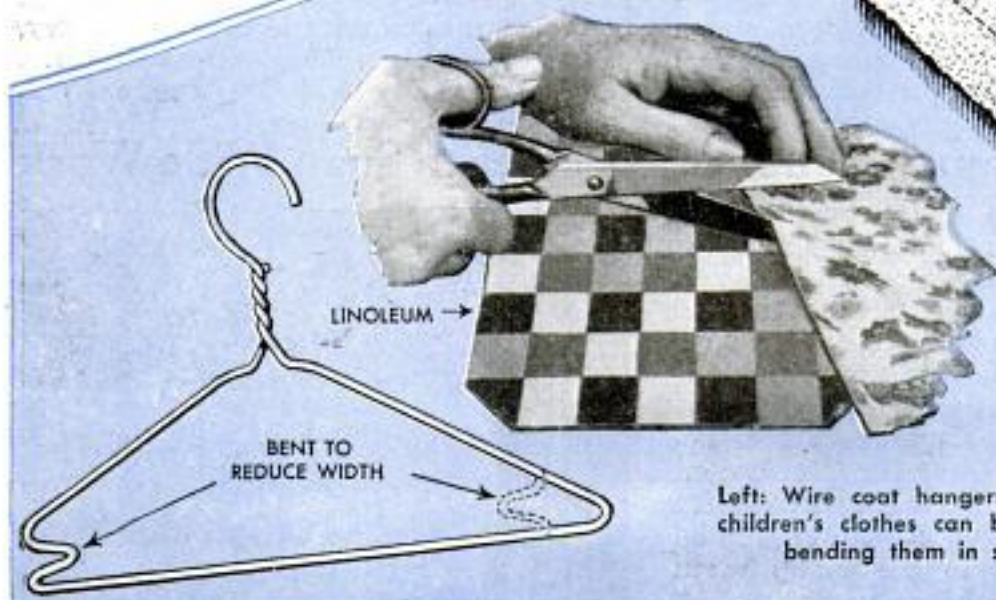


A self-soaping sponge can be made by inserting a cake of soap in a sponge that has been slit part way through the center. This also is a good method of using soap scraps

A square of linoleum is a handy item for a sewing room. Placed on a table it will protect the top surface when pinning and cutting material

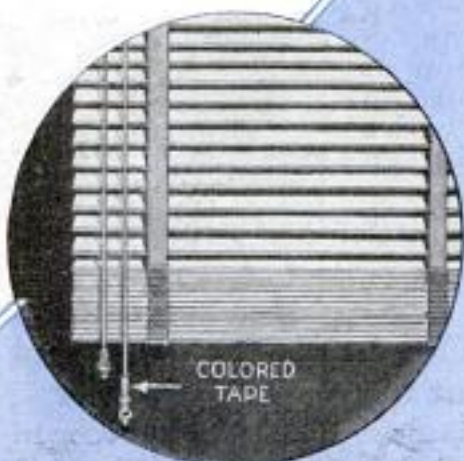


Left: Wire coat hangers that are too wide for children's clothes can be reduced in width by bending them in slightly at the ends



PROBLEMS

Right: Use of a self-draining shut-off valve in a water line inside the basement to prevent a sill cock from freezing will be unnecessary if you install a single valve as shown. The pipe extending through the building wall drains each time the valve is shut off. An ordinary valve can be used if the stem is lengthened



Left: By wrapping a small strip of colored tape around one of the pull cords of your Venetian blinds, you will be able to tell at a glance which cord to pull to tilt the slats forward



Storm windows can be hung without turn buttons by driving screws in the top edge and cutting off the heads. These fit holes drilled in the frames as shown above. Screen-door hooks at the bottom will hold the windows tight in the frame. Below: Lemons won't shrink or dry out if they are placed in a jar with a tight-fitting screw lid and stored in a refrigerator



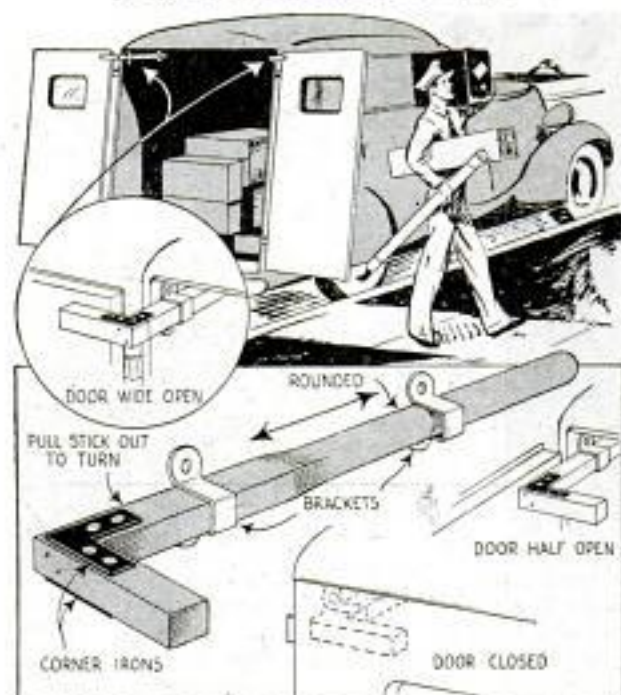
You can carry needles safely in a small bottle. Stick them in the cork as above and add a wad of oiled cotton in the bottom to prevent rust



A shoe-box cover in the bottom of a paper shopping bag will protect the bottom from spilled liquids and keep the bag upright when it is placed on a floor or counter



Delivery-Truck Doors Held Open By Retractable Arms



Delivery-truck doors can be kept open when the truck is standing on a slope, or when a strong wind is blowing, by wooden arms that are held in brackets screwed to the inside of the truck panels near the roof. The arms can be lengths of 2 by 4-in. stock, or similar material, one end of each piece being rounded for about half its length. At the other end a short piece of the same material is nailed or screwed at right angles, the joint being reinforced by corner irons. By pulling the arms part way out so that the squared sides are free of the brackets, the arms can be rotated so that the right-angle projections will hold the doors wide open, as shown in the circular inset. To close the doors, the arms are turned so the projecting pieces face inward.

Opie Read, Jr., Chicago.

Ornamental Sheet-Metal Figures Formed With Shears and Pliers

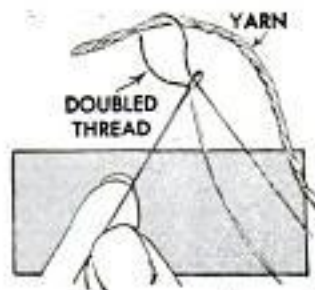


Thin sheet metal is all you need to form small, decorative, metal animals such as the dachshund shown, which can be made any size by enlarging the pattern. After cutting, the edges are filed smooth, the body is formed by bending along the center line and the ears and head are

shaped by hand or with pliers. When the figure has been polished, a thin coat of transparent lacquer may be applied to prevent tarnishing.

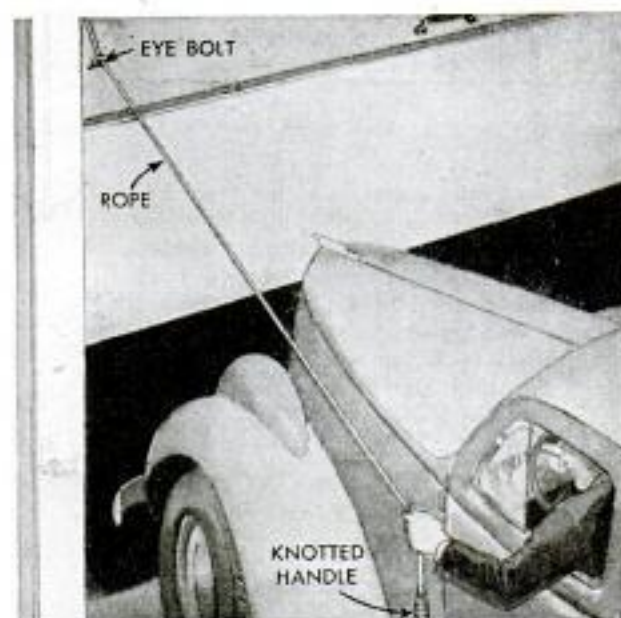
An Easy Way to Thread Yarn Through a Needle

The next time you have to thread yarn through a needle, try this simple method. First, insert the doubled end of a piece of thread through the needle and then insert the yarn end through the resulting loop of thread. You can now pull the thread and yarn through the needle with little trouble.—H. A. Severs, Dayton, O.



Closing Overhead Garage Doors Without Getting Out of Car

I have a three-section, overhead door in my garage that I can close as the car is backed out, thus making it unnecessary to get out of the car. To accomplish this, I fastened a clothesline rope to the upper section and ran it through a small eye bolt in the center section. When backing the



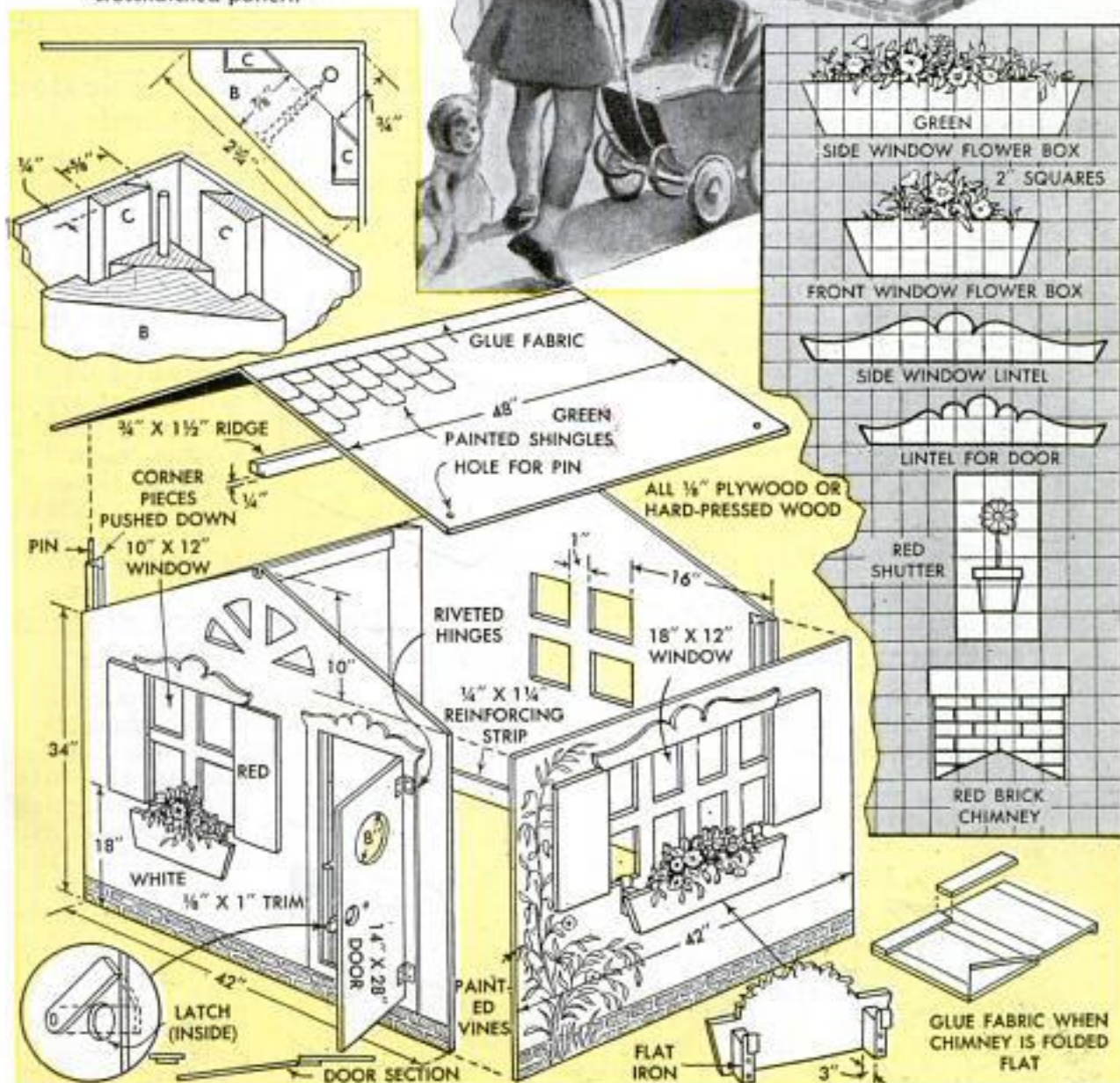
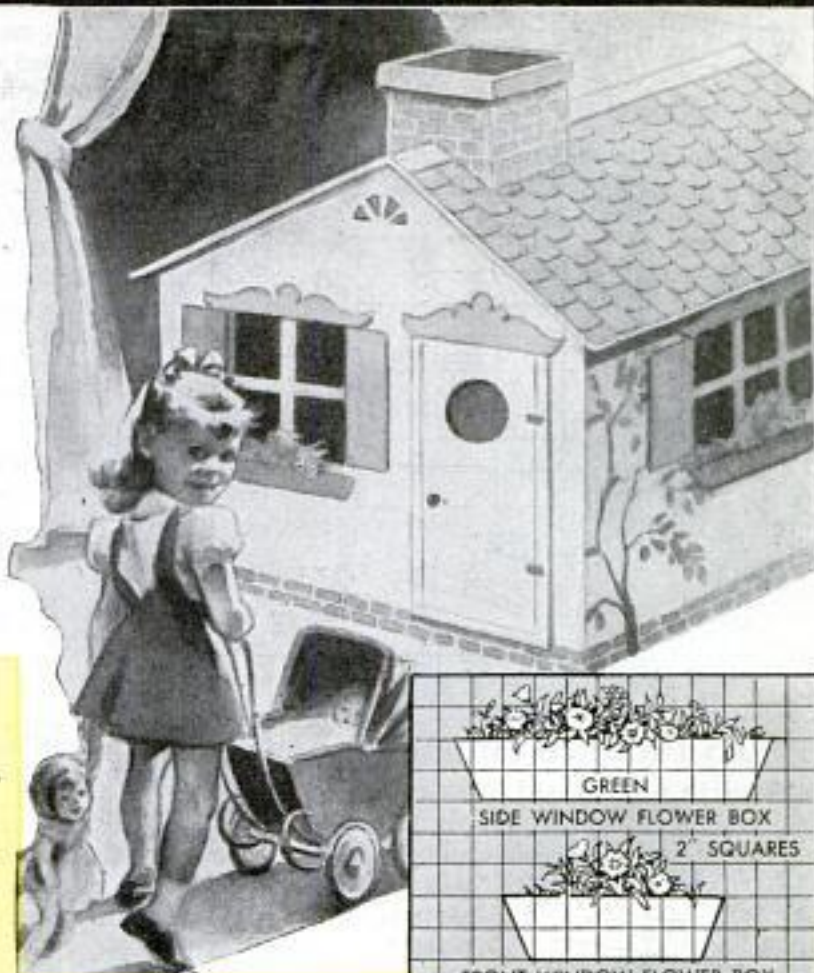
car out of the garage, I grasp the rope, which hangs at the left side of the doorway, and hold it. This pulls the door down. I hold on until the rope becomes taut after the door has closed, then release the rope and it snaps back out of the way.

Gerard E. Langelier, Woodbridge, Conn.

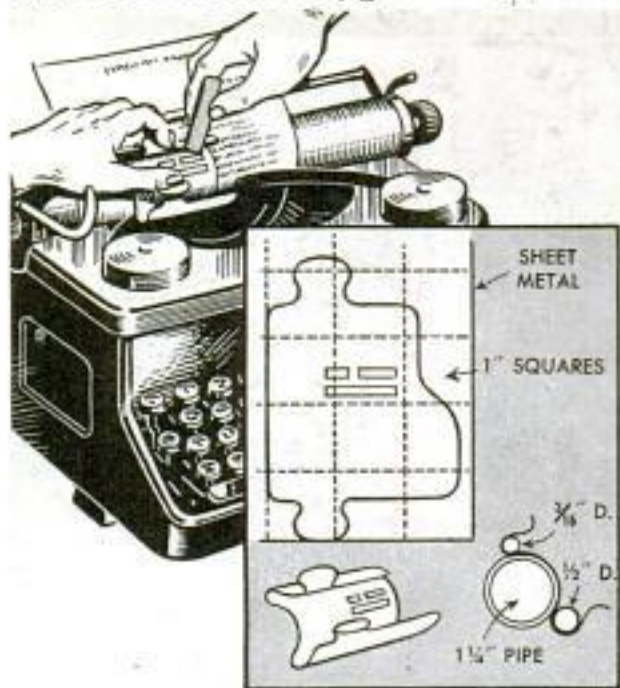
ⓄAn excess amount of oil on an auto starter, generator, distributor or other electrical apparatus may cause trouble.

Build this Knock-down PLAYHOUSE

This trim little playhouse can be set up in 5 min. and when taken down may be stored in a small space such as a closet. The walls are assembled as shown in the upper left-hand detail. A triangular cornerpiece, to which part B is screwed, slides behind strips C, which are glued and nailed to the walls. The roof is supported by a ridge pole and held in place by pins projecting from the ends of the corner pieces. The chimney can be made of the same material as the walls. Two sides are notched to fit the roof angle and glued together. The door is held by a latch which is lifted through a fingerhole in the door. Gaily colored flowers are painted on window boxes and shutters, which are shown in the crosshatched pattern



Sheet-Metal Typewriter Shield Catches Eraser Particles



Typewriters often become clogged so that they need a general overhauling merely because eraser particles fall down onto the key levers where they become wedged and spoil the action. If you do not pull the carriage to one side when erasing so that the particles fall outside the machine, you can still avoid much of this trouble by using an eraser shield to catch them. It is cut from a $4\frac{1}{4}$ by $2\frac{5}{8}$ -in. sheet of thin metal to the shape indicated, and then $\frac{3}{16}$ -in. slots are cut out to provide openings through which typing can be erased. The shield then is formed over a length of $1\frac{1}{4}$ -in. pipe, the diameter of which corresponds to that of the platens on most standard machines. A trough is formed by bending the lower edge around a $\frac{1}{2}$ -in. dowel and the upper edge is bent around a $\frac{3}{16}$ -in. dowel as indicated in the lower detail. Finger tabs are provided for gripping the shield firmly when using it.

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

Stencil Cut Through Cellophane To Produce Smooth Lines

Smooth, unblurred lines are made easily in cutting a mimeograph stencil with a stylus if a sheet of Cellophane first is placed over the stencil.



The Cellophane provides a smooth writing surface, insures against tearing the stencil and prevents the stylus from digging into or cutting entirely through the stencil and ruining it.—H. Perlman, Brooklyn, N. Y.

Wooden Strip Tacked in File Box Prevents Bending Cards

If the cover of a file box strikes the front cards and bends them over as it is closed, the cards can be protected by a strip of wood tacked to the inside of the front of the box.



A $\frac{1}{4}$ by $\frac{3}{4}$ -in. strip somewhat shorter than the length of the box will hold the cards away from the front of the box so that when the cover is closed it will not contact them.—L. Chirey, Milwaukee, Wis.

Compass Point Scores Guide Line For Cutting Balsa Strips

Straight, narrow strips of balsa can be cut accurately with a sharp knife if the wood is first grooved with the pointed end of a compass.



of a compass, which is held against a ruler and drawn across the wood at the proper line. This makes a deep groove which is easily followed and tends to keep the knife in line when cutting the wood.—W. Beck, Mt. Clemens, Mich.

Holes in Drawing Board Plugged With Round Toothpicks

You can renew the surface of your drawing board if it is pitted with thumbtack holes by dipping the pointed ends of round toothpicks into glue and forcing them firmly into holes.



After the glue has dried, break the toothpicks off, remove any jagged ends with a knife, and finish the job by sanding.—Richard Salzer, Baldwin, N. Y.

Marble "Croquet" Is Interesting Indoor Game



Children and adults alike will enjoy this novel marble game, which can be played on any flat surface such as a floor or table top. The game is somewhat like croquet, the object being to shoot a marble through eight cardboard wickets, the winner being the one who accomplishes this in the least number of plays. The wickets are pieces of cardboard hinged together with tape as indicated. Each wicket has a centralized hole at the lower side, triangular pieces of cardboard

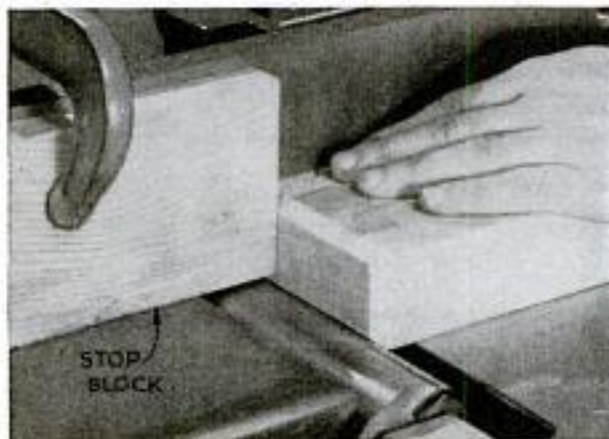
being used to keep the marbles from lodging in the corners where the wickets are hinged together. Each piece is set in at a slight angle and is hinged to one of the wickets, a tab fitting into a slot in the opposite wicket to lock the piece in place and help make the wicket assembly rigid. When not in use, the assembly folds flat for storage. Rules of the game are optional. One shot in turn is the prevailing rule. If an opponent's play causes your marble to pass through a hole, your position is advanced or penalized accordingly, and your next play is resumed from that point.

R. L. Ralston, Jackson, Mich.

Ends of Posts Chamfered Uniformly by Passing Them Over Jointer

Rapid, uniform chamfering of posts can be done on a jointer. A board clamped to the fence stops the work at the same point

on each pass. The chamfer produced by this method is not a perfectly straight cut, but is slightly concave, the curvature matching the diameter of the cutter head. On most work, however, this slight curvature is of no consequence.



Paraffin Protects Felt Hat From Perspiration Stain

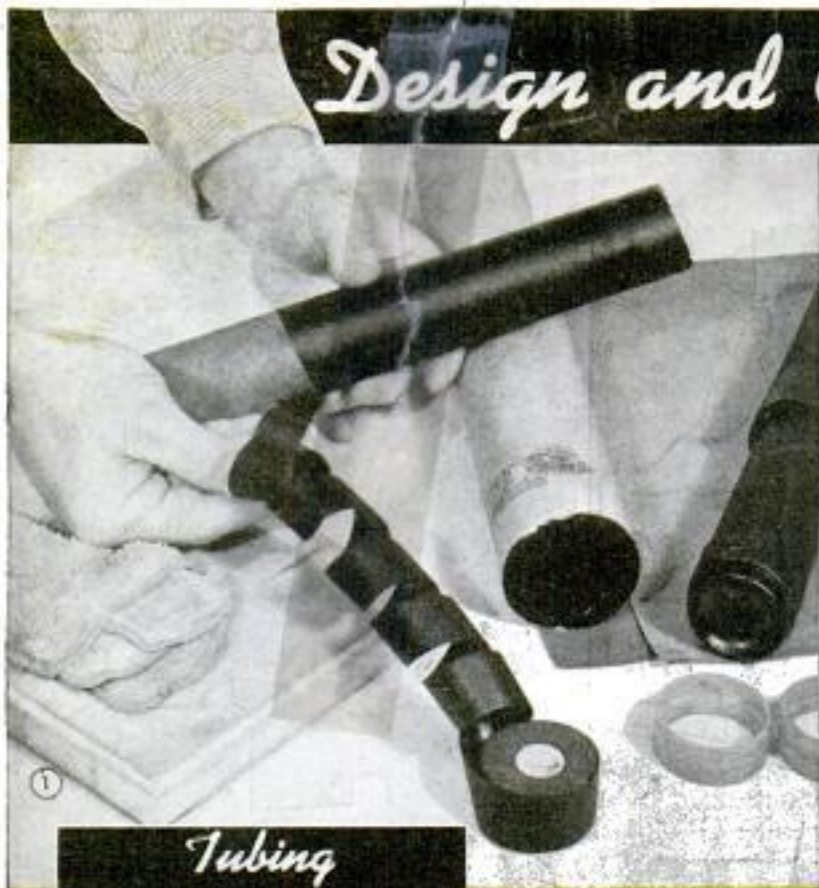
To prevent perspiration from soiling a felt hat, rub the sweat band with a piece of paraffin, being careful to cover thoroughly the lower edge of the band where it is sewed to the felt. This gives the hat band an invisible waterproof coating through which perspiration cannot penetrate.—E. L. Reynolds, Bronxville, N. Y.

Design and Construction

PART I

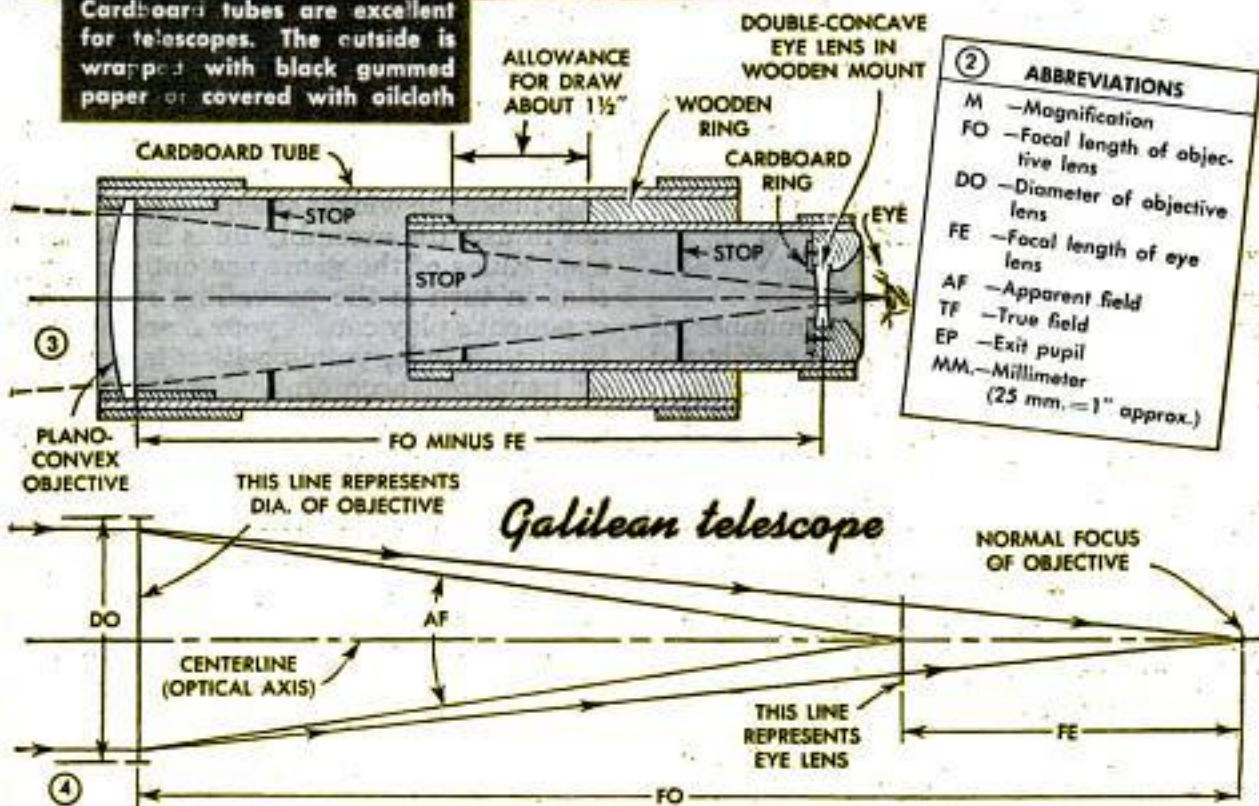
MAKING distant objects appear close by looking through pieces of curved glass is always thrilling, but the enjoyment is increased when you peer through a telescope that you yourself have made. The cost of making a telescope is especially low now because war-surplus stocks of perfect and chipped-edge lenses and prisms are available at low prices. You can make a good scope for as little as one dollar, and a really good terrestrial telescope for only three to five dollars for lenses.

Kinds of telescopes: Telescopes are divided into two



Tubing

Cardboard tubes are excellent for telescopes. The outside is wrapped with black gummed paper or covered with oilcloth



ABBREVIATIONS	
M	—Magnification
FO	—Focal length of objective lens
DO	—Diameter of objective lens
FE	—Focal length of eye lens
AF	—Apparent field
TF	—True field
EP	—Exit pupil
MM.	—Millimeter (25 mm. = 1" approx.)

Galilean telescope

NORMAL VALUES

- M—4 to 7X, top limit about 12X
- DO and FO—Value of f/4 to f/6
- FO—5" to 10" (127 to 254 mm.)
- DO—1" to 2 1/2" (25 to 64 mm.)
- AF—About 16° TF—2° to 4°
- FE—1" to 2" (25 to 50 mm.)
- DIA. OF EYE LENS—Any small size—1/8" to 1/4" dia.
- EP—Galilean telescope has no exit pupil

CALCULATIONS

- $M = FO \div FE$
- AF—Measure angle on layout
- $TF = AF \div M$
- $f/\text{number of objective} = FO \div DO$
- $FE = FO \div \text{Desired } M$
- Field in yards at 1000 yards = $\frac{DO \times 1000}{FO \times M}$

of TELESCOPES

By Sam Brown

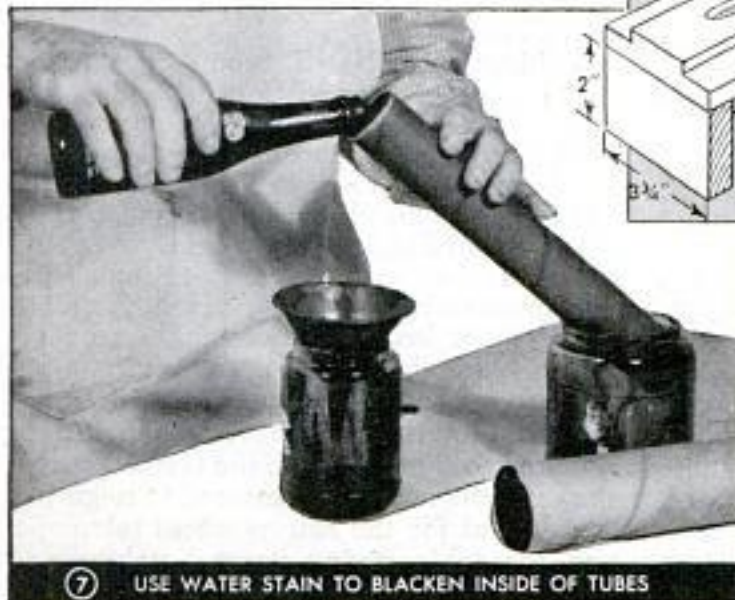
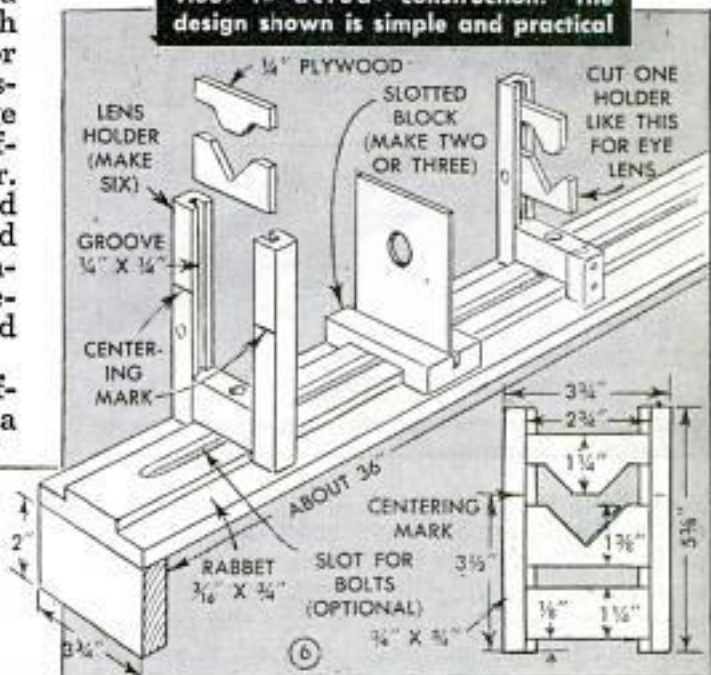


main classes, reflectors and refractors. The reflector uses a mirror to pick up the image while the refractor uses a lens. This article deals exclusively with the refractor type. A refractor used for viewing heavenly bodies is called an astronomical telescope. It shows the image upside down, but this makes little difference when you are looking at a star. Telescopes for viewing objects on land show an upright image and are called terrestrial telescopes. These include various types, such as the Galilean, rifle-scope, spotting scope, monocular and just plain "telescope" or spy glass.

Galilean telescope: This scope is different from all others in that it has a

Optical bench

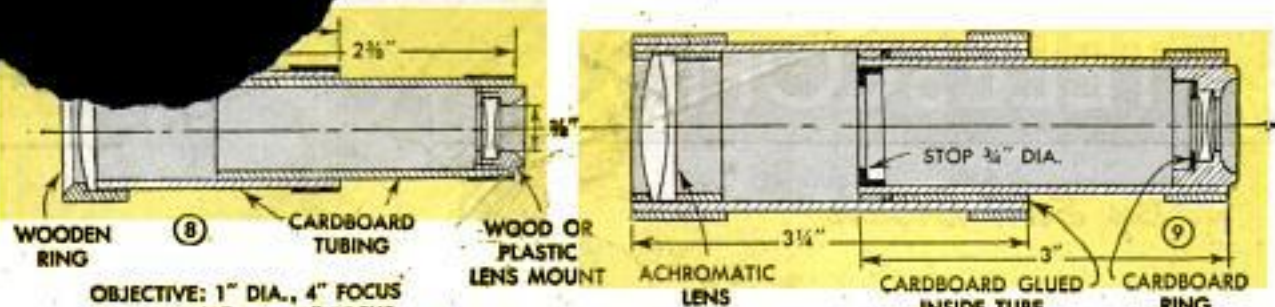
Some kind of bench is almost a necessity for checking lens systems previous to actual construction. The design shown is simple and practical



7 USE WATER STAIN TO BLACKEN INSIDE OF TUBES

negative lens for an eyepiece. Good features are simple construction, a clear, crisp field and an upright image. The one poor feature is that the field of view is small and decreases rapidly with increases in magnification. Hence, as made today, Galilean telescopes usually are confined to 6X or less.

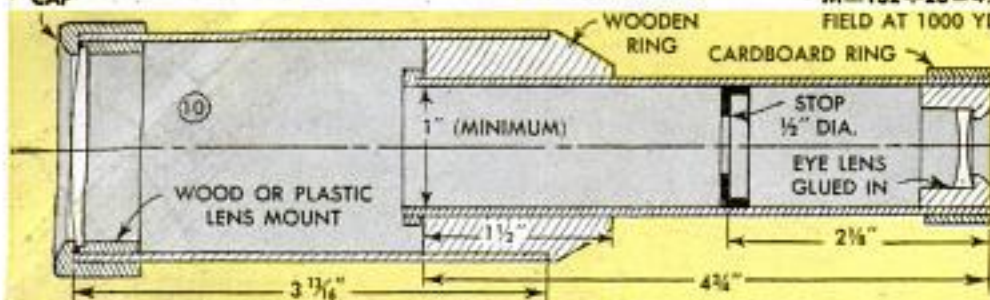
Figs. 3 and 4 show the general construction and layout. Before



OBJECTIVE: 1" DIA., 4" FOCUS
 EYE LENS: 1/2" DIA., 1" FOCUS
 $M=4 \div 1=4X$
 FIELD AT 1000 YDS., 60 yds.

Galilean telescopes (ONE-HALF SIZE)

OBJECTIVE: 32 mm. dia., 132 mm. focus
 EYE LENS: 17 mm. dia., 28 mm. focus
 $M=132 \div 28=4\frac{1}{2}X$
 FIELD AT 1000 YDS., 54 yds.



OBJECTIVE: 42 mm. dia.
 201 mm. focus
 EYE LENS: 17 mm. dia.
 28 mm. focus
 $M=201 \div 28=7X$
 FIELD AT
 1000 YDS., 29 yds.

Typical galilean telescopes

These designs show general construction. An achromatic objective lens is always an improvement. The scopes here are drawn as focused on an object at 18 ft. distance



11 GLARE-STOPS PREVENT INTERNAL REFLECTIONS

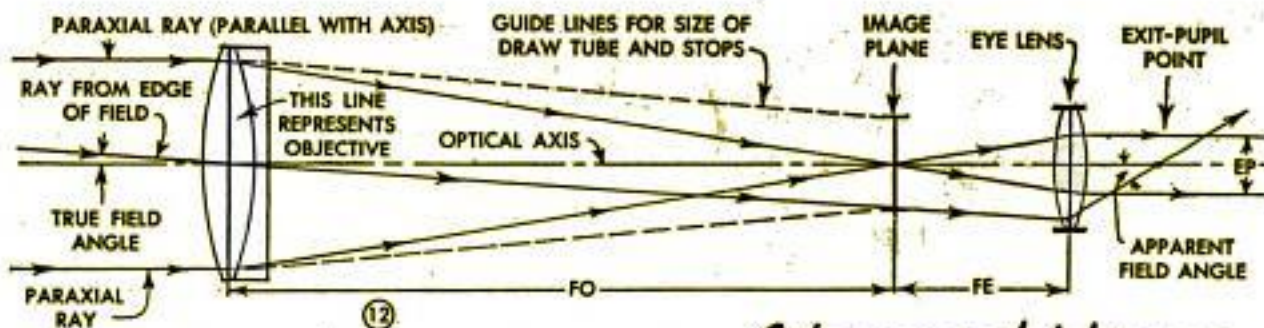
you study this, learn the abbreviations given in Fig. 2, and always read the symbols as full words. It is best to use normal values as given in Fig. 4 when designing your scope, particularly where the f /value of the objective lens is concerned. You will understand quickly that to get a large field with a Galilean telescope you would need a large-diameter objective. Specific instruments are diagrammed in Figs. 8, 9 and 10. These are shown set up at about an 18-ft. focus, whereas Fig. 4 shows the lens spacing at infinity. Focused at infinity means focused for a distant object, usually 300 to 400 yards away. Your telescope is at its shortest draw when focused at infinity. You will have to allow an extra half-inch or so on the draw so that you can focus on near objects. The whole range of focusing

from near to far objects is about 1/2 in. with the average objective, as most of the draw-tube travel is simply a matter of making the telescope as compact as possible. Glare stops prevent internal reflections. You can determine the diameter of these at any point from the AF lines, Fig. 4. One glare stop is enough for the Galilean. This can be made from cardboard with tabs turned over as in Fig. 11, pushed inside the draw-tube and fastened with a dab of glue.

Optical bench: An optical bench is handy for checking any lens system and almost a "must" when you get into five and six-lens systems. The design shown in Figs. 5 and 6 is simple and satisfactory. If you want to make a simpler setup, use a plain board and mount the lenses with modeling clay or wax on small blocks of wood. Test setups can be made indoors at about 18 ft., focusing on printed matter. Have a good light on the copy, but avoid light on the optical bench.

Tubeing: Cardboard tubing is satisfactory for all telescopes. Select sturdy tubes of good wall thickness. Use a black water stain or flat black lacquer to blacken the inside of the tubes as in Fig. 7. Cover the outside with black gummed tape, spiral-wound as in Fig. 1. Oilcloth, canvas or imitation leather in plain wrap-around style also makes a neat outer covering. A metallic-silver or bronze paper makes an ideal covering for the draw tube.

Astronomical telescope: The astronomical is different from the Galilean in that it has a real image inside the telescope, and the eye lens is positive instead of negative. The layout for the astronomical telescope, and the table giving normal values and simple calculations, are shown in Fig. 12.



NORMAL VALUES

DO: $1\frac{1}{2}$ " and up. $f/10$ to $f/15$
 FO: 20" and up
 FO: 10 to 15 times DO
 M: 15 to 60 times DO
 EP: $\frac{1}{4}$ " to $\frac{1}{8}$ "
 FE: $\frac{1}{4}$ " to 1"
 AF: 40°
 TF: $\frac{1}{2}^\circ$ to 2°

CALCULATIONS

$M = FO \div FE$
 $M = DO \div EP$
 $EP = DO \div M$
 $FE = FO \div M$
 $TF = 40^\circ \div M$
 $f/\text{VALUE OF OBJECTIVE} = FO \div DO$
 FIELD IN YDS. } Read two right figures from table
 AT 1000 YDS. }

Astronomical telescope

13 SIZE OF IMAGE

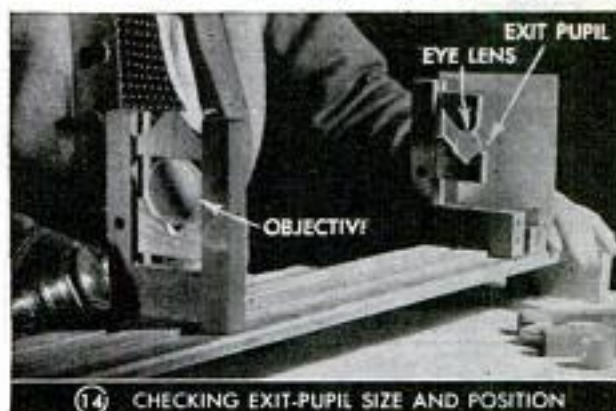
Find figure opposite magnification and multiply this factor by focal length of objective lens

M	Factor	M	Factor	M	Factor
20X	.035	35X	.020	50X	.014
25X	.028	40X	.017	60X	.012
30X	.023	45X	.015	70X	.010

Select your lenses and make a layout as in Fig. 12, checking this directly from the actual setup as made on the optical bench. Determine the image size from table Fig. 13. The pair of paraxial rays will pass through the center of the image and continue until they strike the eye lens, from which they emerge parallel, as shown. The ray from the edge of the field will pass through the center of the objective and the edge of the image and continue until it strikes the eye lens. This is the most important ray to consider. If you can get this through the telescope, the hundreds of other rays from the object viewed will automatically get through. Note that the eye lens must be big enough to catch this ray.

Exit pupil: Stand back about a foot from the eye lens and look at it. You will see a round dot of light in the center. This is the exit pupil of the telescope. Actually, it is an image of the objective lens. Now put a piece of paper or ground glass behind the eye lens and move it back and forth until you get the smallest and sharpest circle of light, Fig. 14. This location is the exit-pupil point and it marks the proper location of the eye. Noting its position from the eye lens, complete your layout drawing as in Fig. 12, continuing the ray from the edge of field through the exit-pupil point. Look again at your test setup and note how large the exit pupil is. A big exit pupil means good illumination; a small exit pupil, poor illumination. Since the astronomical telescope is used for viewing a light source, the matter of illumination is not so important, and the exit pupil can be as small as $\frac{1}{64}$ in.

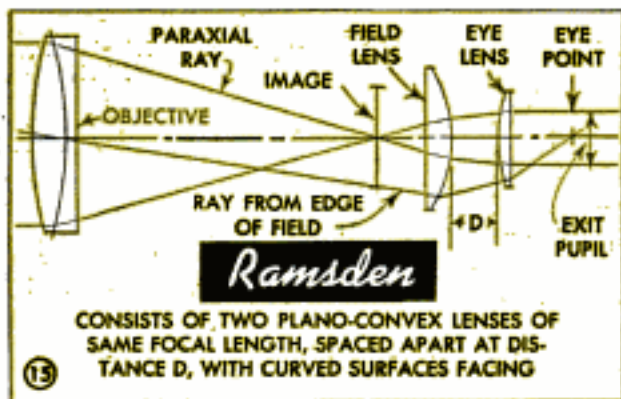
Experiments: While you have the astronomical telescope set up on the optical bench, make a few experiments. Remove the eye lens. Put a piece of ground glass or



14 CHECKING EXIT-PUPIL SIZE AND POSITION

waxed paper at about the position of the image plane and move it back and forth until you get a sharp image. The image received in this manner covers a very wide field, much more than you can see through the eye lens. Now, in place of the ground glass put a piece of printed matter in the image plane. Place the eye lens in position and move it back and forth until the copy is sharp. The image is just the same as a solid piece of copy, and the purpose of the eye lens is to magnify it.

Eyepieces: There are better eyepieces than the single lens. The three common styles in use are shown in Figs. 15 to 19 inclusive. The Ramsden is the easiest to calculate and make; at the same time it is one of the best types of construction, giving a good field without distortion or other faults. The Kellner, Fig. 17, is a slight improvement on the Ramsden. The Huygenian, Fig. 18, is an old reliable, still popular. It differs from the Ramsden in that the image plane is behind the field lens. This style cannot be used directly as a magnifier. It has shorter eye relief (distance from eye point to eye lens) than the Ramsden, a point worth remembering when you are trying to get shorter or longer eye re-

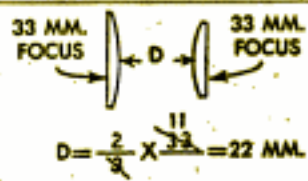


15

CALCULATIONS

D= TWO-THIRDS OF FOCAL LENGTH OF INDIVIDUAL LENS

EXAMPLES



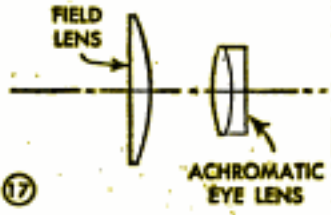
16

COMBINED FOCUS OF BOTH LENSES = $\frac{F \times F}{F + F - D}$

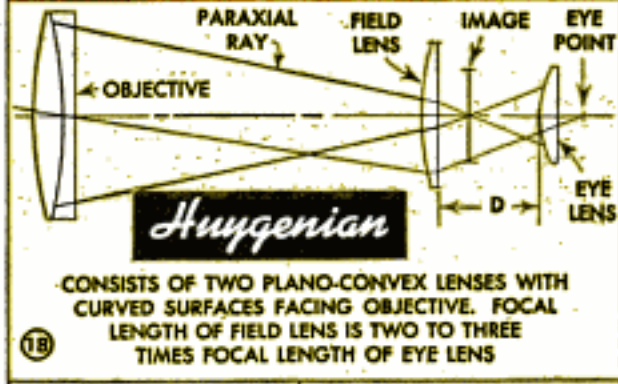
$$FE = \frac{33 \times 33}{33 + 33 - 22} = \frac{1089}{44} = 24 \text{ MM.}$$

Kellner

SAME AS RAMSDEN EXCEPT IT HAS A CEMENTED DOUBLET ACHROMAT AS EYE LENS. CALCULATIONS ARE SAME AS FOR RAMSDEN



17

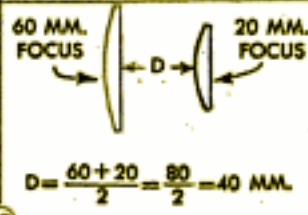


18

CALCULATIONS

D= ONE-HALF OF COMBINED FOCAL LENGTHS

EXAMPLES



19

COMBINED FOCUS CALCULATED SAME AS RAMSDEN

$$FE = \frac{60 \times 20}{60 + 20 - 40} = \frac{1200}{40} = 30 \text{ MM.}$$

Eyepiece designs

Two lenses combined form an eyepiece and give better results than a single lens. Most popular style is the Ramsden although the Huygenian is an old favorite, especially for astronomical telescopes. The mounting can be wood, metal or plastic, turned to shape

lief. Of the two lenses in any eyepiece, the eye lens is the most important as it controls distortion and magnification much more than the field lens. The prime purpose of the field lens is to pick up the light rays from the edge of the field.

The combined focus of the two lenses in the eyepiece is determined by the calculations given in Fig. 16. The example in Fig. 16 shows that a 33-mm. field lens and a 33-mm. eye lens spaced 22 mm. apart will have a focal length of approximately 24 mm. This is not quite the same thing as a single 24-mm. focus lens. When you hold the single 24-mm. focus lens to your eye, you are sharply focused on any image or copy when the lens is 24 mm. away from the image or copy. In the combined lenses you will find the focal plane just a little ahead of the field lens because the 24-mm. focal length is measured from a point between the two lenses. As a matter of fact, the best correction of the combined lenses is obtained when the focal plane is exactly in the plane of the field lens. This means, however, that the field lens is sharply in focus; hence, you can see every speck of dust on it. When you note this condition, your lenses are spaced too far apart. Close them up until the dust specks disappear.

The image stop: The image stop is a round disk of cardboard placed in the image plane. The size of the hole is determined from Fig. 13; also, you can get a good idea of size by viewing a ruled piece of paper through the eyepiece. The image plane formed by the objective and the focal plane of the eyepiece always indicate the same plane when the telescope is focused. This stop is important because it clearly defines the field of view, cutting out weak edge rays and giving a sharp, clean-cut image. It is commonly made a part of the eyepiece, being located between the lenses in the Huygenian and ahead of the field lens in the Ramsden or Kellner. It should be dead sharp as viewed through the eye lens and, when the telescope is focused, it will always coincide with the image plane.

A typical astronomical telescope: Typical construction of a simple astronomical telescope is shown in Figs. 20, 21 and 22. This has a 2 3/8-in. diameter objective (2 1/4 in. clear) and the focal length is 36 in. A draw tube is used for rough focusing; critical focusing is done with a 40-pitch threaded eyepiece. The eyepiece is a Ramsden and can be of 1/4 to 1-in. focus. With a 1/2-in. eyepiece, the magnification would be 72X; with a 22-mm. eyepiece, the magnification would be 41X. Magnification could be pushed up to 144X with a 1/4-in. eyepiece. The exit pupil then would be about 1/64 in., representing about the limit for astronomical use.

Even though you may not wish to build an astronomical telescope, carefully study the drawings and text covering this subject as they are the basis for all terrestrial telescopes. You will need all this data in order to make the popular hand telescope or spy glass.

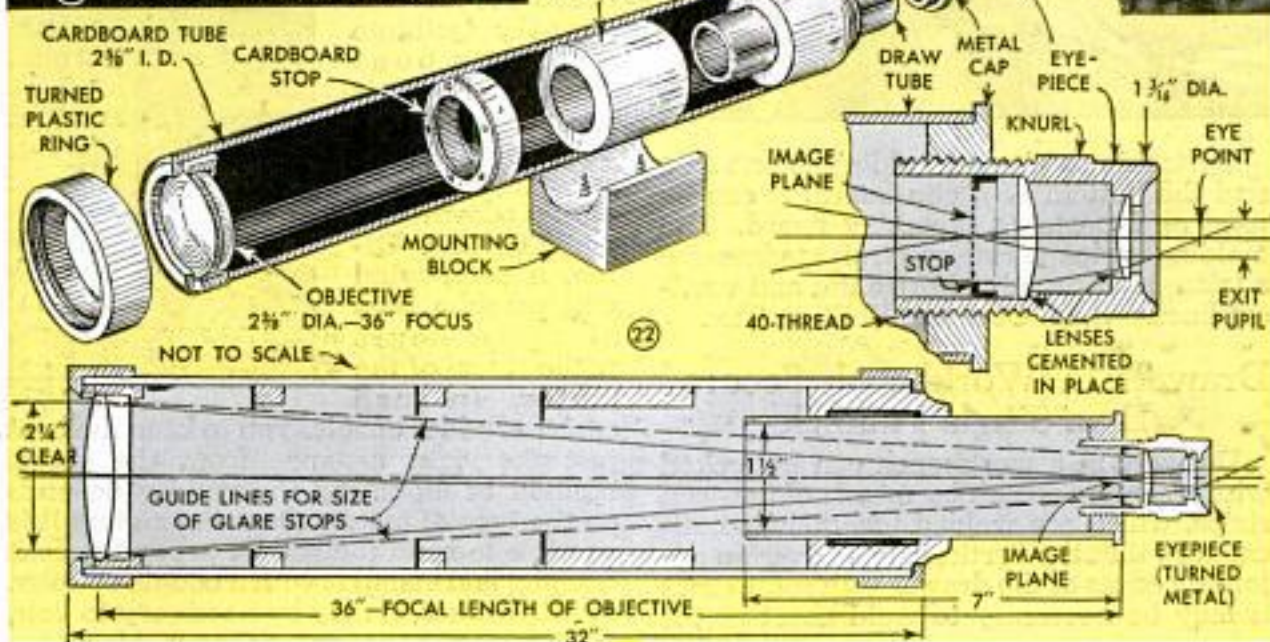
(Continued next month)

Astronomical telescope

This one will magnify up to 144X. It can be fitted with prismatic eyepiece and used at 40X for viewing objects on land



21 TURNING THE WOODEN ENDPIECE



Clipping Sheets for Fast Copying

When addressing envelopes from mailing lists or sheets, each of which contains only one name, if you fasten the sheets together at the lower edge with a paper clip they will fall forward easily as you turn each one after doing your copying. This method is much faster than picking each sheet off a pile in order to copy one name and address.

—N. Campbell, Boston, Mass.



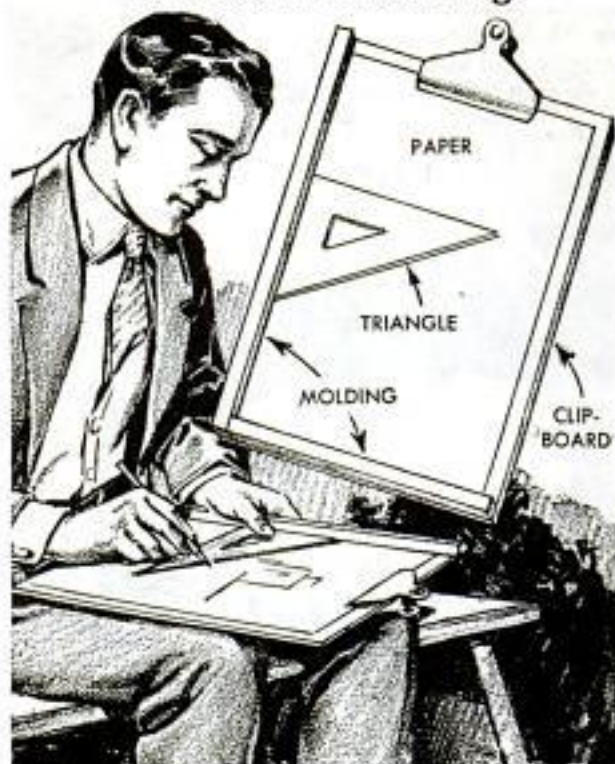
Pencil Erasers Quiet Rattling Door

Rattling of a door caused by a loose fit of the latch in the strike plate can be silenced by inserting two pencil erasers in the door stop. The erasers are forced tightly into holes drilled in the stop, after which the tips are shaved off with a knife until the door will close properly, with the erasers keeping the latch firmly pressed against the strike plate.

—Axel E. Ogren, Chicago.



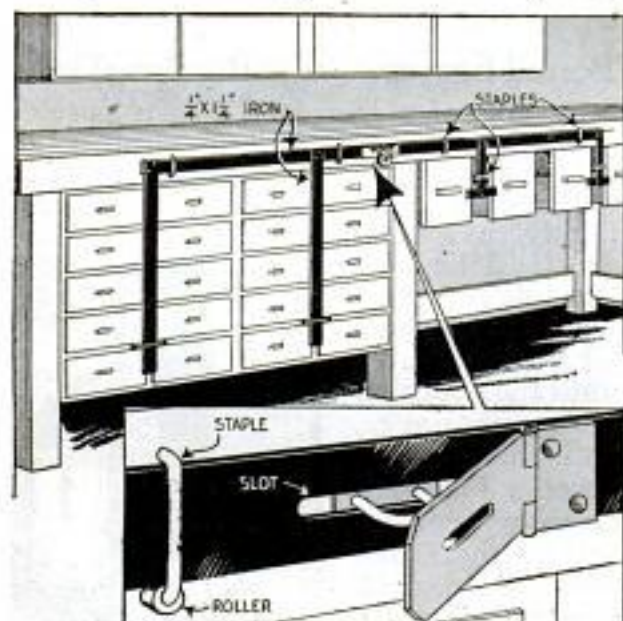
Molding on Edge of Clip Board For Use in Sketching



By tacking strips of molding to one side and the bottom of a clip board, it can be used as a portable sketching board. The molding strips serve as straightedges for a triangle in drawing horizontal and vertical lines.—R. H. Cochran, Phillips, Tex.

Drawers in Workbench Secured By a Single Padlock

Drawers in a workbench can be locked with a single padlock by means of flat-iron strips, which are welded together as indicated so that the vertical strips overlap adjoining edges of the drawers. In some cases it may be necessary to weld short pieces



across the lower ends of the vertical strips as shown in order to reach drawers that are spaced apart several inches. The vertical strips are inserted through staples wide enough to allow them to be shifted to left or right when the padlock is removed, so that one tier of drawers can be opened at a time, thus making it unnecessary to lift out the strips in order to open the drawers. The staples carrying the horizontal strips are fitted with rollers, as shown in the lower detail, to facilitate sliding the strip. A hasp is riveted to the horizontal strip over a slot, through which a staple projects for inserting the padlock.

Abner Houge, Caledonia, Minn.

Rudder on Outboard Motor Helps Steer Boat Into Dock

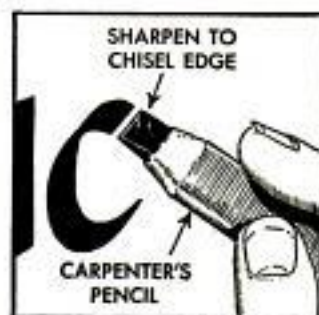
A small sheet-metal rudder fastened to an outboard motor will greatly facilitate docking a boat when the motor is shut off. It also helps when steering a boat along shore downwind while casting. Often, a back wind will push a boat along for hours without use of the motor. In such cases, a rudder enables you to keep the boat just the right distance from the shore. Method of mounting the rudder depends on the type of motor. On some motors it is possible to bend the rudder around a shaft housing and clamp it with a couple of bolts. In other cases, it may be necessary to bolt, screw or otherwise attach the rudder.



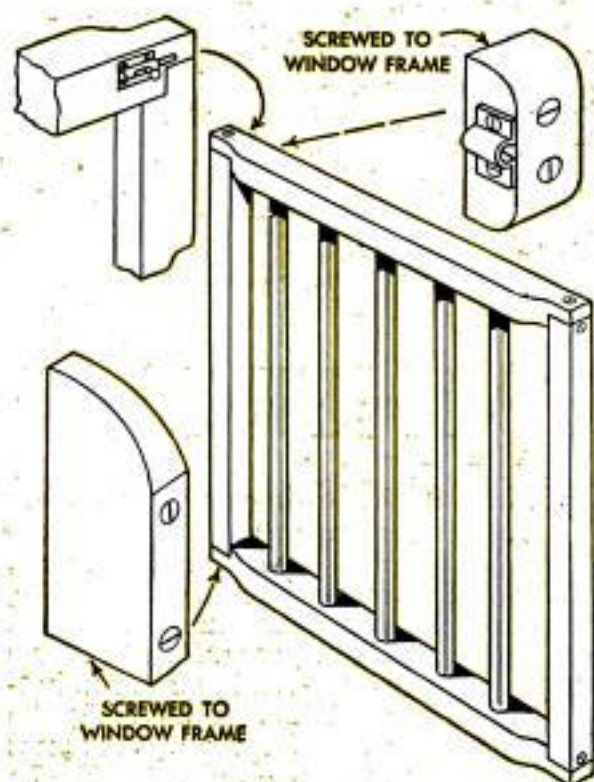
C. H. Brown, Bel Air, Md.

Attractive Lettering Done Quickly With Carpenter's Pencil

You can do attractive free-hand lettering quickly by using an ordinary soft-lead carpenter's pencil which has been sharpened to a chisel edge on sandpaper. Held at about the normal writing slant, the pencil makes a pleasing variation in the width of lines at curves and provides a graceful finish for straight strokes.—Kenneth Murray, Baltimore, Md.



Wooden Window Guard Protects Small Children



Your youngster can't lean out an open window if you install a window guard like the one shown. It can be removed in a jiffy, as it is merely set into the frame against the window stop where it is held by two cleats at the bottom and by sliding bolts at the top. Scrap pieces of yellow pine are suitable for the frame. Side rails can be made of $\frac{3}{4}$ by 2-in. stock, but, as lengths of $\frac{3}{4}$ -in. dowel are inserted in holes drilled in top and bottom rails, these should be a little wider and short enough to fit into the window frame loosely. They are tapered at the ends to join flush with the side rails, and are rabbeted and screwed at the joints. The cleats are set on the window sill and screwed edgewise against the frame with the guard in place so enough space is allowed between the cleats and the stop to take the guard. The cleats are tapered toward the top on the outside surface to permit the guard to be tilted inward slightly when being removed or set in place. The bolts, which are screwed to the outer edges of the top rail, slide into eyes screwed to blocks. These are attached to the stop, where they are hidden when the guard is in place. Or holes can be drilled in the stop to take the bolts, in which case neither the eyes nor the blocks are needed.

Edward A. Hine, Jr., New York City.

☛ To keep your household sponges fresh, simply soak them in cold salt water.

Children Learn How to Tell Time By Hand-Operated Clock

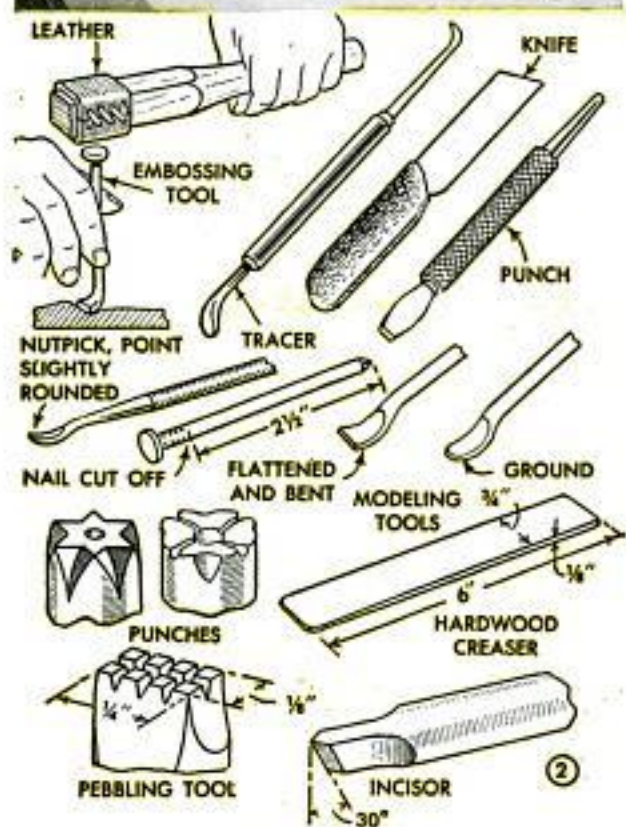
One teacher uses a hand-operated clock in her classroom for teaching pupils to tell time. The clock face is cut from plywood and shellacked, then numerals are painted on it with India ink. The hands are operated from the rear by a knob connected to the works of a discarded alarm clock, as shown in the detail. Only the gear mechanism is needed, so that the hour and minute hands will travel in correct ratio when the knob is rotated.

C. E. Lefevre, St. Paul, Minn.



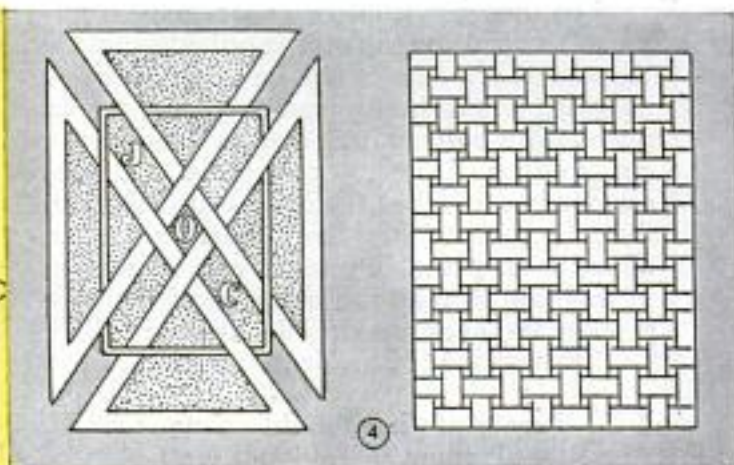
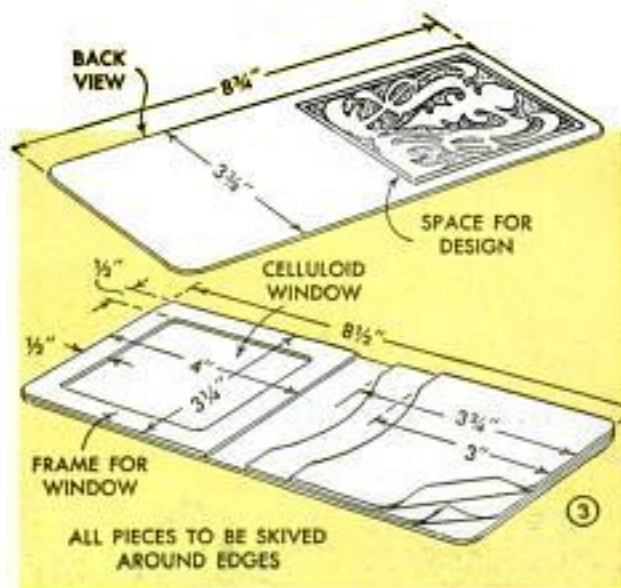


LEATHERCRAFT



WORKING in leather is so easy that even a beginner can produce pleasing, salable articles. Few tools are needed, and most of these can be made from nails, bolts, nutpicks and other common objects, as shown in Fig. 2. A jackknife will do for cutting, but a leather-cutting knife is better adapted for skiving, or beveling the edges of leather, Fig. 13. Though it is not necessary to have a punch like that shown in Fig. 1, this tool is handier for making lacing holes than a nail, which of course can be used. Or a shoemakers' awl can be used as in Fig. 5, the holes being punched in the leather with the aid of a mallet.

For a billfold, the best material is English tooling calf, which has a velvety surface and retains impressions readily. Ooze calfskin or split cowhide with ooze finish also are suitable. To test leather, the thumbnail is pressed into it. If the impression remains, the leather is satisfactory. Five pieces are needed for the billfold shown in Fig. 3: a back piece, which is to be tooled; a second piece slightly shorter than the back to form a paper-money compartment; a piece to take a window, which can be celluloid or Cellophane; and two pockets. The second back piece is shorter than the first in order to prevent a



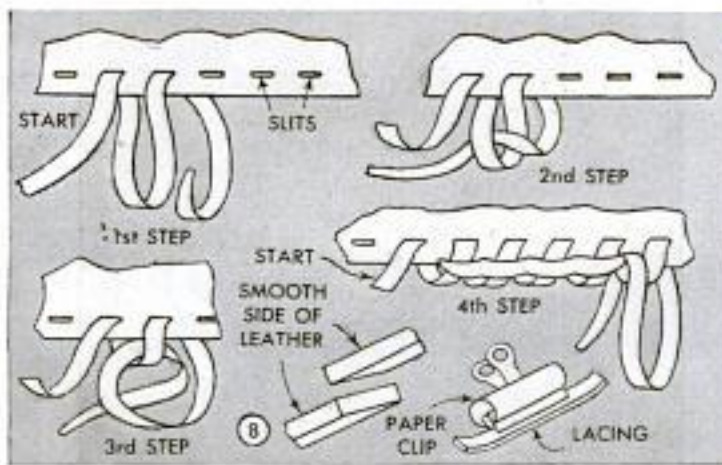
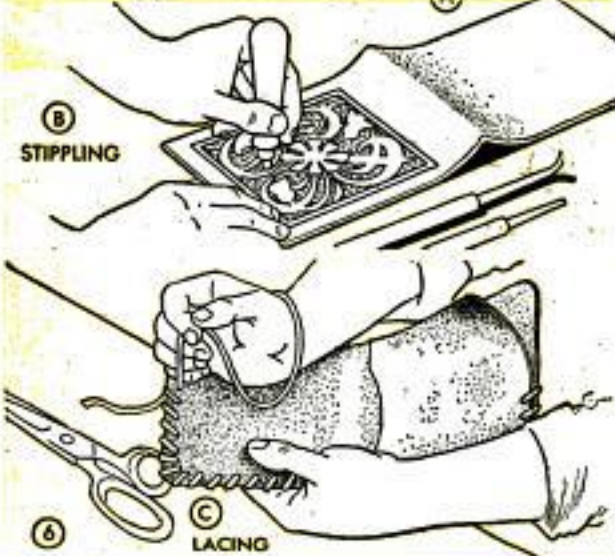


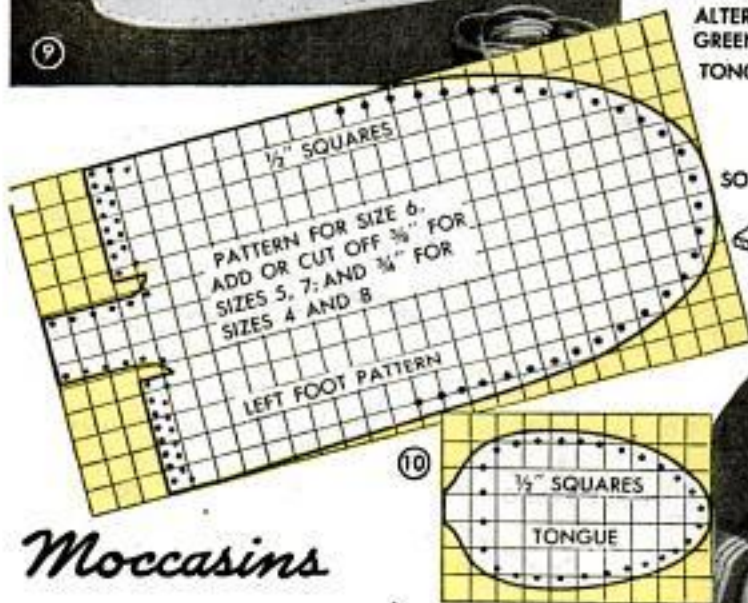
for Fun and Profit

Working with leather is fascinating and profitable. Leather articles attractively embossed and neatly laced make welcome gifts and find a ready sale. Most of the simple tools needed can be made at home

bulge when the pieces are laced and folded. Pieces to be tooled should be cut slightly oversize in case they are pulled out of shape while being worked. Also, margins permit the use of thumbtacks and paper clips for holding the work on a board for trimming.

The design to be tooled should not be intricate or have close lines. The one shown in Fig. 4 is a suggestion that may be varied in many ways. First the design is copied on heavy paper. Then the leather is dampened with a sponge. It should not be soaked so that water oozes out when it is being worked. Now the design is traced to the smooth or hair side with a hard pencil or tracing tool. A straightedge should be used to get clear, straight lines, and the tracing should proceed from the corners toward the center so that the lines do not extend beyond the marked edges, as lines thus traced will remain in the leather permanently. After the design has been





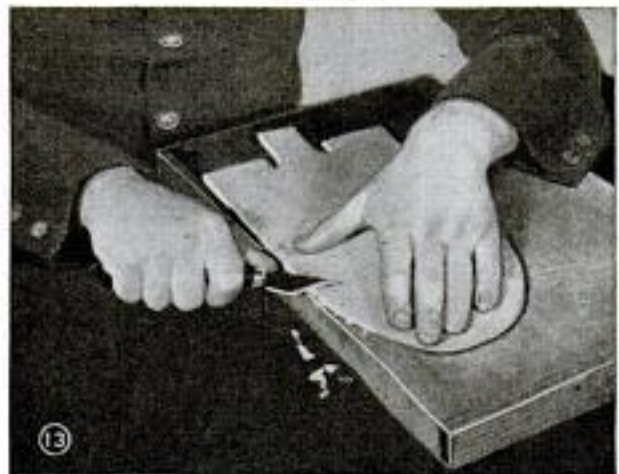
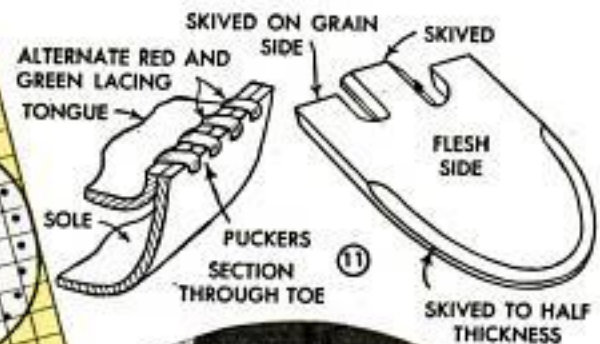
Moccasins

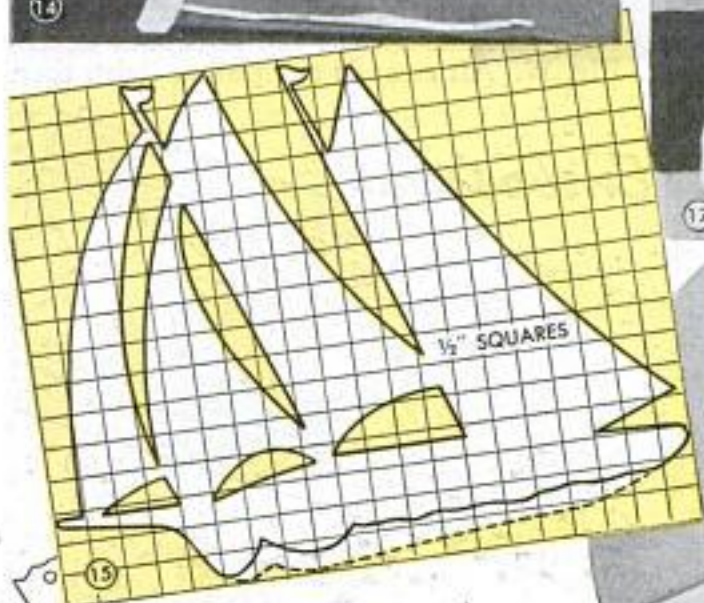
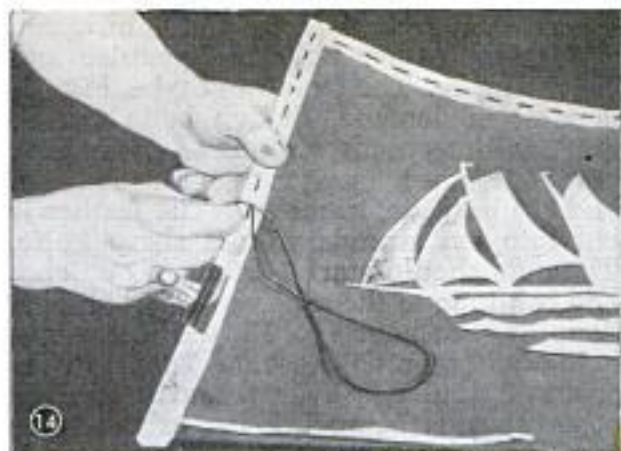
traced, the paper is removed and the leather is placed on a piece of plate glass or other smooth, hard surface, and again dampened, after which the outlines are re-traced as in Fig. 6A. For this purpose a nutpick can be used if the point is rounded slightly to prevent digging into the soft leather. The raised parts of the design can be brought up into bolder relief by using a modeling tool made from a nail with its point flattened and bent. The background can be stippled with an awl or nutpick as at B, Fig. 6, or it can be pebbled with a pebbling tool formed by filing slots in the flattened end of a spike. When all tooling is finished, the work is creased along the center with a hardwood creaser.

Now the pieces can be laced as at C, Fig. 6. Holes should be laid out carefully, not over $\frac{1}{4}$ in. apart, and about $\frac{1}{8}$ in. from the edge, and all pieces should be punched together so that the holes will register. Strips about $\frac{3}{16}$ in. or $\frac{1}{8}$ in. wide can be cut from a strip of calfskin with a sharp knife run

along the edge of a metal straightedge. If the laces are too short, they can be glued and spliced as in the lower details of Fig. 8, which also shows one method of lacing. After lacing around the article, the ends are pulled through two slits, glue is applied and the ends are tucked under the lacing. Then the billfold is ready to be waxed to protect it from scratches and wear. The work is laid on a hard surface where pressure can be applied, and wax is spread over it with a soft cloth, Fig. 7, after which the billfold is polished with a dry cloth to bring out the luster. Or wax can be applied with a soft brush such as a discarded toothbrush.

Two pieces of soft-tanned elk are needed for moccasins. These are cut to the pattern shown in the cross-hatched details, Fig. 10.





Belts

Note that the holes in the tongue are spaced closer than those around the toe and heel, so that the latter will pucker between holes when laced. As elk hide is heavy, the sole should be skived as indicated in Fig. 11 to permit puckering. Skiving is done by laying the piece along the edge of a board and slicing the edge of the leather at a slant or bevel, Fig. 13. Holes can be punched for laces easily with a leather punch, as indicated in Fig. 9, but the heel should not be punched until the moccasin has been fitted to the foot. Lacing is done with pointed laces, as they should fit the holes snugly. Two colors of $\frac{1}{8}$ -in. lacing may be used, each lace being about $2\frac{1}{2}$ times as long as the distance around the toe. Now the moccasin is put on the foot and the flaps are

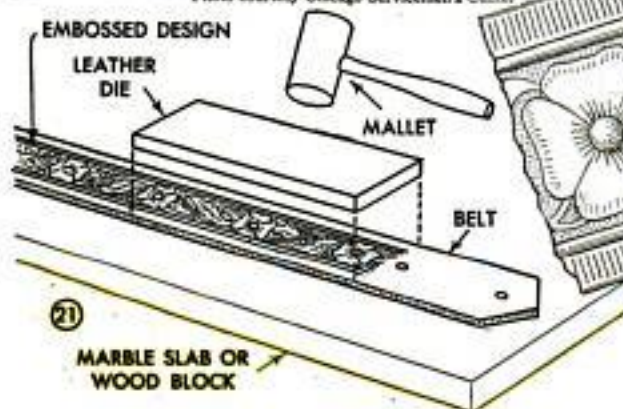


folded around the heel. If these do not meet exactly, the back should be cut down and reshaped to fit. Then lacing holes are punched in the flaps and laces are inserted in the outer row of holes and the flaps are tied as shown in Fig. 12, after which the stay is brought up and laced through the inner row of holes.

Overlaying designs on a background of



Photo courtesy Chicago Servicemen's Center



Embossing



leather is another interesting example of leathercrafting. Fig. 17 shows a pillow being decorated in this way. A pattern, Fig. 15, is laid out on heavy paper, then traced to the leather which is to form the overlay. Suede lambskin is best for both overlay and background. The design then is cut out with a sharp knife and placed, smooth side up, on the rough side of the background piece, where it is mounted with ordinary liquid glue that has been thinned slightly by being placed in a pan of warm water. The glue is applied to the rough side of the design, then scraped off with a knife to remove any surplus. If any parts fail to adhere when pressed against the background, additional glue can be applied with a pointed brush, Fig. 17. After the gluing is finished, the design is covered with tissue paper and weighted with a board loaded with a heavy object. A 1½-in. binding strip then is folded over the edges of the cover pieces (front and back of the pillow) and laced together with ⅛-in. lacing, as in Fig. 14, a paper clip being used to hold the pieces together. Holes are

spaced ⅜ in. from the edge and ½ in. apart.

Braided leather belts are popular and easy to make. The ten-strand type, Fig. 16, is most in demand, though belts can be made with as many strands as desired. A piece of leather ⅓ longer than finished size, and 1⅝ in. wide, is needed. The leather is cut into ten strands with a sharp knife. The cuts should start 7 in. from one end, and continue to the other end. Braiding is done as shown in Fig. 18, the uncut end being held by a nail. Strand 1 is laid over strand 2, under 3, over 4, and so on, the other strands being braided in the same way, as indicated in the left-hand detail, Fig. 16. All strands are pulled tight, then

flattened at intervals by being hammered on a hard surface while covered with a board, as in Fig. 19. Buckle and loop then are added, as shown in the center detail of Fig. 16. The strands at the ends of the belt are skived and glued between folds of the tongue after the buckle and loop have been inserted. When the glue is dry, holes are punched for the lacing, which goes through the strands and tongue.

Embossing a belt requires a die in which a design is cut, as in Fig. 20. Of course, a design can be tooled into the leather as previously described, but a die-formed design is more distinct. For the die, a 5-in. length of heavy cowhide about 1¼ in. wide is needed. A design such as the one shown in Fig. 22 is cut into it with an incisor, illustrated in Fig. 2. The tool is held firmly, and almost vertically, and cuts should be ⅛ in. deep. Next, the belt strap is moistened and laid on a hardwood board or slab of marble, the die is laid over it and pounded with a mallet as indicated in Fig. 21. The die then is moved along the belt and hammered again, until the entire belt has been embossed. After this, a buckle and strap are sewed on, and, if desired, the background can be darkened with leather stain to bring out the pattern.

Portable Incinerator Saves Carrying Leaves

If you burn leaves, a wire rack on wheels like this one will enable you to do the job where the leaves are raked instead of carrying them to a bonfire or incinerator. Rear wheels and handle of the rack were taken from a discarded lawn mower. The frame of a porch swing furnished the body, and its springs formed a grate from which the ashes fall onto a metal plate. Any other materials will do just as well, if the metal plate is spaced slightly below the grate so that ashes can be distributed evenly over the ground.—Edwards H. Smith, Beaver Dam, Wis.



Tight Screws Are Removed Easily By Heating With Soldering Iron



A well known method of removing wood or machine screws that have corroded is to heat their heads so that the expansion and contraction of the metal will loosen them sufficiently for removal with a screw driver. The method of applying heat, which often is a problem, can be solved easily

by using a soldering iron. The iron is applied to the screw as hot as possible. If

the iron has a bit or copper that can be removed, more rapid heating of the screw will result by reversing the bit so that a flat surface instead of a point will be presented to the screw head.

W. C. Wilhite, Carlinville, Ill.

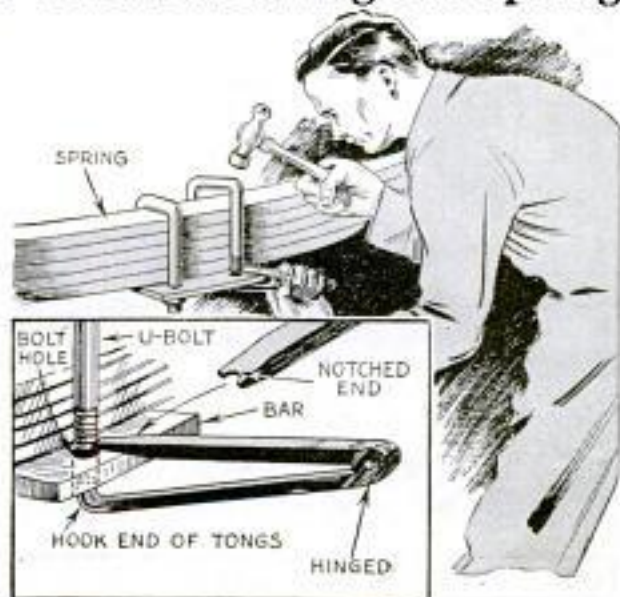
Crushed Egg Shells Scour Bottles

Crushed egg shells provide an excellent abrasive for scouring milk bottles and other utensils. To clean a milk bottle, drop in the crushed shell of one egg, pour in a little hot water, and shake vigorously with a rotary motion for a few seconds. Soiled particles clinging to hard-to-clean portions of the bottle are removed by the sharp edges of the shell particles, and the bottle is cleaned perfectly. Try crushed egg shells, also, for scouring aluminum ware, granite utensils or other difficult scouring jobs.—Vera Esther Grate, Columbus, O.

Flat-Iron Tongs Align U-Bolts When Installing Car Spring

In order to avoid damaging the threads on a U-bolt when installing an auto spring, tongs can be used to align the bolt ends and force them into the holes in the supporting plate. The tongs are made from two pieces of flat iron hinged together at one end. One arm is flattened and notched to fit between the bolt threads as a pry bar. The end of the other arm is bent at right angles so that it can be inserted part way into the hole in the plate. In use, one end of the U-bolt is inserted in one of the plate holes, after which the tongs are used as indicated to line up the other end of the bolt with the hole in the plate.

Empty tobacco sacks filled with ashes, fine sand or commercial cleanser provide ideal emergency pot cleaners.





TRICKS *of*

By George L. Lewis

ALTHOUGH most fur-bearing animals can be trapped only during the "open" season prescribed by law, wolves and coyotes are considered so destructive to livestock that they may be caught at any time. In fact, many states pay a bounty for killing them. Before setting your traps, therefore, it is best to consult the laws of your state to determine when certain kinds of animals may be trapped. Wolves are numerous in Alaska and Canada, although they are found in considerable numbers in many sections of the United States as well, especially in the South and West. Coyotes, which are sometimes called "prairie wolves" or "brush wolves," are found in all far-western states and in many other localities as far east as New York. Usually bobcats and badgers inhabit the same sections, and foxes can be found in most parts of the country, though they are more numerous in the East. Minks and muskrats are plentiful in every state, in Alaska and Canada.

There are many methods of trapping, some of which require much equipment, but simple ways generally will be found highly successful and much less expensive, and will assure a reasonable return on the money invested for supplies. Steel traps for coyotes can be used also for foxes, bobcats and badgers. Sizes 4½ and 14 are best for wolves, size 3 or 4 for bobcats, badgers, lynxes and coyotes, and size 2 for foxes. The "jump" type, in the left-hand detail of Fig. 3, and the regular double-spring type, Fig. 2, are satisfactory. Gloves should be worn when handling traps used to catch land fur bearers, as any strange scent may frighten them away. For this reason it is unwise to smoke when attending your trap line. Also, before being used, all traps should be boiled for a few minutes in a tincture of sage leaves, tree bark, pine needles or grass to eradicate human scents and substitute, instead, the natural odors familiar to animals. Of course gasoline, ker-



①



②

SETTING TRAP FOR COYOTE



TRAPPING

osene, creosote and other volatile or pungent preparations used in camping must be kept as far from the traps as possible.

Coyotes will not approach traps set near trees, large stumps, rocks or brush, or among thick bushes or timber. The ideal place for a trap, therefore, is an open space about 30 ft. in diameter, nearly devoid of vegetation, where there is little grass, and where a bush grows not more than 16 in. high. If no small bush grows naturally in such a place, one can be transplanted, as in Fig. 2. The earth must be fairly dry and not contain gravel. Traps for all land animals except bears should be be staked down securely.

In preparing a set, first make a depression in the ground just wide and long enough to take the trap. This can be done best with a small hatchet or camp ax, Fig. 1. Although the trap shown beside the hunter has only one spring, the double-spring type should be used if the set is made for coyotes. The hole should be deep enough so that after the trap has been covered with a sheet of newspaper or strip of burlap and $\frac{1}{4}$ in. of fine dirt, the set is level with the surrounding earth. To spread the dirt, rub it between gloved hands as in Fig. 4, discarding all stones and large lumps. Keep all kinks out of the trap chain so that it will not rattle when an animal steps on it, and remove your tracks by brushing the surrounding ground lightly with a piece of cloth as in Fig. 5, or the scent bag shown in Fig. 12. For bait, apply scent to the top of a wooden stake that has been driven flush with the ground on the side of the trap nearest the bush so that the coyote will not step on the chain to get to the bait. The trap chain should be wired securely to the stake. For bait, oil of anise, 1 oz., added to ground carp, sucker or trout that has been allowed to decompose in a glass jar is satisfactory, though many other materials can be used. As a rule, each trapper prefers the particular type of bait that seems to be most attractive to the animals that are to be trapped.



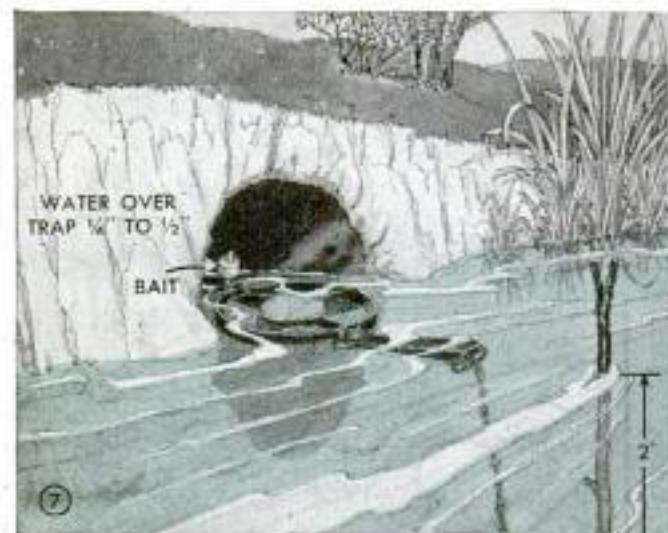
4 DIRT RUBBED BETWEEN GLOVES



5 BRUSHING AWAY FOOTPRINTS



⑥



⑦

Ordinarily, it is not good practice to use meat for bait except when snow covers the ground. A good container for fish scents is a "pop" bottle with a 5 or 6-in. softwood plug for a stopper, Fig. 11. This can be removed easily without getting any of the scent on your hands. For a cover to protect the bottle from breakage, the sleeve of a discarded sweater or the leg of a pair of overalls sewed together at one end is excellent, Fig. 12. Moreover, the cover can be used to brush away footprints from around trap sets, thus making it unnecessary to carry extra equipment for this purpose.

Another way of setting a trap for large animals is to conceal it on a game trail regularly used by them, where it is secured by a peg driven down out of sight and covered with dirt. No scent is used for this type of set. When trapping coyotes in this way, great care must be taken in placing the trap on the trail, as coyotes are extremely wary. A trail out in the open should be selected, and the trap must be set not closer than 20 or 30 ft. to rocks,

trees, bushes or fences. Also, traps should not be set in the bed of a deep wash or dry ditch. On the other hand, for bobcats, wolves, foxes and badgers, these precautions are unnecessary. Lynxes can be caught right at the base of a tree. After completing a trail set, place a small stick or piece of brush directly across the trail about 2 in. from the concealed trap as in Fig. 6. In approaching the stick, a coyote will space its steps so as to step over it and directly into the trap.

Because of the great numbers of muskrats to be found in almost every pond, stream and lake, the pelts of these animals account for a great proportion of the average trapper's income. Muskrats are comparatively easy to trap if one important fact is kept in mind: their legs and feet are tender and brittle. If the animal is not drowned within a few seconds after being caught in a trap, it will twist off its leg and escape, and the trapper will have lost a valuable pelt. A number 1 or 1½ trap, such as shown in the right-hand detail of Fig. 3, is suit-



⑧ RAFT TRAP FOR MUSKRAT OR MINK

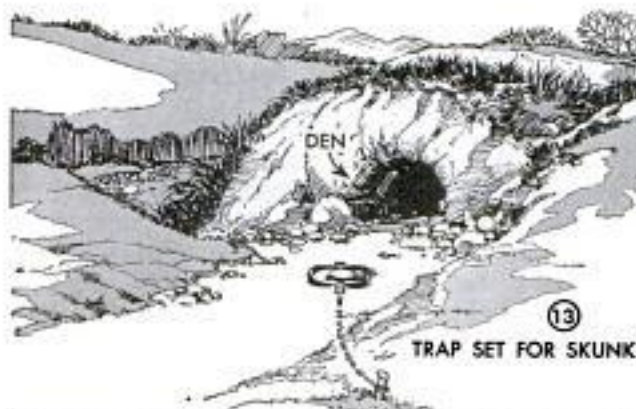


⑨

able. Set the trap near the edge of the water close to the animal's den so that the trap will be submerged to a depth of $\frac{1}{4}$ in. Be sure that the water within a foot or two of the trap is at least 2 ft. deep, Fig. 7, or add as much wire to the trap chain as necessary so that when caught, the muskrat can swim to deep water and drown. In cold weather, holes are cut in the ice to make the sets. Fig. 10 shows a rat being removed from such a set. Bait is placed on a small stick near the trap so that the muskrat must get into the trap in trying to reach it.

Where depth of water in a stream fluctuates, a raft trap can be used. This is made of poles or logs 6 to 9 in. in diameter and 18 to 24 in. long. These are joined at one end and braced at the other as in Fig. 8, a narrow board being nailed between the logs as a platform on which the trap is secured. This will be kept submerged by the weight of the logs. The set should be near water at least 2 ft. deep so that the muskrat will drown immediately. Parsnips are best for bait, though carrots, apples, potatoes and celery may be used.

The same size trap is suitable also for mink, skunk, weasel and marten. Of these,



the mink has the most valuable pelt. This animal lives near water, its den being above water in the bank of a stream or shore of a lake or pond. The mink is a meat eater, feeding on fish, frogs, small turtles, crabs, crawfish, birds' eggs, mice, muskrats and rabbits. Traps should be set near driftwood at the water's edge, Fig. 9, and should be covered with rotted wood, dry leaves, grass or feathers as in Fig. 14. Also, the ground near the trap should be sprinkled with water as in Fig. 15 to remove all traces of human scent.

Traps for weasel and marten need not be set at the water's edge and can be left exposed. Although fish-oil scent can be used for bait, rabbit flesh or the heads and entrails of chickens are more satisfactory. Be sure, in removing a weasel from the trap, that you do not allow the white fur to become bloodstained, as such stains are

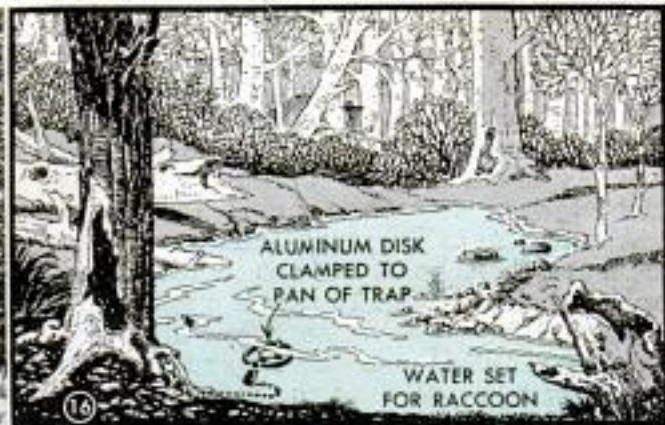


13

MAN SCENT DESTROYED WITH WATER

almost impossible to remove from the fur.

Skunks have no fear of traps, which can be exposed as in Fig. 13. Also, it is best to set the trap several inches back from the den entrance and stake it with a chain so that the trapped animal cannot drag it



ALUMINUM DISK
CLAMPED TO
PAN OF TRAP

WATER SET
FOR RACCOON

down the burrow, as you may have considerable trouble digging out the animal. For bait, fish-oil scent may be used, but in larger quantities than for coyotes. This should be mixed with decayed meat or strong cheese. When caught, skunks should be shot with a 22-cal. rifle.

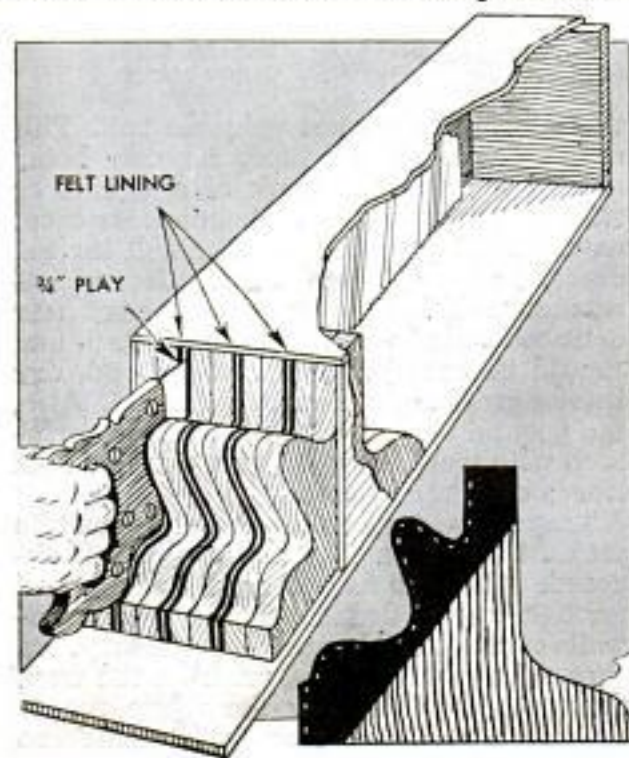
Raccoons prefer thickly wooded country. They frequent streams where heavy timber grows at the shoreline and are caught most often at the water's edge. Set your trap so that water covers it to a depth of $\frac{1}{2}$ in. as for a muskrat set, but instead of using regular bait, clamp a shiny metal disk on the trap pan as in Fig. 16, or the pan can be coated with aluminum paint.

Felt-Lined Sheath for Hand Saws Protects Against Rust

Saws can be protected from moisture and rusting when not in use by storing them in a sheath like this one. It is a wooden box with one end fitted with pieces of $\frac{3}{4}$ -in. stock cut to conform to the saw handles and lined with oiled felt, shown in black in the detail. Six such cutout pieces are

needed to hold three saws. Before assembling the endpieces, which are glued and screwed to top and bottom of the box, they should be shellacked or sized to be impervious to oil. Note that $\frac{3}{4}$ -in. play is allowed in height of the box so that saws can be lifted slightly for inserting or removing.

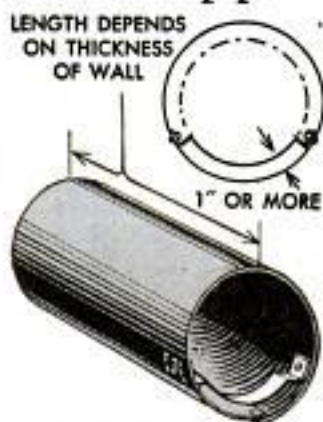
Fred Strickland, Portland, Ore.



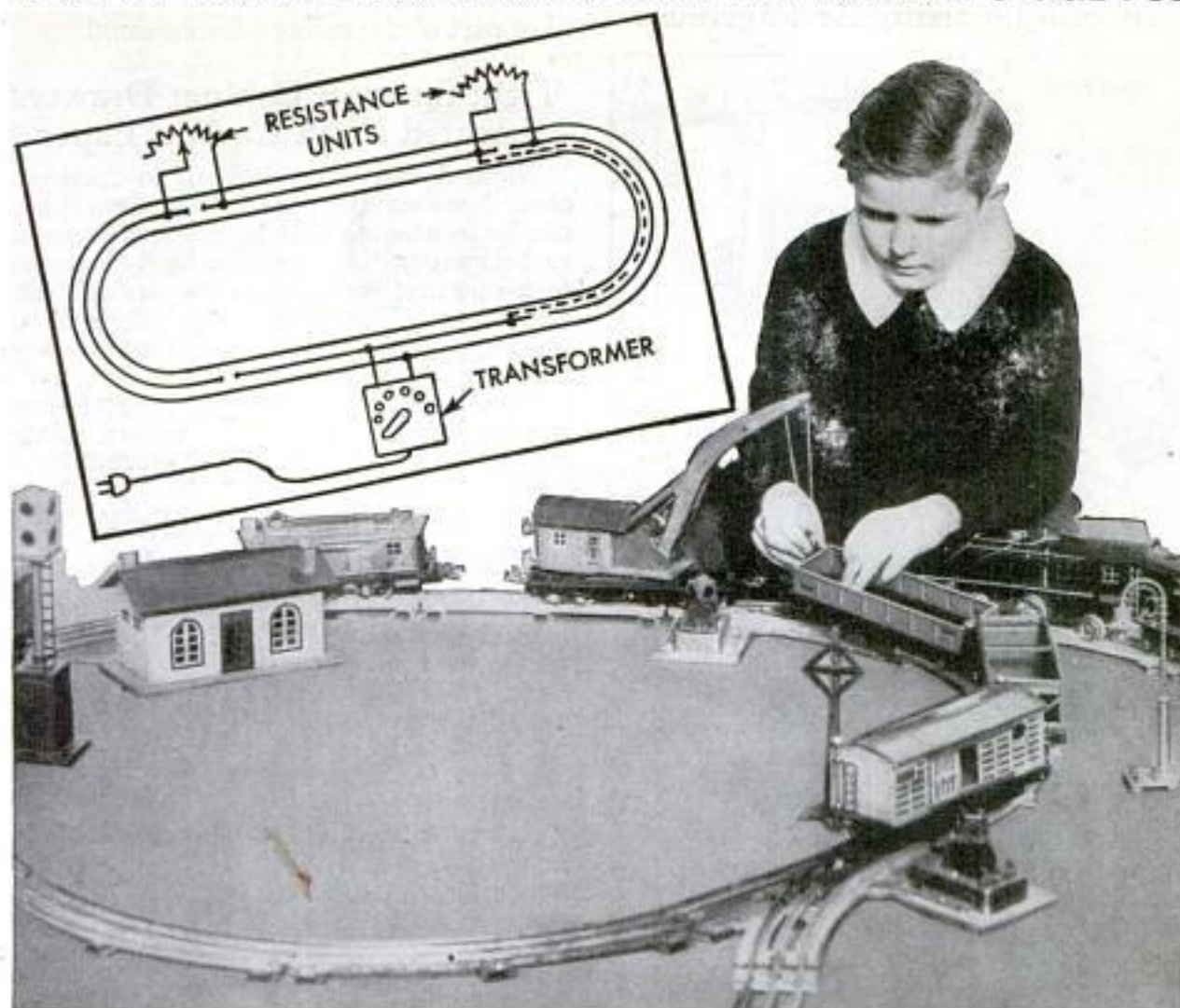
Wall Thimble for Stovepipe

If you are unable to purchase a thimble to protect a wall where a stovepipe runs through it, one can be made by bending a piece of sheet metal to shape and bolting or riveting it together at the joint, or you can use a piece of large stove or furnace pipe. The length of the thimble depends on the thickness of the wall, and its diameter should be at least 2 in. larger than that of the stovepipe. Two strips of metal formed to support the pipe are bolted or riveted in place as indicated.

Mrs. F. R. Platt, Elbridge, N. Y.



Automatic Control Slows Down Train at Curves

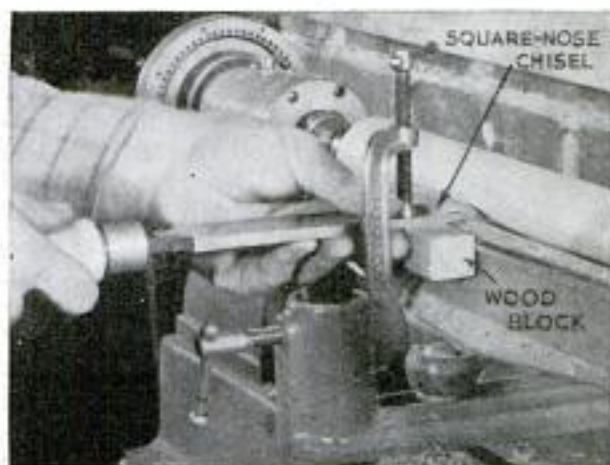


A simple change in the track system of your toy electric train will cause the train automatically to slow down at curves so that it will not jump the track, while allowing full speed on the straightaway. All you do is file off from the straight-track sections about $\frac{1}{16}$ in. from the ends of the center rails that connect with the curved sections, after taking out the pins, then at-

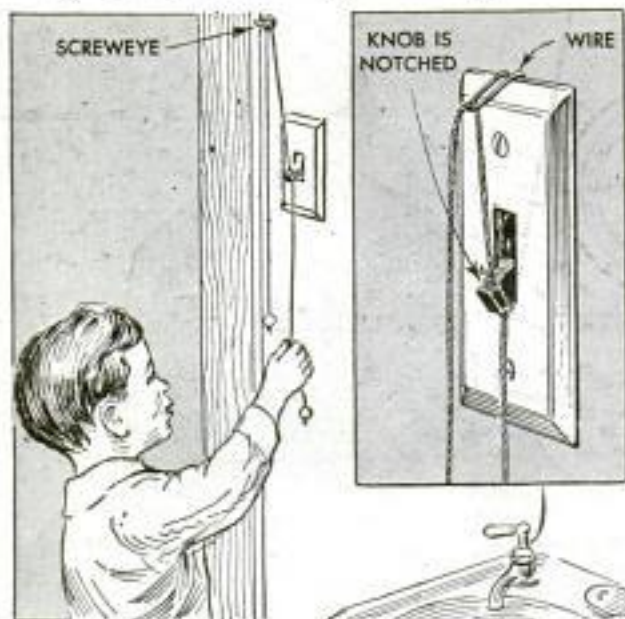
tach a variable-resistance unit to bridge the gaps as shown in the wiring diagram. The resistance unit can be adjusted so that the train will slow down when rounding the curves. To carry the full load of current to other sections of track, a length of insulated wire is attached to the center track, as shown by the broken line in the diagram.—Fred Lettino, Astoria, N. Y.

Block Clamped to a Chisel Guides Turning of Cylinder

When you want to turn a perfect cylinder in a wood-turning lathe, use this simple trick of clamping a block of wood to the chisel to control the depth of cut. Make the work as perfect as you can by ordinary turning, then carefully align the tool rest parallel with the lathe bed and proceed with a light finishing cut with the block of wood attached to a square-nose chisel for a stop guide as indicated. With a corresponding setting of the tool rest, the same setup can be used for turning tapers. Also, with a wooden pattern fitted to the tool rest, the same method can be used for duplicating long curves or other contours.



Small Child Operates Wall Switch By Simple String Arrangement



A child too short to reach a wall switch can turn it on and off if you tie a string to the toggle and arrange it as shown. One end of the string hangs down from the toggle and the other end is extended above it either by running it through a screw eye located on an adjacent door frame, or by bending a piece of wire to form a loop and fastening it behind the switch plate. The corners of the toggle should be notched so that the string will not slip off.

Laundry Bag Lining in Hamper Saves Time and Labor

Laundry bags made to fit inside your clothes hamper will facilitate the work of sending your laundry out. If you attach a pad and pencil to the hamper, also, and keep a record as each piece is placed in the bag, it will not be necessary to remove the clothes from the hamper, which can be lifted from the hamper and sent directly to the laundry.

E. E. Downey, Salisbury Mills, N. Y.

Checks Protected by Tinting



Erasures on checks are detected instantly if the background on which the amount is written has been tinted. Blocks of a contrasting color may be printed on those portions of the check, or colored ink or water

color may be used. Any attempted alteration by erasing will be indicated by removal of part of the colored background.

Tight Spots in Cabinet Drawers Located With Carbon Paper

When drawers are difficult to open and close because they stick, the tight place can be located quickly by placing sheets of carbon paper over the most likely location, then opening and closing the drawer several times. When the carbon paper is removed, it leaves a mark on the wood wherever the drawer is tight, and the excess wood can be planed off. The same method is also handy when doors and windows stick.—Stanton Tiernan, Baltimore, Md.

Soldering Iron for Light Work From Woodburning Pencil

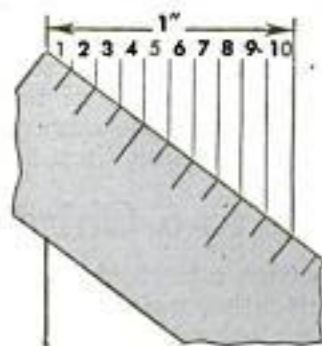
An electrically heated pencil of the type used to burn designs into wood makes an excellent soldering iron for light work in an emergency. Such a pencil is also very handy for radio workers and others who have occasion to solder wires and do similar light soldering.



WOOD-BURNING PENCIL

Arthur Denton, East Hampton, N. Y.

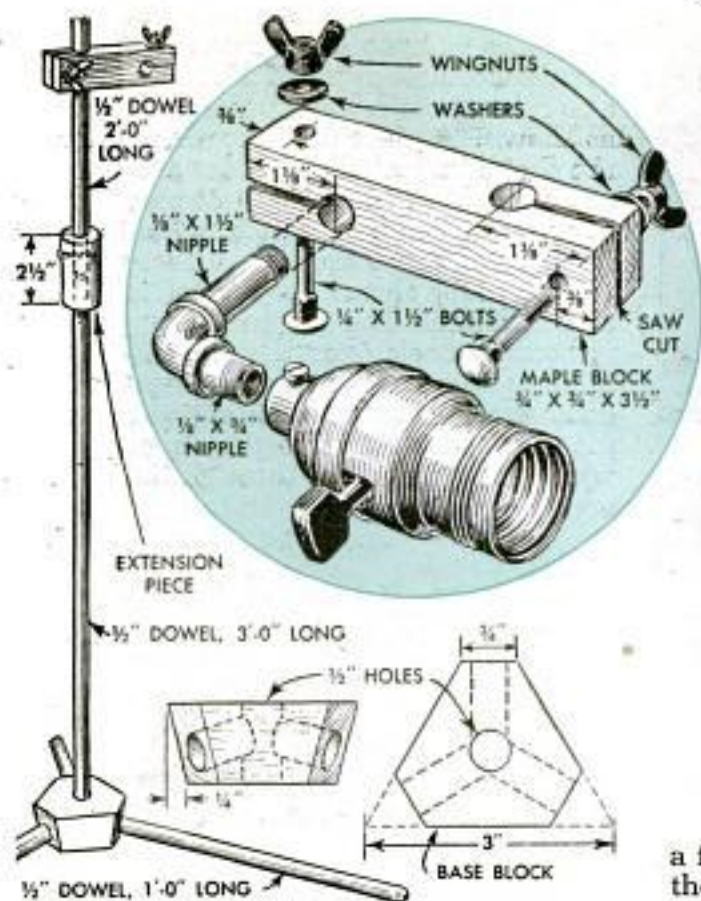
Ruled Card Used to Divide Inch Into Odd Fractions



Inches can be divided into fractions not found on the ordinary ruler by the use of a card measured off into equal spaces. A $\frac{1}{4}$ -in. space makes a convenient unit in measuring out such fractions. For ex-

ample, to divide the inch into 10ths, simply draw two parallel lines an inch apart and lay the card diagonally across them so that 10 of the equal spaces are included between the lines; then mark the location of these points. Lines drawn at these points parallel to the outside lines marking the inch space will divide that space into 10 equal parts. If sixths of an inch had been required, the card would have been placed so that only six of the equal parts fell between the inch marks.

Wooden Photoflood-Lamp Stand Is Adjustable



a few drops are needed, enough to darken the water in a small tray. Prints are immersed in the solution and kept there until the high lights take on a bluish tint, when the prints are transferred to a hypo fixing bath, in which they are allowed to remain until the bluish tint disappears.

For supporting a photoflood lamp, an adjustable stand can be made from a few lengths of dowel, some scrap wood, several pipe fittings and a standard lamp socket. When made to the dimensions given here, it will hold a lamp as high as 3 ft. without an extension, and up to 5 ft. high with one in place, as indicated in the left-hand drawing. Also, it can be taken apart quickly and stored in a small space. For a standard, a 3-ft. length of dowel is inserted in a hole drilled in a triangular block, the corners of which are cut off and the flats drilled at an angle to take dowel legs, as shown in the lower details. An extension for the standard is held by a coupling, which is merely a short length of 1-in. dowel drilled through the center. An adjustable head is made by drilling and slotting a wooden block, then inserting pipe fittings and bolts as in the circular detail.

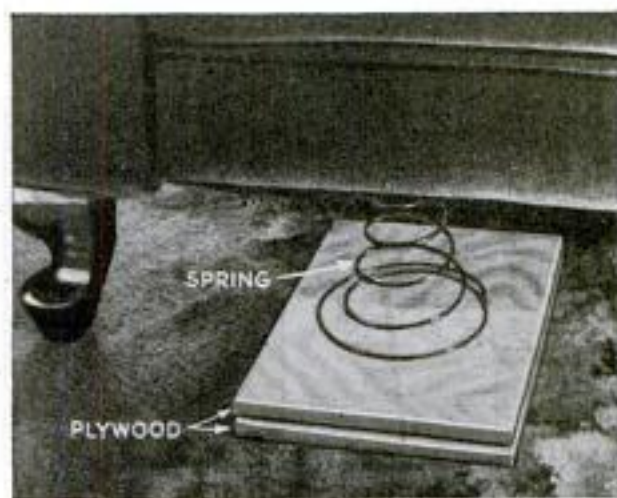
Jack Wills, Brightwaters, N. Y.

Iodine Solution Acts as Reducer On Overexposed Photoprints

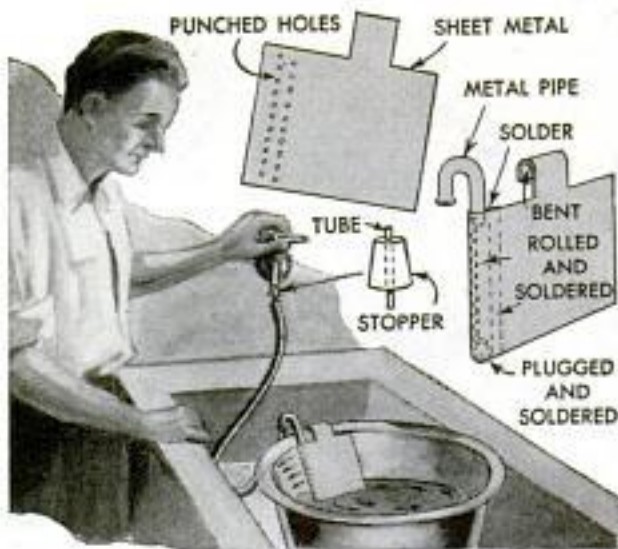
If a favorite negative is so thin that prints made from it are always dark from overexposure regardless of the grade of paper used, try reducing the print instead of intensifying the negative. Ordinary tincture of iodine can be used for this purpose. Only

Simple Improvised Photo Press

When I needed a press to flatten some photoprints and none was available, one was improvised from two pieces of plywood and a coil spring from a cushion. The photograph to be pressed was placed between the plywood pieces, which were laid under a low piece of furniture so that the spring exerted pressure on the upper piece of wood.—William Swallow, Brooklyn, N. Y.



Washer Helps to Circulate Water Rapidly Over Prints



To wash photo prints after fixing so that all traces of hypo are removed, the water should circulate rapidly. For this purpose, a circular container can be used if equipped as shown. A piece of sheet metal is cut to the shape indicated and holes are punched at one end. Then a length of pipe is fitted at the punched end, which is bent around it tightly and soldered its full length. The bottom of the channel so formed is plugged and soldered. The tab in the upper edge is bent to hook over the rim of the container, and a rubber hose, connected to an ordinary faucet stopper, is slipped over the pipe to lead water into the channel, from where it is forced out through the holes to create rapid circulation in the container.

A. Borghi, Brooklyn, N. Y.

End of Print-Paper Box Beveled To Open Easily in Darkroom

You can avoid much of the difficulty often experienced in removing a tight-fitting cover from a box of photo-printing paper in a darkroom by keeping the paper in a box which has one end beveled.



The end and sides of the box should be cut at about the angle indicated. Pressing on this end of the closed box with the thumb and finger raises the cover at the opposite end so that it is easy to remove.

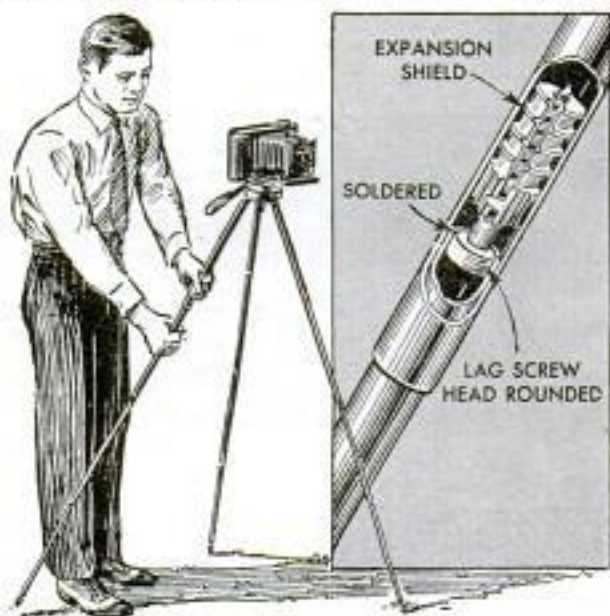
Wax on Reel of Developing Tank Prevents Sticking of Film

Roll film will slide easily when inserted in the grooves of a developing tank reel if a thin coat of hard wax is applied to the reel. The grooves can be coated uniformly with an old toothbrush. Care should be taken to smooth out or remove all lumps



of wax, as these may obstruct free passage of the film in the grooves. Also, if they adhere to the film, they may prevent the developer from acting on the emulsion and spoil the film.—C. E. Packer, Chicago.

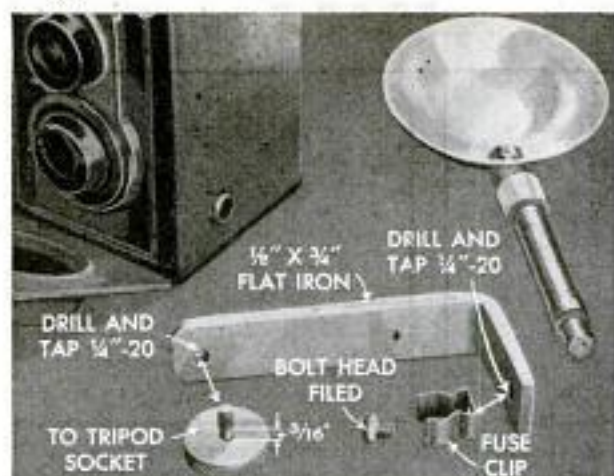
Height Adjustment of Tripod Legs Locked by Lag Screws



If the ball catch on the leg of a telescoping tripod is worn so that it will not hold the leg extended when a camera is mounted on the tripod, you can substitute a lag screw and expansion shield which will hold the leg securely at any desired extension. The head of the lag screw is rounded to fit snugly within the lower leg, where it is soldered. Then the shield is slipped inside the upper leg, and the screw is threaded into it. As the shield is not fastened, it can be pushed or pulled any distance, and when the lower leg is twisted, the screw turns into the shield to expand it and lock the leg.—Carl J. Terjung, Brooklyn, N. Y.

Homemade photo-developing tanks can be made leakproof by applying boat-caulking compound to the cracks. It is acidproof and will not dry out.

Open-Flash Photos With a Hand-Held Camera



If a tripod is not used, photoflash exposures are difficult if not impossible to make without a synchronizer, as one hand is needed to hold the camera and the other to press the cable release. However, a bracket can be used to hold both the camera and the flash gun with one hand, leaving the other to operate the shutter. The bracket is made from a piece of flat iron bent to an L shape and drilled and tapped near the ends to take 1/4-20 bolts. A knurled-head bolt threaded into the hole in the longer end of the bracket engages the tripod socket in the camera. For a distance of about 3/16 in. adjacent to the head, the screw diameter is reduced enough to eliminate the threads. This permits it to turn in the threaded hole without dropping out when the camera is not attached. A clip taken from a discarded cartridge-fuse holder is attached to the shorter end of the bracket with a 1/4-20 bolt, the head of which is filed flat on two sides to permit it to slip between the clip prongs. In use, the flash-gun barrel is pressed into the fuse clip, and the bracket is grasped in one hand.

Frank Sues, Akron, O.

Worn Photo Reflector Renovated By Tin Foil Lining

When photoflood reflectors of the painted type lose their reflecting qualities as the paint cracks or chips off the inner surface, the luster can be renewed by lining the reflector with sheets of tinfoil, which can be taken from packages of film or obtained from photo studios. The inside of the reflector first is given a coat of shellac, which acts as an adhesive to bind the foil. Spun-metal reflectors that have become tarnished can be renovated in the same way. When applied inside an enlarger lamp housing, the foil not only increases the light, but also diffuses it.

J. B. Muecke, Ottawa, Kan.



Cardboard Serves as a "Ceiling" For Outdoor Flash Photos

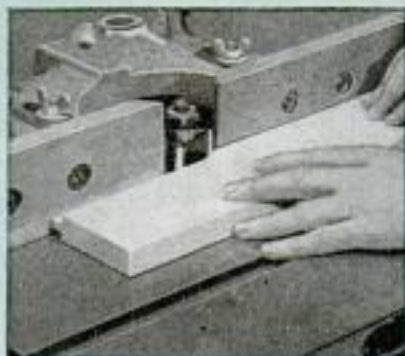
Outdoor flash photos, especially those taken at night, are sometimes weak and flat because there is no ceiling that will reflect the light down onto the subject to give the necessary contrast. However, a sheet of light-colored, fairly heavy cardboard can be used as an improvised ceiling to direct the light of the flash over the scene. The cardboard should be just large enough to project over the reflector without sagging. A small hole in the cardboard allows it to be attached to the reflector with a paper clip.—C. C. Caswell, Clarinda, Ia.



CRAFT QUIZ



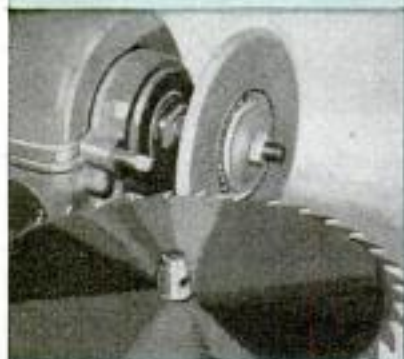
1. Snowshoe frames are made of—
 (a) Northern pine (c) Hemlock
 (b) Hickory (d) Northern cedar



2. He is cutting a—
 (a) Tongue (c) Rabbet
 (b) Groove (d) Cove



3. This drill-press accessory is a—
 (a) French spindle (c) Carving bit
 (b) Molding head (d) Planer head



4. This work on a circular saw is—
 (a) Gumming (c) Kerfing
 (b) Swaging (d) Rolling



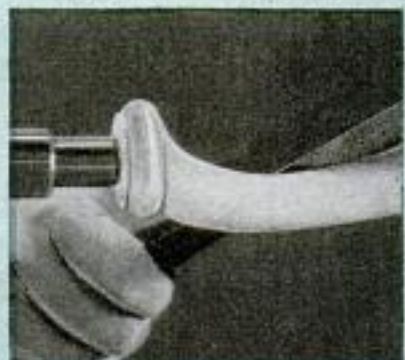
5. This 2-in. spiral has a lead of—
 (a) 3 in. (c) 1 in.
 (b) 1 3/4 in. (d) 4 1/2 in.



6. For smoothest cross-cutting, use a—
 (a) Planer saw (c) Rip saw
 (b) Chamfering saw (d) Crosscut saw



7. Band-saw blades require—
 (a) Gumming (c) Free wheeling
 (b) Tracking (d) Roller guides



8. This table leg has a—
 (a) Pad foot (c) Dutch foot
 (b) Claw foot (d) Ball foot



9. Wood to turn this ball is—
 (a) Walnut (c) Maple
 (b) Mahogany (d) Yellow pine

ANSWERS: 1-b; 2-a; 3-d; 4-a (sometimes called galling); 5-b (lead is distance thread advances in one revolution); 6-a; 7-b; 8-b; 9-d; 10-c & d (both is another name for diamond dust); 11-d



10. Best abrasive for glass drilling is—
 (a) Silicon carbide (c) Diamond dust
 (b) Boron carbide (d) Bort



11. For smooth finish on dowels use paper—
 (a) No. 3 (c) No. 2/0
 (b) 60-grit (d) No. 3/0



Direct taping

Outline taping

MASKING TAPE

for Striping and Lettering

MASKING tape is a great help to the finisher with an occasional job of lettering or striping. The most popular tape is the crepe-back paper variety, which has enough flexibility for curves. The adhesive usually is rubber-base cement, which holds well, yet strips clean. However, plain paper or cloth tapes can be used.

Two methods of taping are commonly employed. In one, the tape is applied to the letter or stripe, the background being sprayed on while the stripe or letter is thus protected. In the second method, the background is sprayed first, then the letter is outlined and sprayed. Direct taping as applied

By this method, the work is covered with paper and tape so that only the stripe or lettering is exposed for spraying



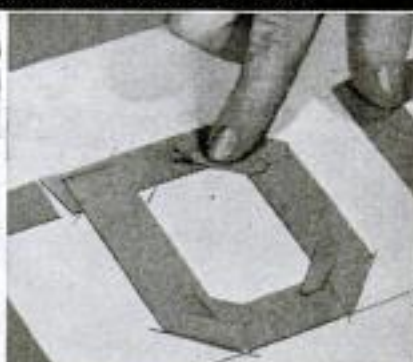
⑦ SKETCH OR TRACE LETTERS



⑧ APPLY TAPE OVER SKETCH, OVERLAPPING ALL CORNERS



⑨ TRIM CORNERS WITH KNIFE OR LIFT TAPE, TRIM WITH SCISSORS



⑩ USE CUTTINGS TO FILL INSIDE



⑫

Direct Lettering

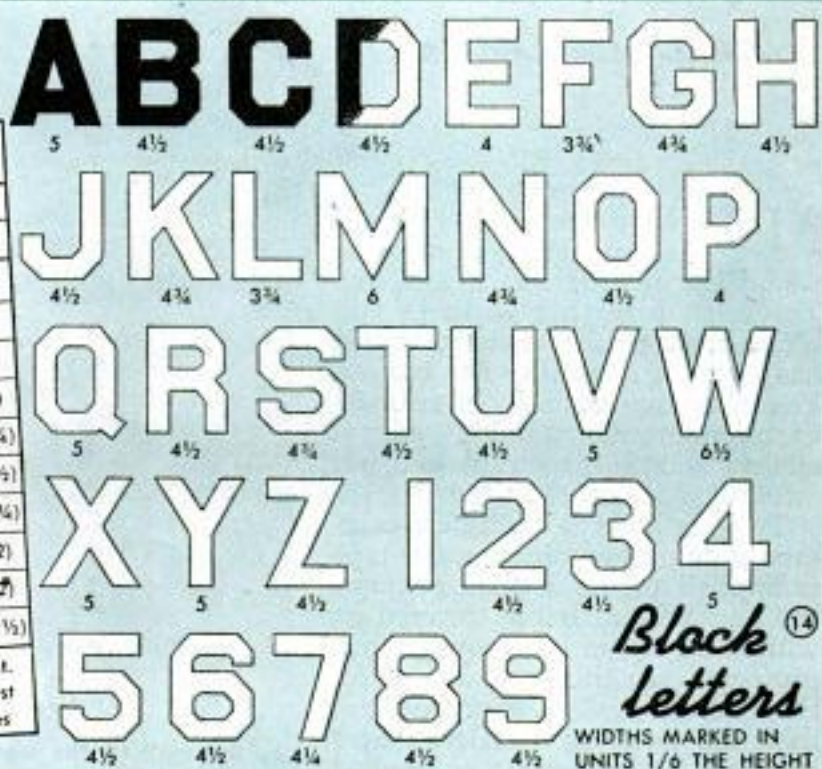
This method used for letters 3 to 10 in. high. Tape gives uniform stems

to a simple stripe is shown in Figs. 2 to 5 inclusive. The area comprising the stripe is sprayed first, using a round spray and allowing the edges to fan out. After this partial coat has dried, the tape is applied and pressed or rolled down firmly. The whole panel then is sprayed, after which stripping of the tape reveals the stripe. The direct method of spraying also is illustrated by Fig. 1. In this instance, the black stripe was first roughed in, followed by the white upper portion sprayed right over the tape, and finished by spraying the lower red portion while protecting the upper white with a cardboard mask.

⑬ TAPE WIDTH TO USE FOR DIRECT LETTERING

Height of Letter	Width of Tape *		
	Thin	Medium	Heavy
3	.515 (1/2)	.60 (1/2 or 3/4)	.75 (3/4)
3 1/2	.59 (1/2)	.70 (3/4)	.87 (7/8)
4	.69 (1/2 or 3/4)	.80 (3/4 or 7/8)	1.00 (1)
4 1/2	.76 (3/4)	.90 (7/8)	1.12 (1)
5	.86 (7/8)	1.00 (1)	1.25 (1 1/4)
6	1.03 (1)	1.20 (1 1/4)	1.50 (1 1/2)
7	1.20 (1 1/4)	1.40 (1 1/2)	1.75 (1 3/4)
8	1.37 (1 3/4)	1.60 (1 1/2)	2.00 (2)
9	1.54 (1 1/2)	1.80 (1 3/4)	2.25 (2 1/4)
10	1.70 (1 3/4)	2.00 (2)	2.50 (2 1/2)

* Based on stems 1/8, 1/4 and 1/2 the height. First figure is exact. Second figure is nearest standard width. All dimensions in inches



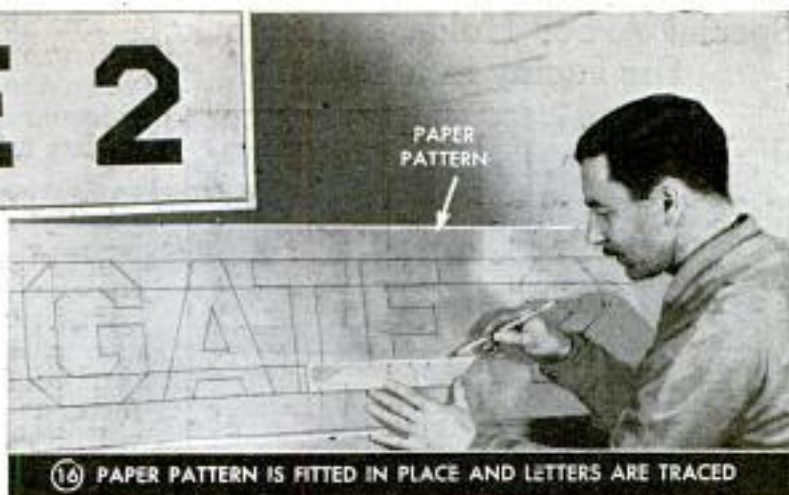
GATE 2

Outline lettering

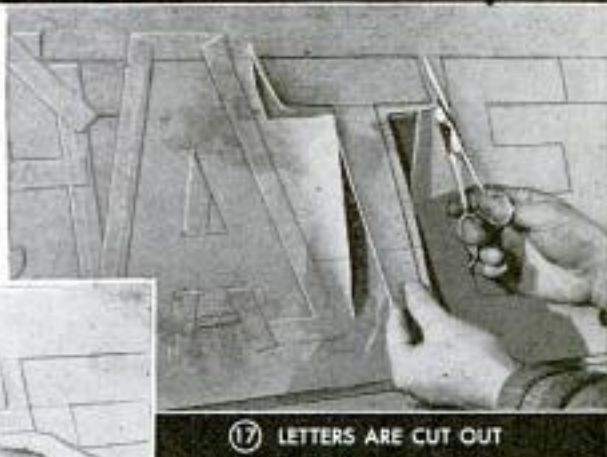
This is especially useful for large letters. Tape is applied to the outlines of a paper pattern to make a combined mask and stencil

The second method of masking as used for a stripe is pictured in Fig. 6. The whole area of the work must be protected with tape and paper aprons, leaving the stripe area clear for spraying.

Direct masking of lettering is shown in photos 7 to 12. The inexperienced worker first should draw the lettering on paper, transferring the lines to the work by the familiar method of blackening the back of the paper and then tracing, Fig. 7. However, with very little experience it is quite easy to letter simple block letters, such as shown in Fig. 14, directly on the work. The table, Fig. 13, gives the width of tape to use for thin, medium and heavy stems. The widths of the letters themselves are determined by using a measuring unit one-sixth the height of the lettering. Note when taping, Fig. 8, that all corners are overlapped. This not only stiffens the letter for possible re-use, but also provides a guide when trimming the corners. Corners usually are cut with a stencil knife, as in Fig. 9, but it is also practical to mark corners with a pencil



16 PAPER PATTERN IS FITTED IN PLACE AND LETTERS ARE TRACED



17 LETTERS ARE CUT OUT



18 TAPE APPLIED

and then lift the tape and cut with a pair of scissors, Fig. 10. In either case, the piece cut off fills the inside of the corner as shown in Fig. 11.

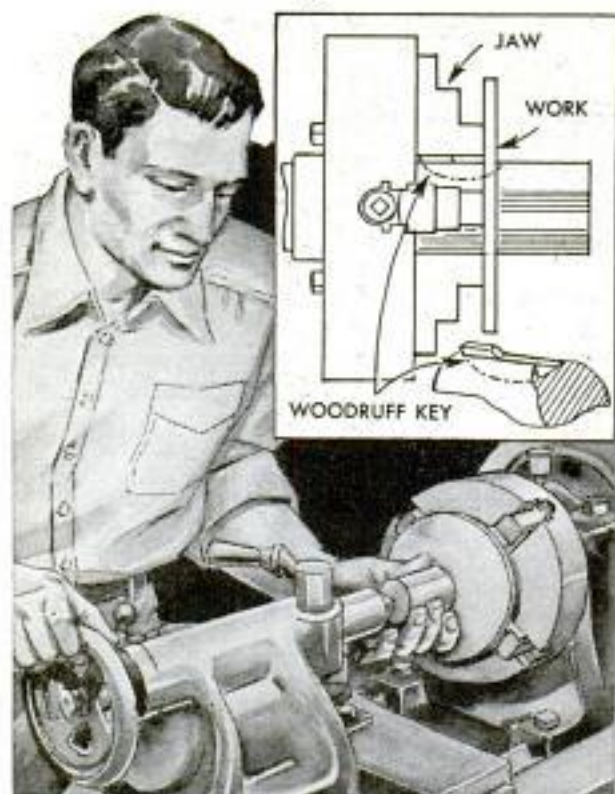
Letters over 10 in. high are done best with the outline method. Fig. 15 is an example. In this setup, the background color is finish-sprayed. A paper pattern of the lettering then is made, after which the lettering is transferred to the work as in Fig. 16. The paper pattern in this case serves a double purpose, since it also acts as a stencil. How this is done can be seen in Figs. 17 and 18, the letters being cut outside the line, and the tape applied to the exact outline of the letter and also overlapping the paper pattern, Fig. 18. Spraying is done as in Fig. 19. This combined mask and stencil can be stripped and used several times if needed.

Letters less than 3 in. high are best worked with a stencil cut directly from a wide tape. Wide tapes also are useful for more ornate lettering or designs. This kind of tape can be cut directly over the work.



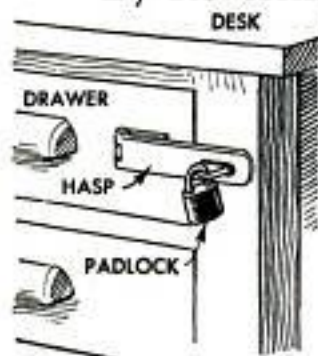
19 SPRAYING IS DONE WITH ROUND SPRAY

Special Arbor Holds Thin Stock For Facing in a Lathe



The problem of holding thin stock, such as large washers and similar work, in a lathe for facing, is solved by using an arbor like the one shown. It is a piece of round stock fitted with a Woodruff key, the stock being of a diameter to permit a sliding fit in the bore of the work. In use, the arbor is held by three jaws of a four-jaw chuck, the fourth jaw pressing down on one end of the key, which is stepped at this end. This forces the other end of the key tightly against the bore of the work to hold it firmly. With this arrangement, it is not necessary to remove the arbor from the chuck to take off the work. Instead, just loosen the jaw that presses on the key so that the work will slip off. An arbor of this type is especially handy if you have to face a number of pieces that have the same size bore.—H. Moore, Leeds, England.

Lock Is Made More Secure By Reversing the Hasp

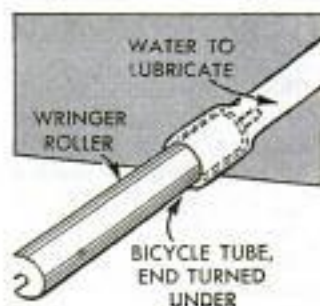


In cases where a hasp and padlock are used to secure a desk drawer, door of a building or lid of a tool-chest, screw the hasp in place as indicated and the lock will be more difficult to re-

move. The hasp is placed in a reversed position so that the screw heads are covered when the lock is in place. As a further safeguard, use bolts instead of screws, with a plate on the other side of the wood.

Bicycle Tube Repairs Wringer

Wringer rolls that have become soft, gummy or excessively pitted can be covered for temporary use with a section cut from a bicycle inner tube. One end of the tube is turned under, as shown, and stretched over the end of the roller. Water is applied to the tube so that it can be pulled over the wringer roll. Then the ends of the tube are trimmed.



H. E. Arthur, Dunbar, W. Va.

Masking Tape on Striping Guide Protects New Paint Finish

In order to avoid waiting for the finish on a newly painted vehicle to dry hard so that striping can be applied, the end of the guide prong on the striping tool can be wrapped in masking tape. This is soaked in water until it is soft, after which the striper can be used immediately, as the softened paper will glide smoothly over the new finish without scratching.—R. L. Card, Tweed, Ont., Can.



Leather Washer Absorbs Shock Of Drill-Press Spindle

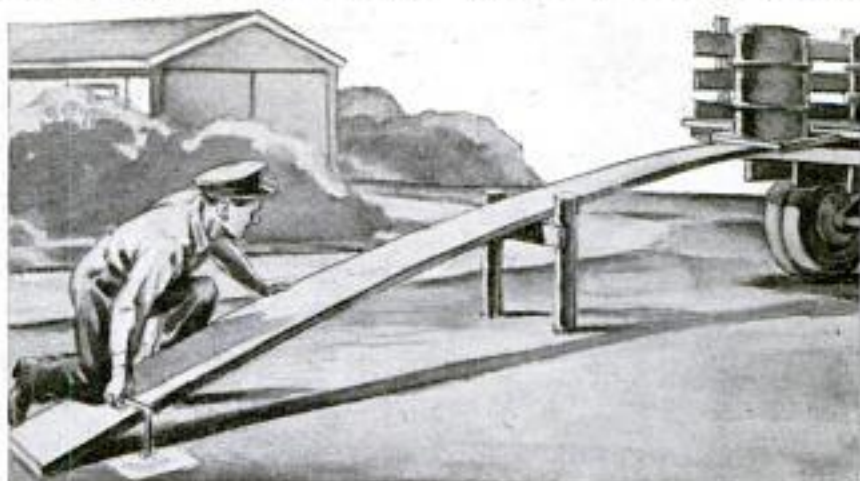


On drill presses where a spring returns the spindle to normal position, wear and noise are avoided by placing a heavy leather washer around the quill. This reduces the shock caused by the collar on the quill striking the head of the casting.—H. W. Holt, San Gabriel, Calif.

Heavy Objects Easily Lifted to Level of Truck

Farmers, dairymen and others whose work necessitates lifting heavy objects onto trucks can avoid much of the strain of this work by using a lever arrangement like the one shown. The device consists of a plank of suitable length and thickness pivoted across a frame, and a crank-shaped stop located near one end for holding the plank in the raised position. The pivot frame can be merely a short length of wood nailed to two stakes driven into the ground. In use, the crank stop is turned to permit the plank to be tilted forward so that the object to be loaded can be set on the end, which is provided with cleats to hold it. Then the plank is tilted up by pressing on the other end and secured by turning the crank over it. If desired, a truck now can be backed in and the load rolled onto it.

Walter C. Fabell, Brooklyn, N. Y.



edge of the table acts as guide for the knife. Laying the paper on the table abrasive side down prevents slipping, and an ordinary table knife sharpened to a rough edge on an emery wheel makes an ideal cutter.

Harry French, Detroit, Mich.

Arrow Painted Above Barn Door Guides Driver of Hay Load

The difficulty of driving a load of hay into a barn without being able to see the sides of the doorway led one farmer to paint a large arrow on the wall directly in the center of the opening. By observing this guide, the driver can enter without having one side of the load rub heavily against the door post, which would not only make it difficult for the team to pull the load, but might also dislodge part of it.

Wood Auxiliary Jaws on C-Clamp Held by Shower-Curtain Rings

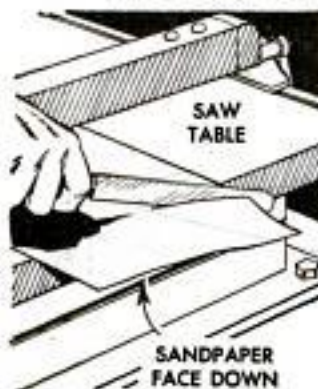


To hold wood blocks used as auxiliary jaws in place while adjusting C-clamps, one cabinetmaker secures the blocks with shower-curtain rings over which small screw eyes, driven into the blocks, are

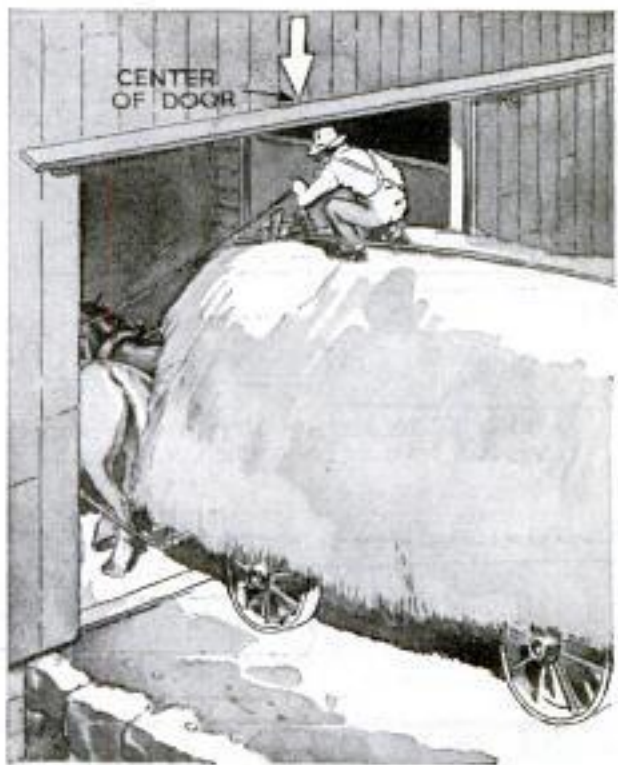
slipped. When not needed, the blocks can be removed quickly by detaching the rings.

Jack Bronte, Grass Valley, Cal.

Sandpaper Is Cut Uniformly At Edge of Saw Table

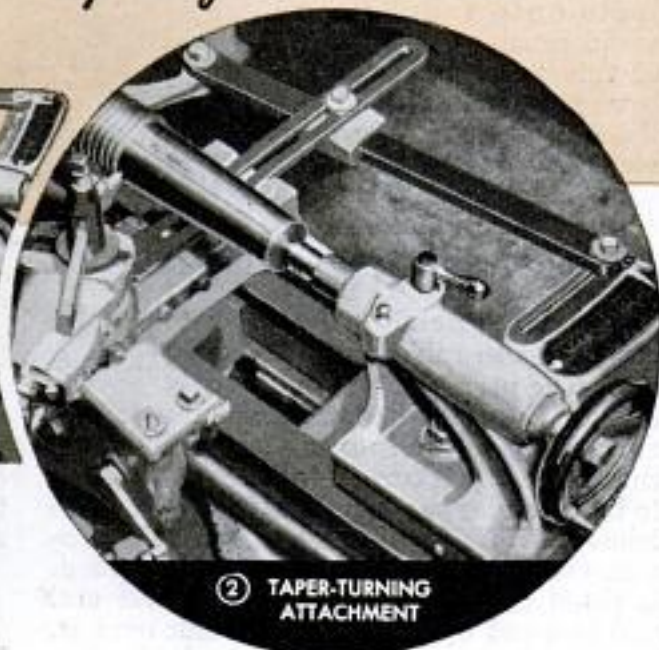
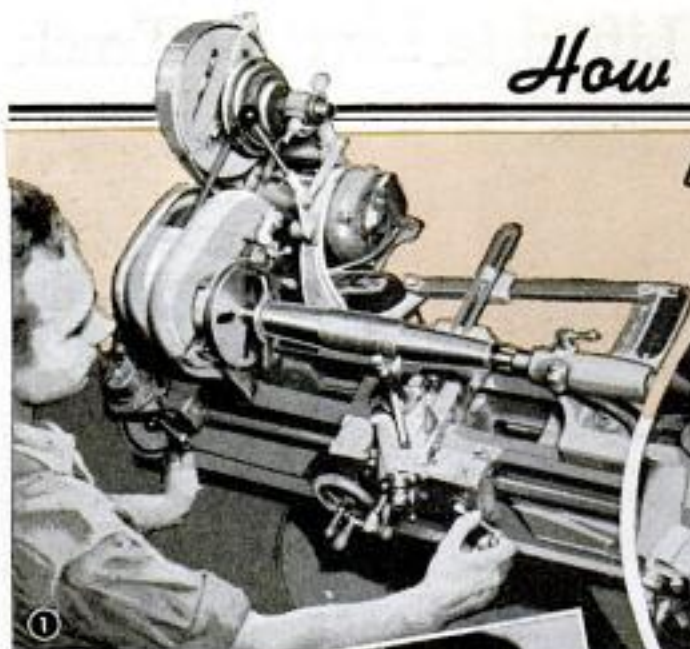


Sandpaper can be cut smoothly to uniform widths and lengths on a saw table. The paper is placed on the table against the saw fence, which then serves as a guide in cutting the pieces to uniform size. The

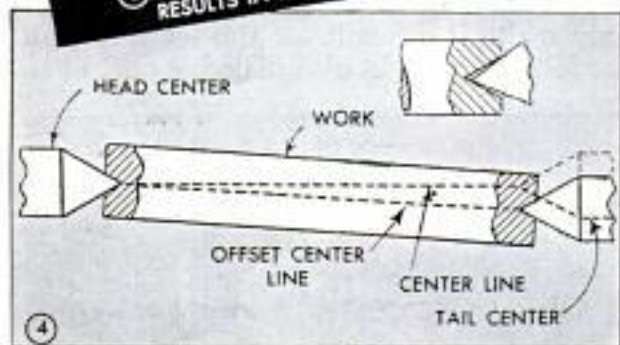


How to TAPER, FACE

by H. J. Chamberland

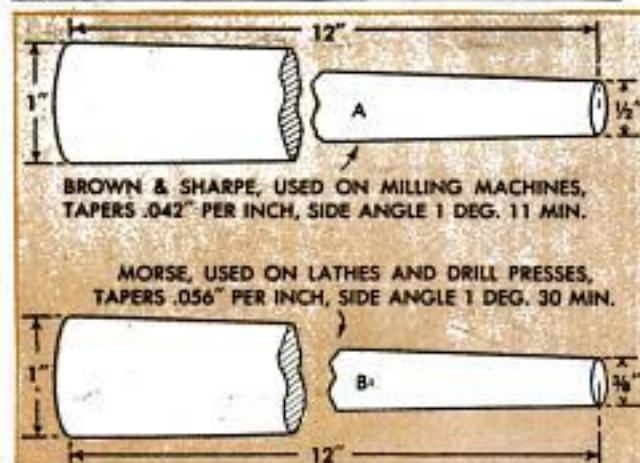


③ OFFSETTING TAILSTOCK CENTER RESULTS IN POOR BEARING SURFACES



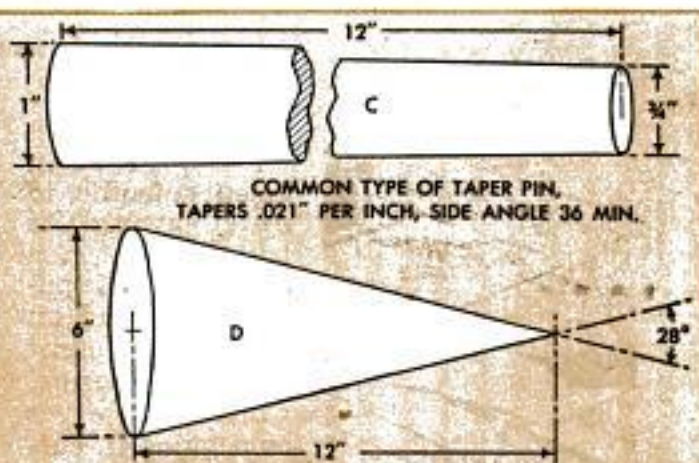
THE most common methods of turning tapers are to use an attachment like the one shown in Figs. 1, 2, and 6, and to offset the tailstock center as in Figs. 3 and 4.

In most shops a taper attachment is a sound investment because it saves time, assures accuracy and extends the life of lathe centers. It also is advantageous in duplicating tapers of different lengths and in boring internal tapers. Tapering by offsetting the tailstock, although common practice, has several disadvantages. Primarily, the centers must be thrown out of alignment by moving the tail center toward the operator; both lathe centers therefore remain parallel with the lathe bed ways, but the work is positioned at an angle corresponding to the amount of offset. This arrangement results in inade-



BROWN & SHARPE, USED ON MILLING MACHINES, TAPERS .042" PER INCH, SIDE ANGLE 1 DEG. 11 MIN.

MORSE, USED ON LATHES AND DRILL PRESSES, TAPERS .056" PER INCH, SIDE ANGLE 1 DEG. 30 MIN.



COMMON TYPE OF TAPER PIN, TAPERS .021" PER INCH, SIDE ANGLE 36 MIN.

⑤ SHAPES AND ANGLES OF COMMONLY USED TAPERS

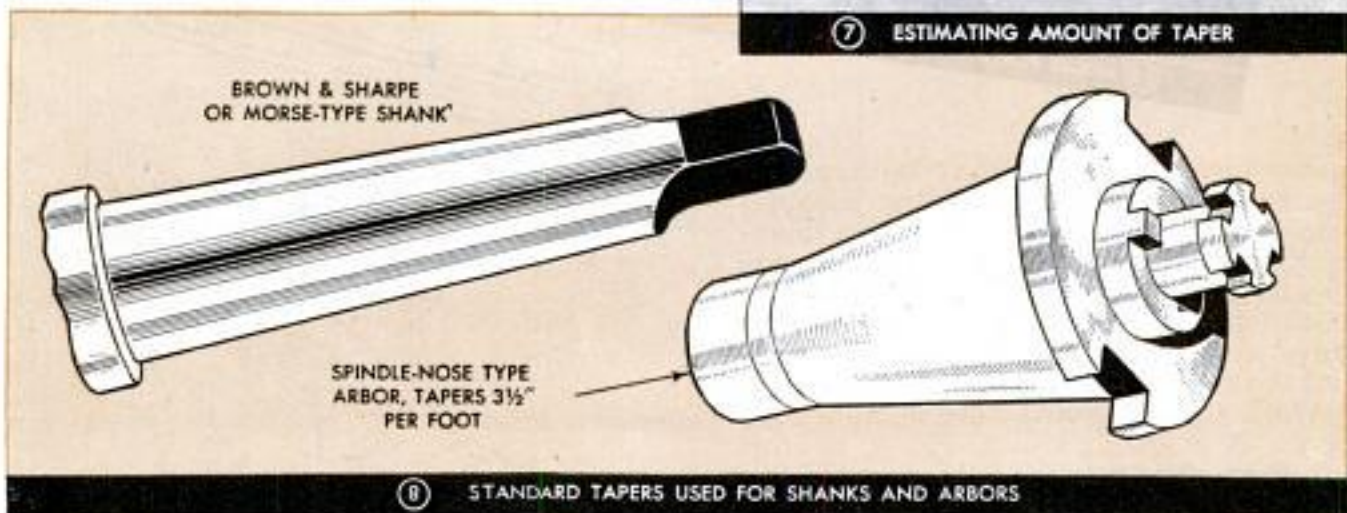
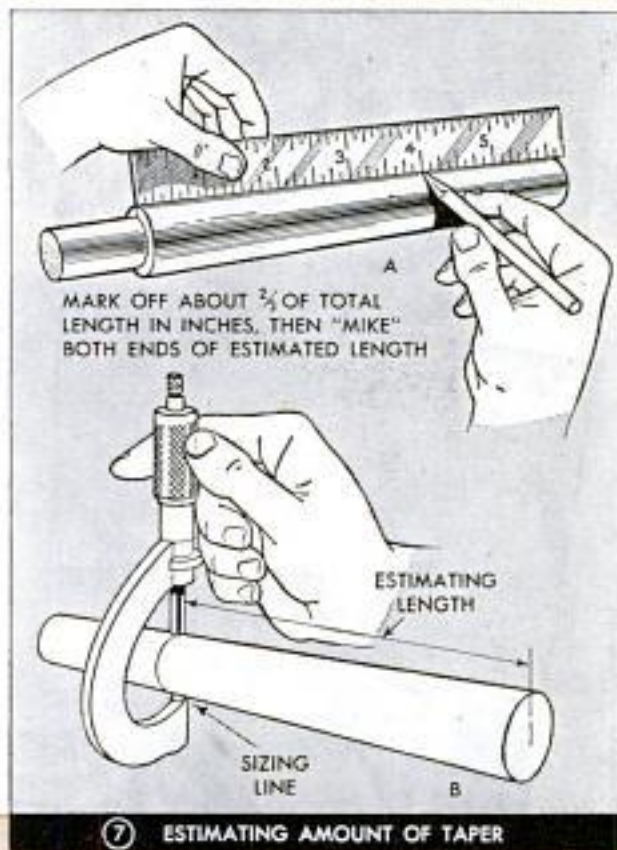
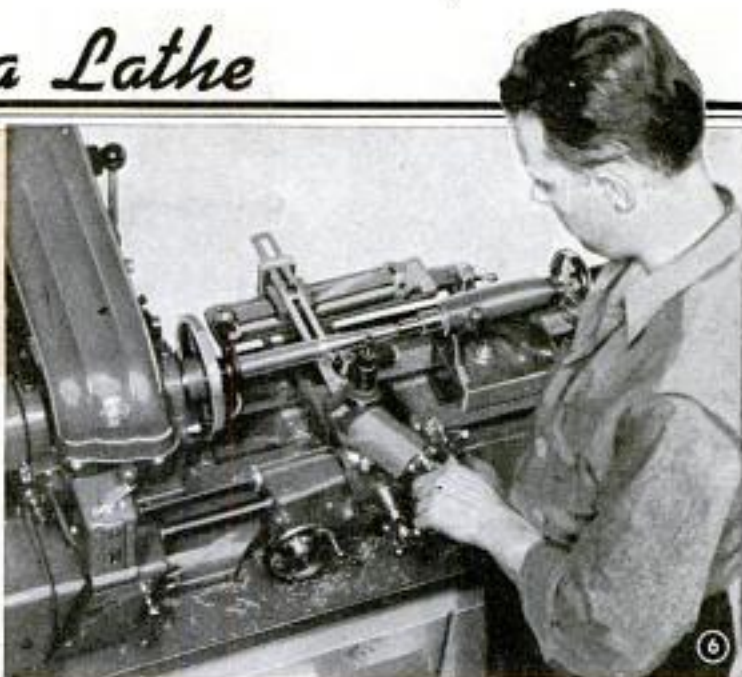
and BORE in a Lathe

Explaining the most common setups for tapering, facing and boring, and the correct way of grinding lathe tools and drills

quate bearing surfaces between the lathe centers and work centers, thus eventually destroying the accuracy of the lathe centers for straight work.

Tapering with the tailstock set over requires a new adjustment with each change in length of taper. An easy and accurate method of determining the amount of taper is to mark off approximately two thirds of the entire tapering length in even inches, as in detail A of Fig. 7, and then "mike" both ends as in detail B until the difference in thousandths of an inch of the estimated length corresponds to the taper per foot desired. For example, assuming that the full length of a Morse taper is $5\frac{7}{8}$ in., an estimating length of 4 in. would call for a difference of .208 in. between the large and small diameters or .052 in. per in. of length.

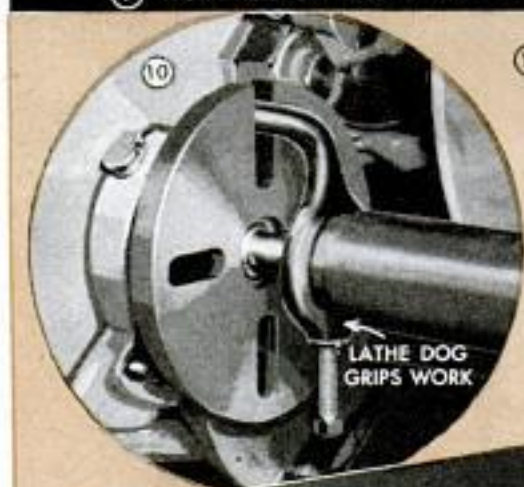
The difference between the diameters of the two extreme ends of a tapered piece of work, expressed in inches per foot, is known as "taper per foot." Tapers most commonly used in shop practice are the Morse, Brown & Sharpe and pin tapers. Details A, B and C of Fig. 5 show the difference between both ends of each taper based on a 1-in. large diameter and a full 12-in. length. The Morse tapers and the Brown & Sharpe tapers are classified as No. 0, 1, 2, 3, etc., and No. 1, 2, 3, 4, etc., re-



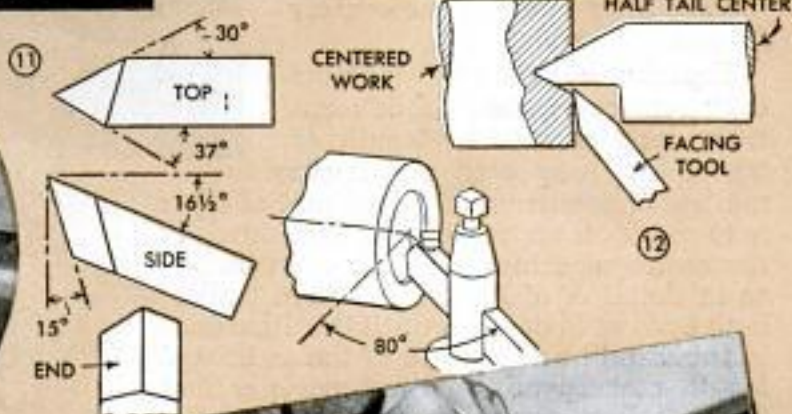


9 WORK HELD ON MAGNETIC CHUCK

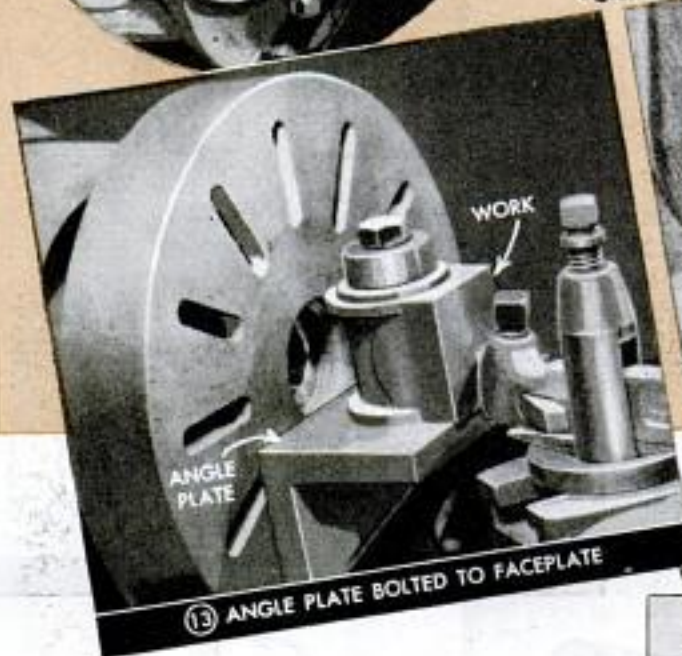
chuck is quick-acting and saves much time when a number of parts are to be faced. Short cylindrical work can be held in a 3-jaw universal chuck or a 4-jaw independent chuck, and work of irregular shape can be held on a faceplate as in Fig. 13. Shafting and similar work often is held in a chuck with the aid of a steady rest, or is mounted between centers and rotated with the aid of a faceplate and a lathe dog as in Fig. 10. Work to be drilled, bored or otherwise worked internally should first be faced. In facing operations, the cutting tool is started at zero center and ad-



LATHE DOG GRIPS WORK



12



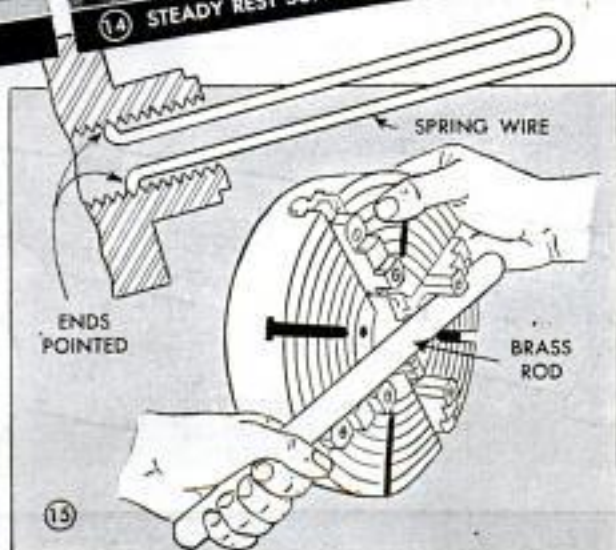
13 ANGLE PLATE BOLTED TO FACEPLATE



14 STEADY REST SUPPORTS WORK FOR END DRILLING

spectively. A taper means both angles combined, the angle remaining constant regardless of length. Based on a 6-in. diameter piece of work, a 6-in. taper corresponds to a 28-deg. included angle and would cone itself out on an exact 12-in. length as indicated in detail D. Fig. 8 shows the standard tapers used for shanks and arbors.

Work to be faced is held in numerous ways. A magnetic chuck, Fig. 9, is ideal for disks. The work is held securely and both sides may be faced accurately. The



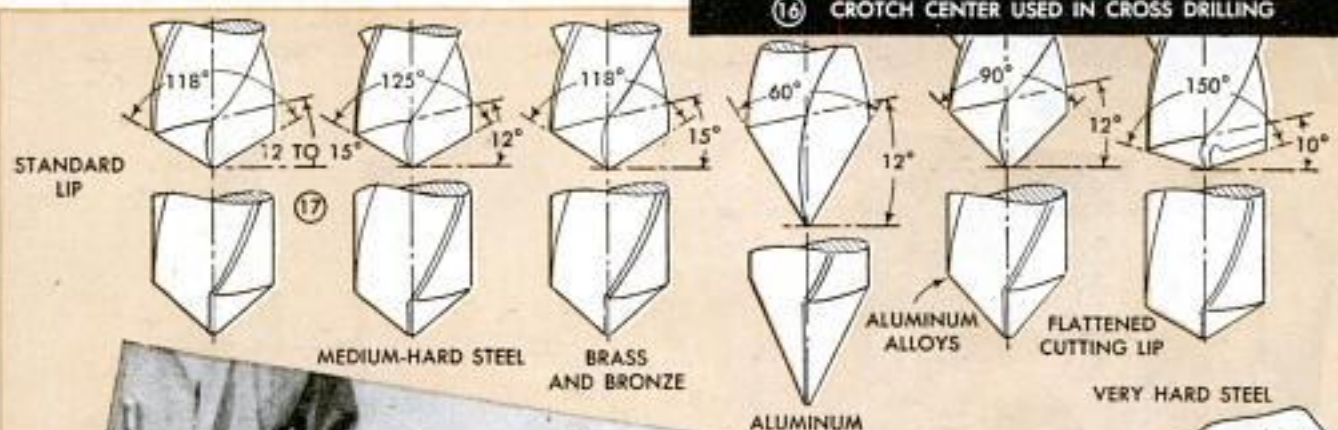
15

vanced toward the full work diameter. Work speed when facing should be kept just below the vibration point; therefore rate of feed should be decreased as the circumference of work increases.

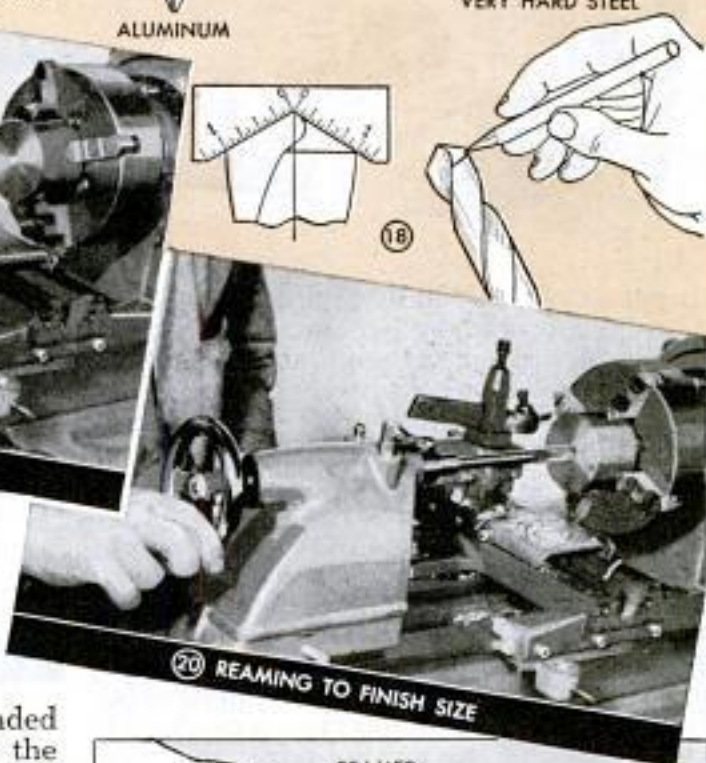
Regular right-hand or left-hand turning tools often are used for facing work held between centers, but better results are obtained in all facing operations if a tool bit is ground especially for this purpose. Fig. 11 shows the various angles of such a tool. A half-center which provides clearance for the tool when facing work held between centers is shown in Fig. 12. When shaping this



16 CROTCH CENTER USED IN CROSS DRILLING



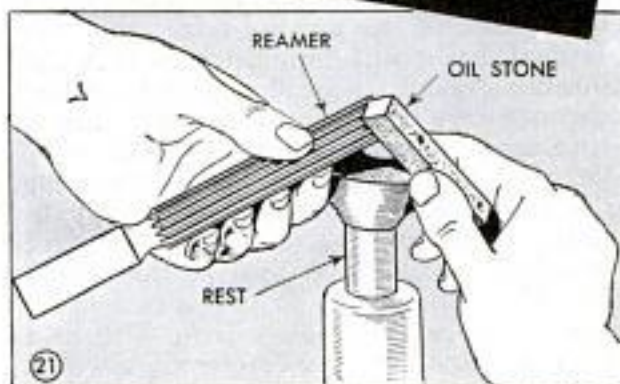
19 DRILLING WITH UNDERSIZE BIT



20 REAMING TO FINISH SIZE

center care should be taken to avoid grinding closer than to within $\frac{1}{32}$ in. of the centerline or the center will act as a cutting tool. The point of the tool must set on the centerline of the work to produce a flat cut and to avoid interference with the recommended clearance and rake angle. Depth of the roughing cut should not exceed $\frac{1}{32}$ in. If depth of the finishing cut is held within .010 in. and the correct speed and feed are applied, the surface finish should be satisfactory.

Drilling, boring and reaming all add up to machining a hole. However, a hole cannot be bored unless it has been drilled large enough to clear the boring tool. A drill should cut accurately regardless of how the hole is to be finished. This is especially





aluminum oxide of 60 grain, K grade, about 6 in. in diameter. It should be operated at no less than 4000 s.f.p.m.

When a hole is to be sized with a reamer, the drill diameter should be $\frac{1}{64}$ in. under that of the reamer; using a still smaller drill and taking an intermediate boring cut is the most practical for maximum accuracy. Generally, the less material removed with the reamer the more accurate the hole. Reamers can be kept in good condition by going over the cutting edges very lightly with an oil stone, Fig. 21, each time they are used. This practice makes



true if a drill is actually to finish a hole, or is to be followed by a reamer. A boring operation will correct any out-of-round or tapering hole resulting from an incorrectly ground drill provided that a sufficient amount of material remains with which to correct the error.

A drill even of the highest grade is only as good as its two lips or cutting edges. Where a substantial amount of drill-point grinding has to be done, there is no substitute for a drill-grinding fixture. Fig. 17 shows how a number of drill points are ground for drilling different materials. Fig. 18 shows how the lip clearance should appear back of the cutting edge, and also a typical drill-point gauge, which is indispensable even to a skilled grinder. The clearance can be more easily determined with the eye than can the length and angle, bearing in mind that both lips may appear to be of the same angle but may vary in length, or vice versa. Grinding of a drill free-hand should be done on the wheel face. Mechanical drill grinding usually is done on the side of the wheel. The best wheel for this purpose is one of vitrified

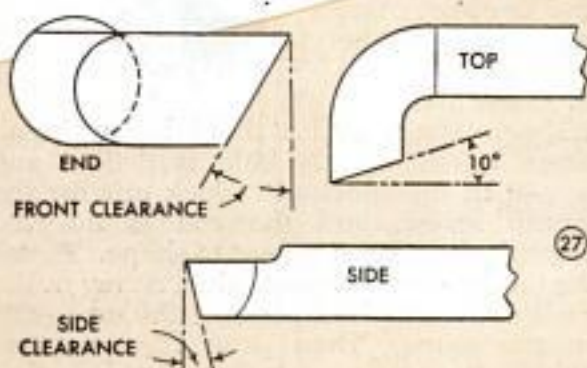
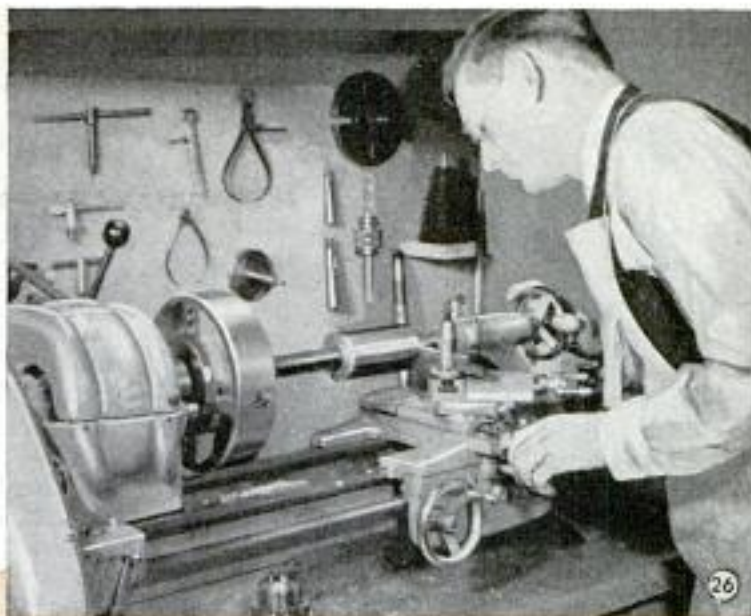


grinding unnecessary as it removes all fine particles of metal pressed against the cutting edges. This idea also applies to drills. To drill and ream a hole, chuck the work, then face it and make a hole with a small drill. Follow this with an undersize drill, Fig. 19, and then ream it as in Fig. 20.

While it is customary to hold all drills under $\frac{1}{2}$ in. in size in drill chucks, the amateur machinist will get better results by using drills that have Morse-taper shanks, especially for drills over $\frac{1}{4}$ in. in size. Work may be drilled by rotating the drill

rather than the work, as in Fig. 16, which shows a taper-shank drill held in the headstock to cross-drill a cylindrical bar with the aid of a crotch center.

Boring is one of the most common machining operations and requires slightly more practice than turning to do accurate work. The advantage of boring is that any size hole can be produced after drilling a hole large enough to provide clearance for the boring tool. A $\frac{1}{4}$ -in. hole can be bored to a diameter of 6 in. by using larger and more rigid boring tools as the diameter of the bore increases, and it is possible



BORING-TOOL ANGLES

Front clearance varies with hole size. Should be not less than 10 deg., may be as much as 20 deg. for small holes. Side clearance—the same as for external tool bits. Back and side rake—about half that of external angles, sometimes less



ance and rake angles recommended for boring tools. All lathe tool bits may be

ground on a 4-in. cup wheel as indicated.

If work is to be turned after boring, it is mounted on a mandrel and the assembly is held between both lathe centers, or it is held by chucking one end as in Fig. 26.

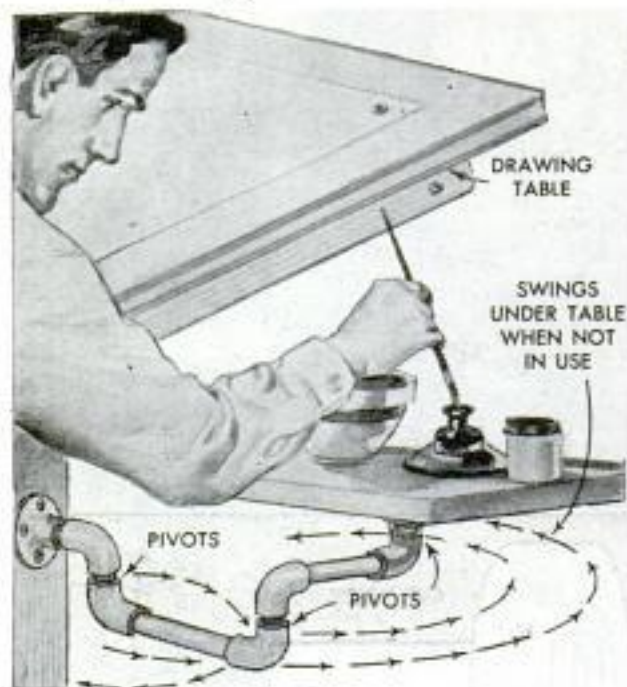
Short bar stock can be turned, drilled or bored when accurately trued in a universal or independent chuck. Long bars, however, require the use of a steady rest, which must be adjusted correctly. After truing the end of the work, place the steady rest close to the chuck, bolt it down and adjust the three bronze jaws so that they barely contact the bar. Then, release the top jaw and slide the steady rest into operating position. After again bolting the rest to the bed, adjust the top jaw with a strip of paper about .001 in. thick, as in Fig. 14, to avoid binding. If the bar does not run true, either it is bent or the chuck is defective.

Chucks should be handled carefully. If a chuck does not screw off the spindle easily, a length of brass bar used as in Fig. 15 will do the trick. The internal threads of the chuck can be cleaned with a length of spring wire shaped and used as indicated.

to work as close as .002 and even .001 in. of the desired size. Also, you can do internal threading with a boring tool as pictured in Fig. 23.

Boring tools are of the plain or inserted type. Fig. 25 shows a plain or solid type tool mounted directly in the tool post. This type usually is intended for small bores but sometimes is made from $\frac{1}{2}$ -in. tool steel to bore holes as large as 3 in. in diameter. Fig. 24 shows a small boring tool of this type, which is supported in a specially made holder. A boring tool having an inserted bit is shown in Fig. 22. This tool provides maximum rigidity and is used in boring large holes. It is economical as the small bit can be replaced. The holder is adjustable vertically to substitute for the rocker adjustment used on other boring tools. Whether the boring tool is of the solid or inserted type the shape of the cutting section is the same. Fig. 27 gives clear-

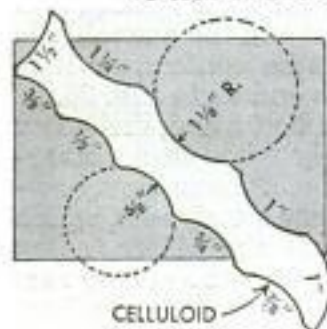
Shelf for Draftsman's Instruments Swings Under Table



Instead of keeping his drawing instruments and other equipment on a table or chair near his work, one draftsman attached a swinging shelf to his drawing table for holding these articles. The shelf is a piece of hardwood of suitable dimensions, and is attached by pipe and fittings. By leaving two joints loose, the shelf can be swung out of the way when not in use.

J. B. Baucher, Montreal, Can.

Handy Fillet and Radius Gauge Cut From Celluloid



As a timesaver in checking fillets and radii, this handy gauge, which can be cut from celluloid or clear plastic, will be useful to cabinetmakers and metal workers as well as to home craftsmen. The gauge need be only as large as a pocket comb. All radii are laid out by compass, then routed and filed smooth.

Jules Duchin, Bayonne, N. J.

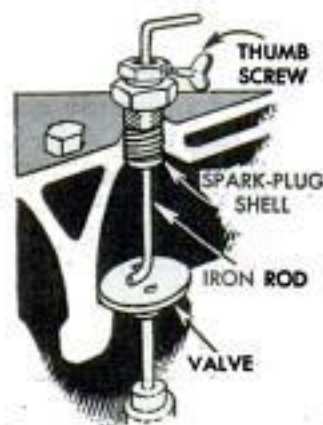
Stain-and-Shellac Mixture Speeds Wood Finishing

The usual two operations of finishing wood by staining and shellacking can be combined easily to save time. To do this, mix boiling water, 1 qt., with the required amount of stain powder, and then add bicarbonate of soda, 1 oz. This will saponify

the water and permit the addition of 4-lb.-cut white shellac, 2 oz. Let the mixture cool, then spray or brush in the usual manner. In storage, this mixture will keep just as well as plain water stain.

Replacing Auto Valve Springs Without Removing Head

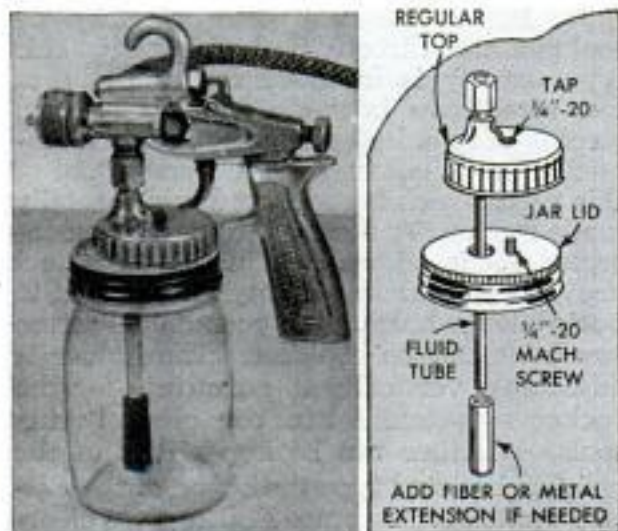
The job of replacing auto valve springs without removing the cylinder head is made easier by the use of this little tool, which holds the valve down while the spring is compressed to remove the keeper. The tool consists of the shell of a discarded spark plug and



a short length of rod held by a thumb screw as shown. A hole is drilled and tapped in the spark-plug lock nut for the thumb screw, and the rod is inserted through the plug and bent to shape. To use the tool, remove a spark plug, screw in the shell and turn the rod until the end rests on the valve. Then push it down and tighten the screw to lock the rod so that the spring can be compressed.

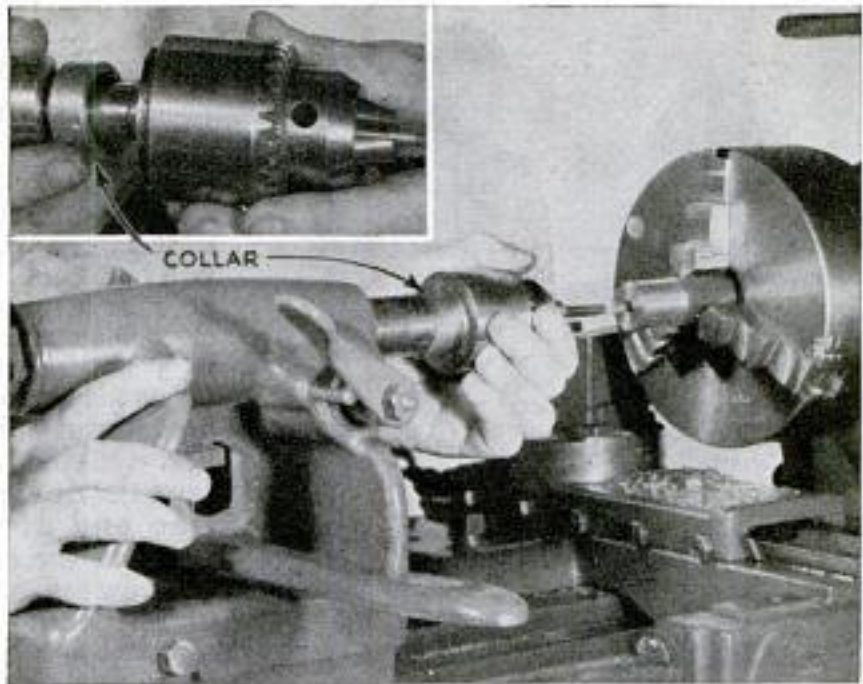
Spray-Gun Top Can Be Attached To Any Size Glass Jar

If you have a suction-type spray gun you can easily adapt it for use on any kind of glass jar that may be available. Cut a hole in the lid of the jar for the fluid tube and fasten the lid to the regular spray-gun top with a short machine screw. If the fluid tube is too short to reach well into the jar, it can be extended with a short piece of fiber or metal tubing.



Tapping in Lathe Done With Chuck and Collar

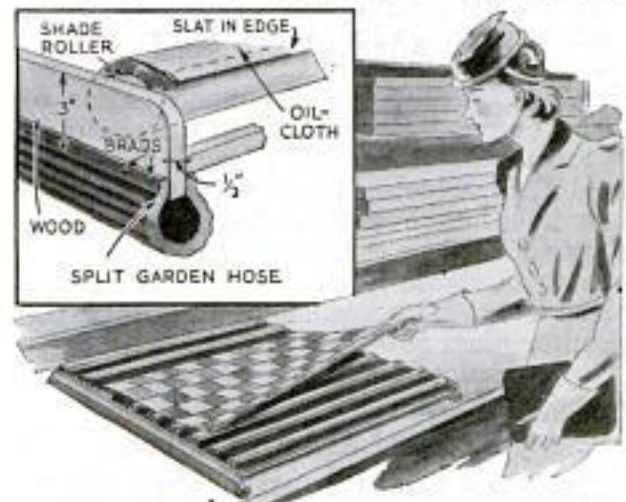
Here is a simple way of using a drill chuck to do light tapping jobs in a lathe. This method is accurate and much faster than hand tapping. To set up the lathe for the work, first turn a metal collar that will slip loosely over the chuck shank, making the collar just wide enough to prevent the chuck from seating firmly so that it can be rotated when placed in the tailstock ram. In use, center the work to be tapped in the lathe chuck and hold the tap in the drill chuck. After starting the lathe to rotate the work, feed the tap into it by advancing the tailstock while you grip the drill chuck with one hand to keep it from rotating. On light work you will find that the chuck can be held as the tap



advances into the work, but when the tap reaches the bottom of the hole the chuck will spin.

Samples Wound on Shade Rollers Are Easily Inspected

Merchants will not only save time, but will prevent soiling or damaging their yard goods such as oilcloth by frequent handling, if they show only samples of the goods instead of unwrapping and exhibiting entire bolts. The samples are wound on window-shade rollers, which are held in a frame on the counter. The frame consists of two wooden strips long enough to support the desired number of rollers, and two end pieces that join them as shown in the detail. A length of split garden hose is slipped over the lower edge of each strip to protect the counter and prevent the frame from sliding when the samples are pulled out for display.



Rubber Ball Forms Shield for Lens of Flashlight Carried in a Toolbox



To avoid damage to the lens of his flashlight when it was tossed around in his toolbox, one mechanic cut the side from a small hollow rubber ball and then slit the edges of the opening so that it could be forced over the lens cap to cover it. This provided a resilient shield that could be taken off or put on with ease.

☐ A light oil generally is more efficient than a heavy oil for a car, since oil must flow to bearings, piston rings and similar parts before its lubricating action can begin, and heavy oils will not flow readily between such closely fitting parts.

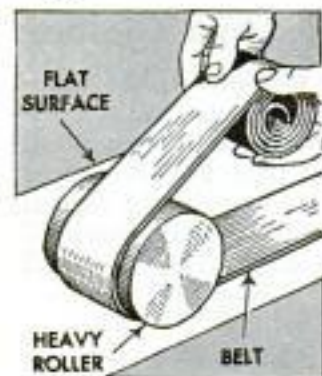
Lighted Box Under Counter Top Helps Customers View Negatives



Merchants who accept films for developing and printing can build additional good will among their customers by installing under the glass of a counter top an illuminated box for viewing finished negatives. The box, which can be made either of wood or metal, is fitted with a lamp bulb of low wattage and covered with a sheet of opal glass, which diffuses the light so that negatives held over it can be viewed easily. Vents should be drilled or punched in the box to dissipate heat. The box is held in place by metal hooks slipped between the counter glass and frame as indicated.

Bruce MacIntosh, Galveston, Tex.

Heavy Roller Laid on Leather Belt Squeezes Out Cleaning Solution



After cleaning grease and dirt from a machine-pulley belt of leather or cotton by immersing it in a naphtha, gasoline or other cleansing solution, it can be dried quickly by extending it on a flat surface and laying

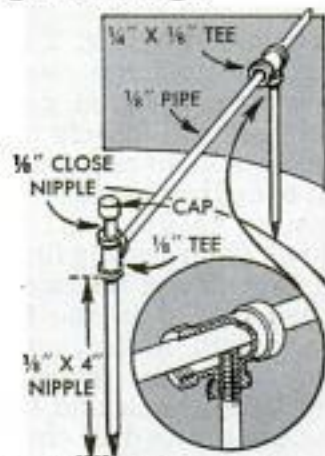
on it a heavy roller such as a length of bar stock of suitable dimension. Then one end of the belt is pulled up, causing the roller to move along and squeeze the belt.

The heaviest roller available should be used in order to squeeze out the liquid.

W. F. Schaphorst, Newark, N. J.

Large Beam Compass Assembled From Pipe Fittings

Pipe fittings are used to make the beam compass shown here, which will be found suitable for laying out circles or arcs of very large diameter as the beam, or horizontal member, can be of any length desired. One end of the beam is threaded to screw into a tee, in one end of which a 4-in. nipple is screwed tightly, the other end being pointed. A pipe cap on a short nipple is screwed into the upper end of the tee as a hold down for pressing the point into the work. Another tee, of 1/4-in. bore, slides on the beam, and a 4 1/2-in. nipple, pointed like the other, is screwed into it. This nipple is threaded so that it can be screwed against the beam to lock the nipple.

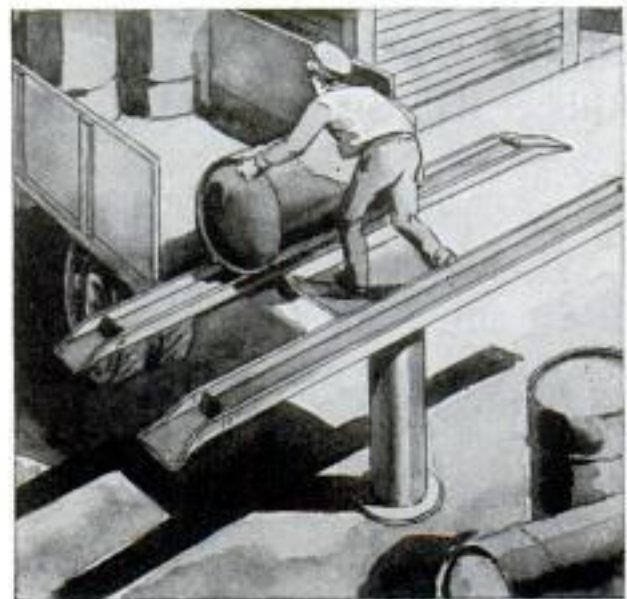


Julian N. Weathers, Sheffield, Ala.

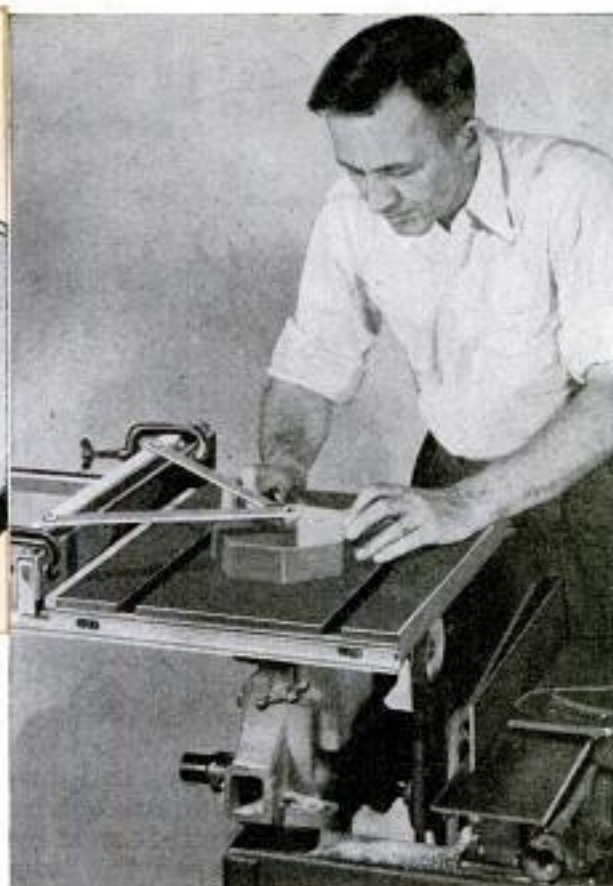
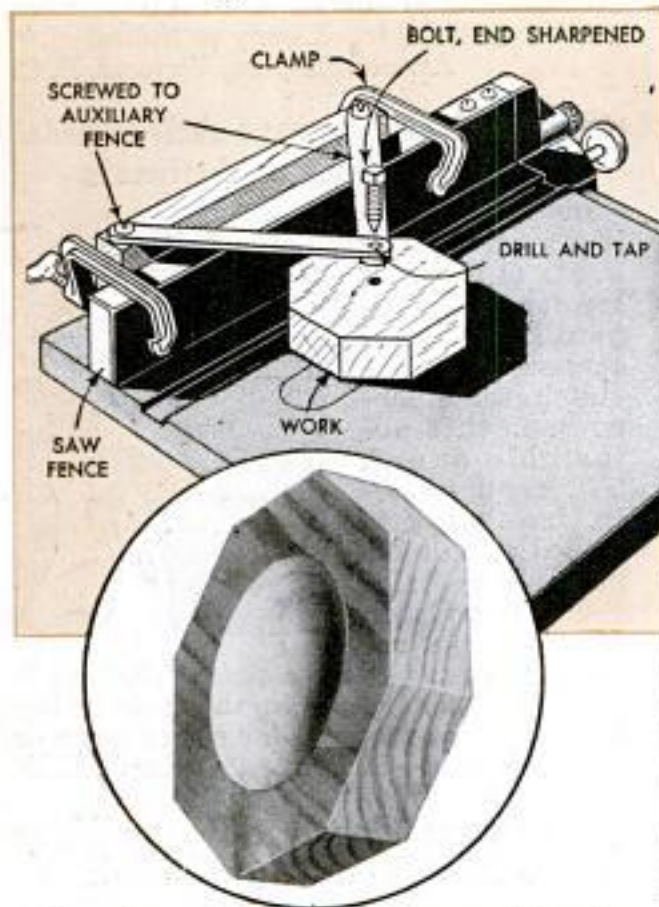
Bulky Freight Is Handled Easily By Using Auto Lift

The owner of a filling station uses his auto lift to load or unload oil drums and other heavy freight. To do this, roll a drum on the lowered lift and raise it to approximately the height of the truck bed. Then back the truck into position, adjust the lift flush with the bed and roll off the drum.

Cpl. Harold A. George, Keesler Field, Miss.



Molding Head on Circular Saw Cuts Recesses

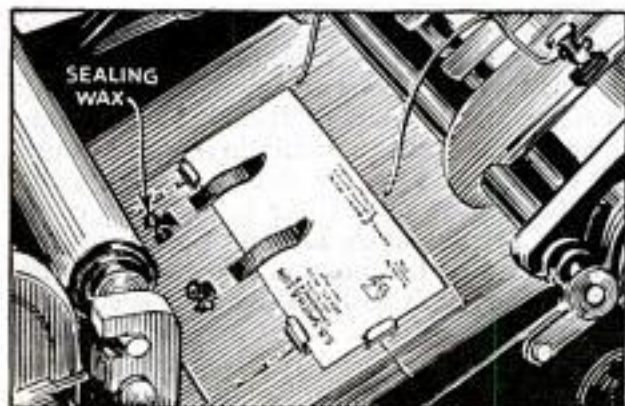


Round recesses in ash trays, small bowls and similar pieces can be cut quickly on a circular saw of the type on which the table or saw blade can be raised and lowered. A molding head is attached to the saw mandrel, although the work can be done with a regular blade. For a pivot on which to rotate the work, a bolt having the end ground to a point is used. It is held directly over the centerline of the molding head by two lengths of flat iron, which are screwed to a board or auxiliary fence. This is clamped to the regular saw fence as shown. With

the work fitted to the pivot, the saw table is lowered gradually until the required depth of cut is reached. Then the work is rotated to complete the recess. This method is faster than lathe work and can be used to good advantage in production runs, as the cut requires a minimum amount of sanding. The average circular-saw molding head will cut a recess of 4-in. diameter by $\frac{3}{4}$ in. deep. Special long knives or larger heads can be used if needed, the shape of the cutter being immaterial so long as the actual cutting end is not too wide.

Printing Warped Envelopes Simplified by Metal Fingers

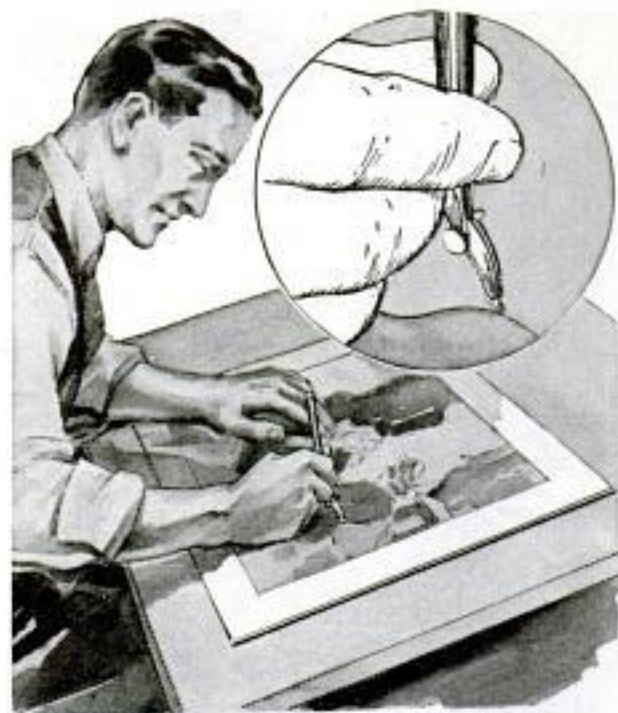
Feeding envelopes into a platen press by automatic feeder is sometimes difficult because the envelopes do not lie flat, causing



them to slip past the gauge pins. I solved this problem by cutting and bending two lengths of flat clock spring to the shape shown, and then inserting the ends in the tympan sheet, where they are held by sealing wax to act as fingers for work fed against the gauge pins. The fingers guide the envelopes to the gauge pins and hold them even when the press runs at high speed.—G. T. Clayton, Los Angeles, Cal.

☞ If radiators are painted when they are only moderately warm, the finish will last longer than it would if they were painted when either stone cold or very hot, since a moderate heat tends to bake the paint on, but extreme heat cracks the finish.

Knife Blade Set in Contour Pen Cuts Ben Day Speedily

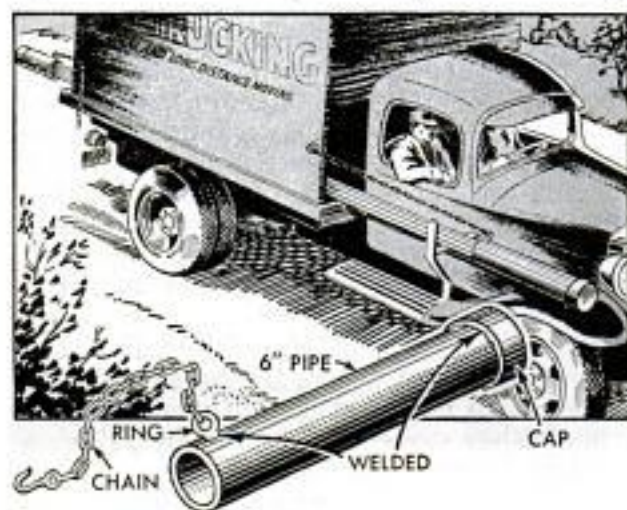


Trimming the edges of Ben Day and similar transparent application patterns can be speeded greatly by using a knife formed by clamping a thin blade between the jaws of a discarded contour pen. Such a knife can be made by grinding down a small blade so that it fits snugly in the pen. Then both blade and pen are cleaned and tinned and sweat-soldered together.

Ronald L. Ives, Tooele, Utah.

Iron Caps Slip Over Long Pipe To Keep It on Truck

In my work as a trucker, I often haul long pipe, rods, etc., that project from both ends of the truck body, and experience considerable difficulty in preventing the material from slipping either forward or backward when traveling over hilly country. The trouble was finally avoided by

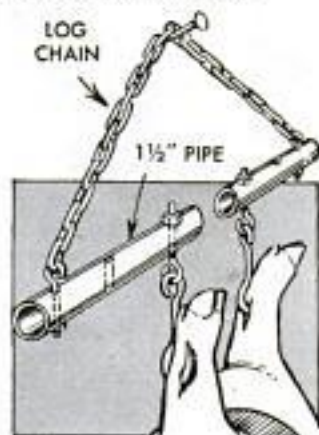


making holders of 6-in. pipe like the one shown. These were slipped over bundles of the material and fitted with chains for attaching to the truck body as indicated.

Arnold Malpass, Victoria, B. C.

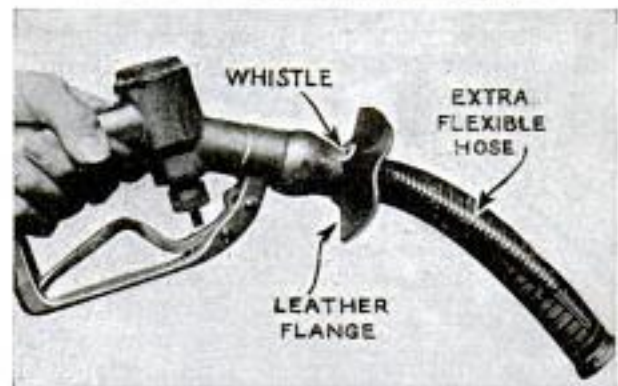
Gambrel Hooks Are Adjustable To Suit Various Animals

Instead of having several gambrels of different lengths for suspending animal carcasses of various sizes, a butcher uses this adjustable one. A 5-ft. length of 1½-in. iron pipe is drilled at suitable intervals to take ⅝-in. eyebolts on which hooks are



hung for suspending a carcass. The pipe is held by a chain as shown, the eyebolts being spaced as required for either large or small animals.—D. Bruyer, Burbank, S. D.

Whistle on Gasoline-Pump Hose Tells When Tank Is Full



When a motorist tells Dale Watson, owner of a gasoline service station of Lasara, Tex., to "fill 'er up," the service station proprietor does so without looking into the filler hole to see when the tank is full. Air displaced by gasoline as the tank fills sounds a small whistle on one side of the filler hose nozzle. The whistle is mounted on the end of a short flexible hose as indicated. When the gas level in the tank reaches the bottom of the short hose, air cannot enter and the whistle stops. Length of the extra hose is determined by the lengths of the tank filler tubes most commonly serviced. A leather flange at the upper end of the hose nozzle fits over the tank filler tube to help prevent displaced air from escaping without passing through the whistle.

Gene Smith, Raymondville, Tex.

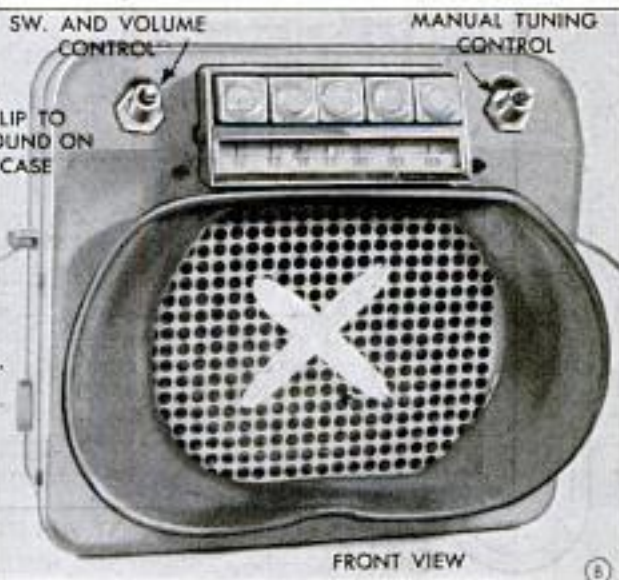
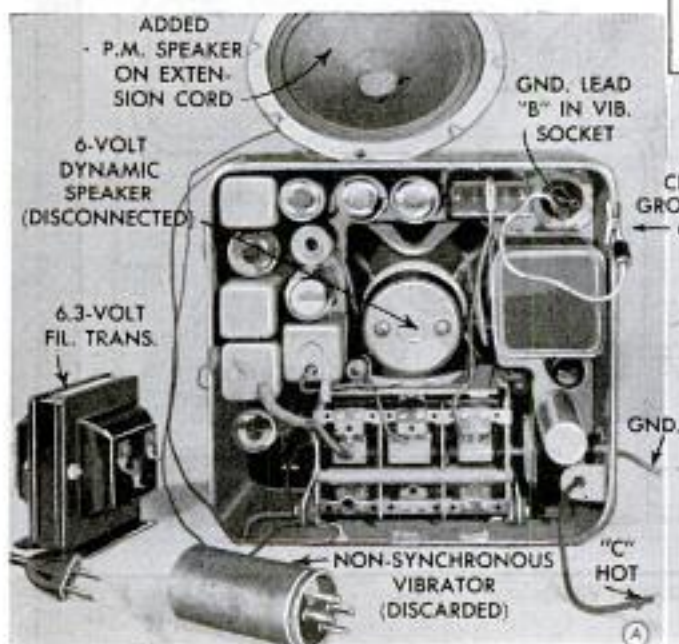
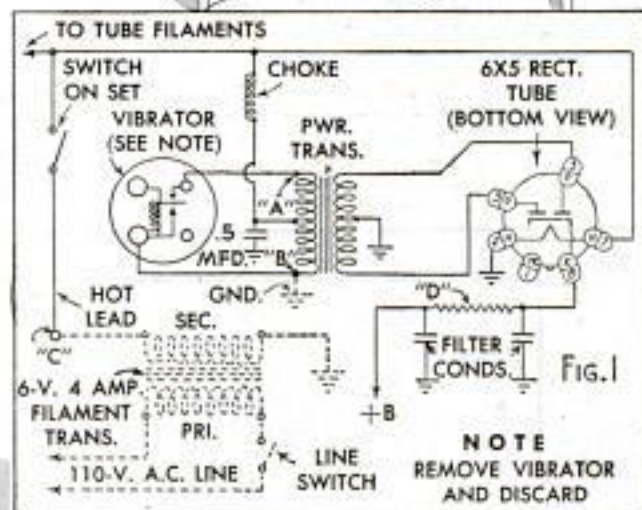
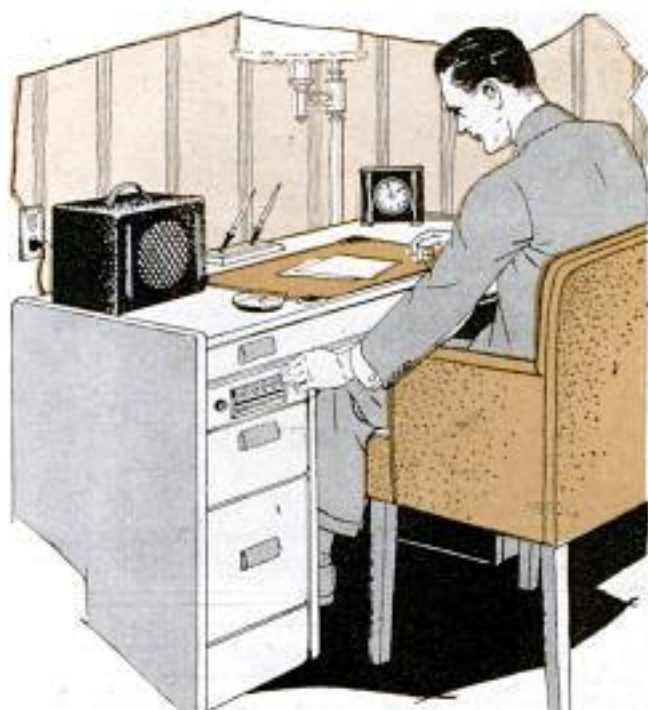


AUTO RADIO CONVERTED FOR A.C. OPERATION

By Joseph Vanella

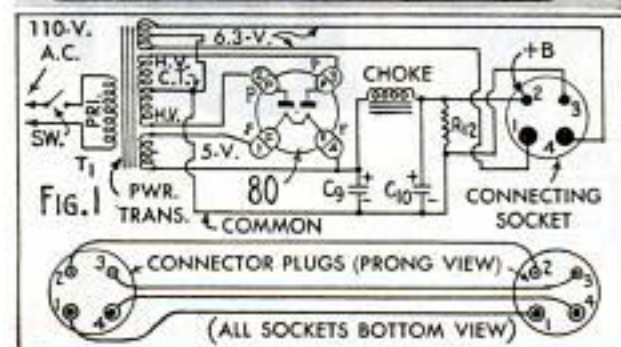
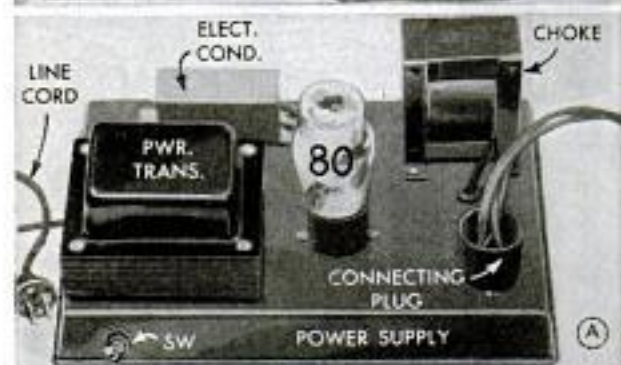
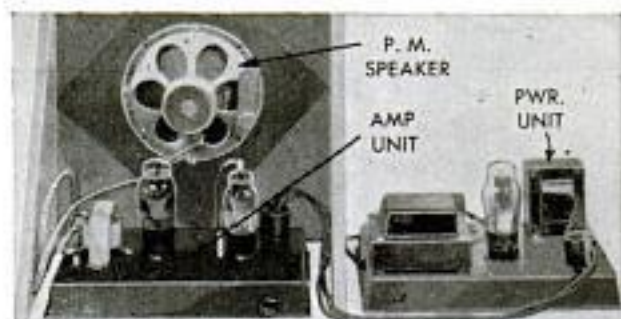
IF YOU have an idle auto set that employs a non-synchronous vibrator—and most of them do—it is a simple matter to change it over for 110-volt a.c. operation in your home or office. The receiver can be installed in a console cabinet or in a desk drawer as illustrated if sufficient ventilation is provided.

First remove and discard the plug-in vibrator unit. Next, ground point "B" on the power transformer; this is done by simply tracing the lead in the vibrator socket as indicated in Fig. 1, soldering a flexible lead to the socket prong and bringing it out to a spring clip on the metal case as shown in photo A. Now disconnect the 6-volt dynamic speaker, photo B, in the set and substitute a permanent magnet type speaker. Connect a 6.3-volt, 4-amp. filament transformer, as indicated by the dotted lines in Fig. 1, to the input 6-volt "hot" lead at point "C"; the other secondary lead goes to ground on the chassis. If the set uses an 0Z4 rectifier tube, change to a type 6X5. To do this connect a wire from the filament prong lug of one of the other tubes to pin No. 7 on the 0Z4 socket and connect its No. 2 pin to ground. If excessive hum is present, use a 15-hy. 75-ma. choke in place of the resistor at point "D."



THREE-TUBE EIGHT-WATT "CAKE

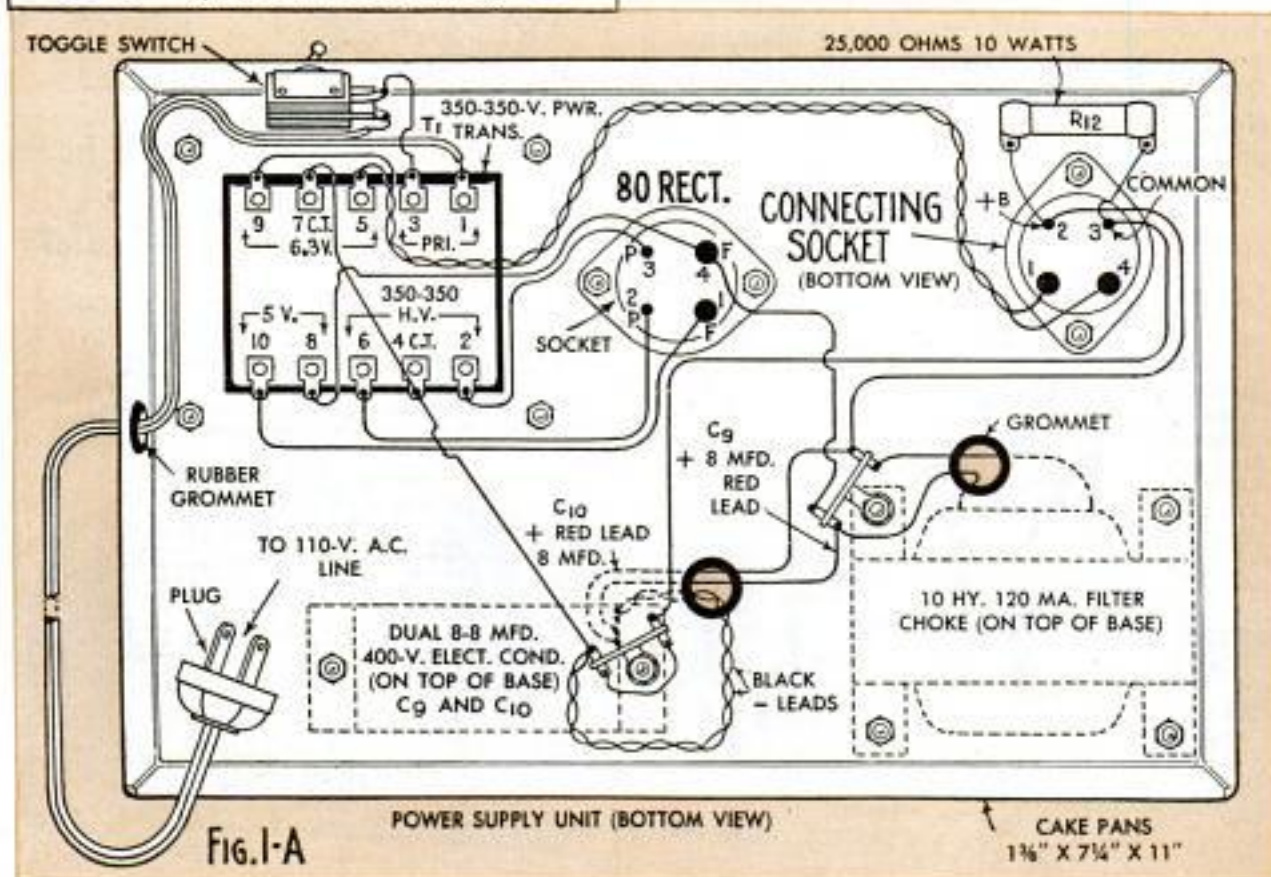
By Stan Johnson



SPLENDID tone quality and plenty of volume are features of this practical and easy to build phono amplifier which is conservatively rated at 8 watts of audio output, or about twice the volume that could be used in the average room of a house. The secret of its excellent tone quality lies in the use of a circuit employing degenerative feedback. Hum and all forms of distortion are thus reduced to a very low value. Only three tubes are employed; a 6V6-G may be substituted for the 6L6-G output tube without any circuit changes. Ordinary gunmetal-finish cake pans are used for the power unit and amplifier proper; any pans of similar dimensions may be employed as chassis bases. Building the amplifier and power supply in two separate units has one important advantage: the 300-volt power supply unit may be used later to power a small amateur transmitter.

The power supply transformer should have three windings: a 6.3-volt winding for the tube heaters, a 5-volt winding for the type-80 rectifier tube, and a high-voltage winding providing about 350 volts each side of the center tap at 100 ma. or more.

A schematic circuit diagram for the power supply unit, photo A, appears in Fig. 1 and the pictorial wiring diagram in Fig.

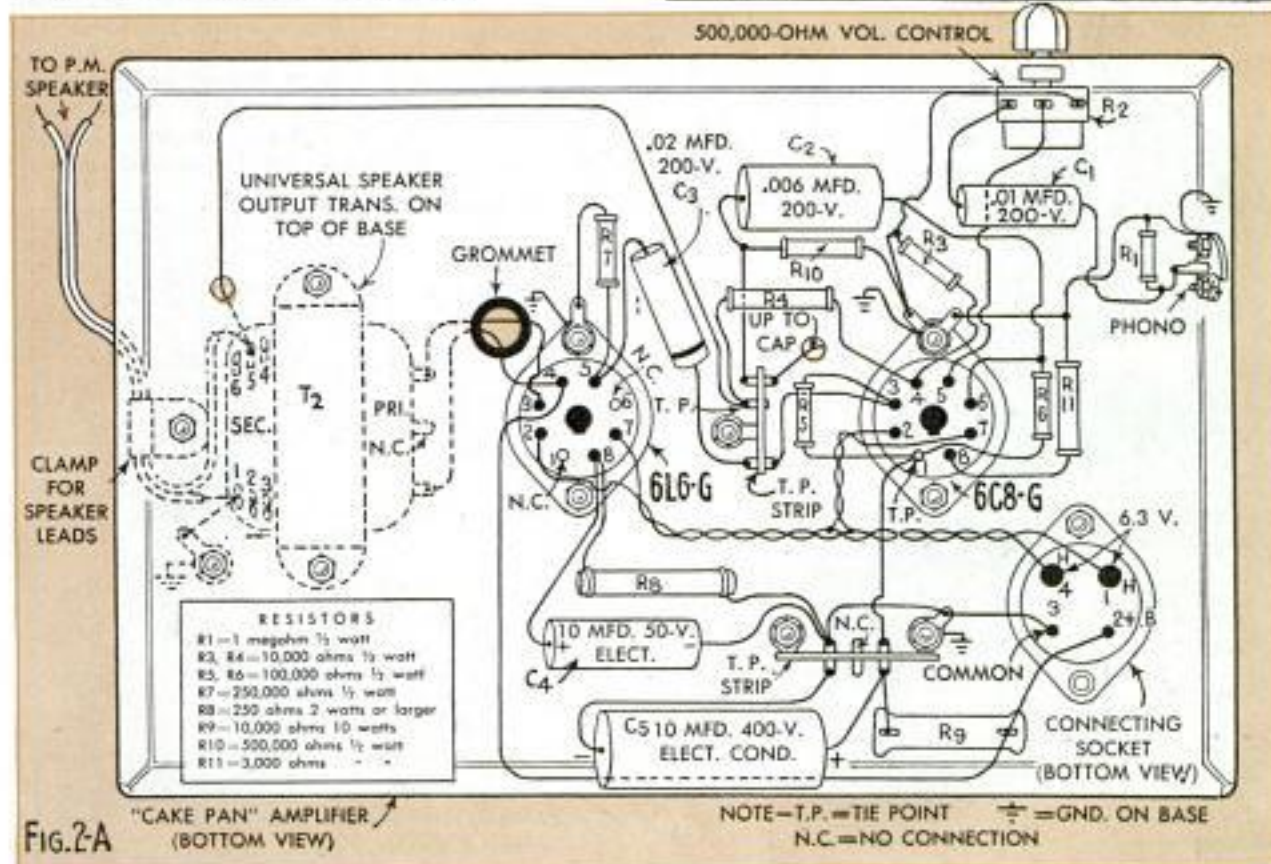
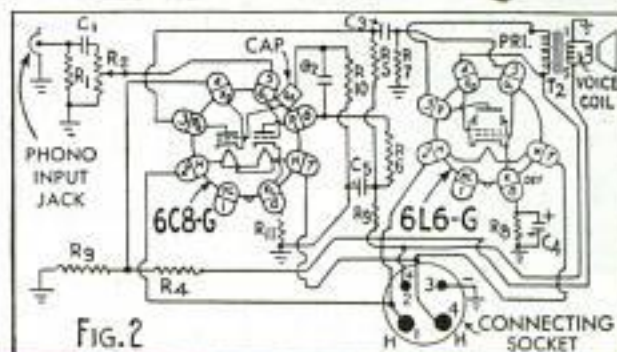
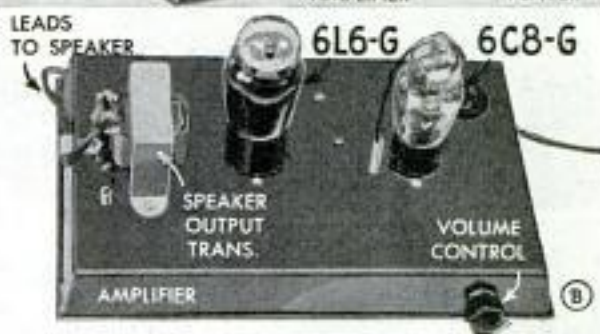


PAN" PHONO AMPLIFIER

1-A. Filter condensers C_9 and C_{10} may be either 8 or 10-mfd. dual electrolytic units. Output voltage leads for the tube heaters, the high voltage B-positive and common ground are brought out to a 4-prong socket. A 4-prong plug-and-cable connector about 2 ft. long is used to couple the power unit to the amplifier.

All parts used in the amplifier unit, photo B, are standard values found in any well stocked experimenter's junk box. The universal output transformer T_2 should be of good quality. The taps selected must match a 4000-ohm load for the tube. A PM speaker any size from 8 to 12 in. may be used. This is mounted on a pressed wood panel 2 ft. square supported by simple wooden end pieces as shown in the photo at upper right. The schematic circuit diagram for the amplifier unit is given in Fig. 2 and the simplified wiring diagram for this unit appears in Fig. 2-A.

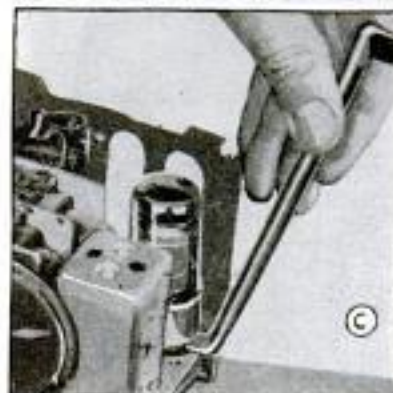
To operate, plug your record player, either crystal or magnetic pickup type, into the "phono" jack, set the gain control (R_2) at about half level and switch on the amplifier. If there is a loud howl in the speaker turn off the amplifier and reverse connections 1 and 5 on the speaker output transformer. Detailed student material list R-338 is available from Popular Mechanics radio and electronics department upon receipt of ordinary letter postage.



Helpful RADIO HINTS



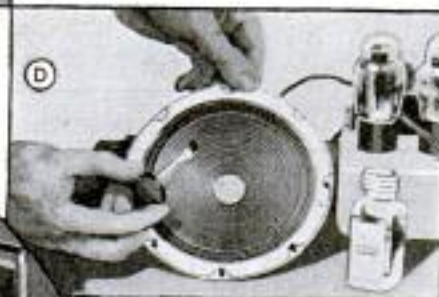
(A) All soldered connections in radio circuits should be mechanically strong and free from corrosion to be electrically efficient. Rosin core wire solder is used for this purpose; heat the work thoroughly, and avoid the use of acid flux



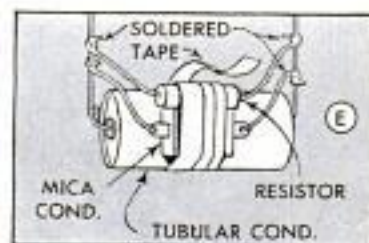
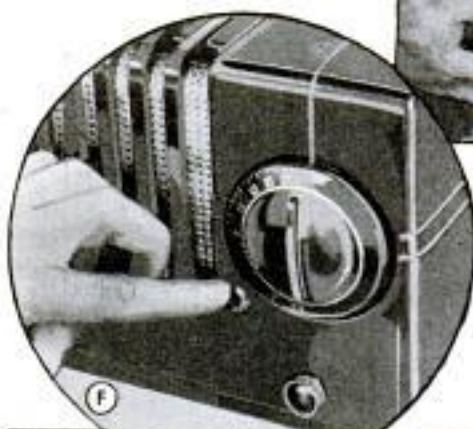
(B) Dust lodged between variable condenser plates may contain minute metal particles that can cause crackling noises when tuning. A pipe cleaner run between the plates as shown will clean them. (C) An offset screw driver is handy for removing tight-fitting tubes from chassis sockets; an ordinary screw driver may be bent for the purpose



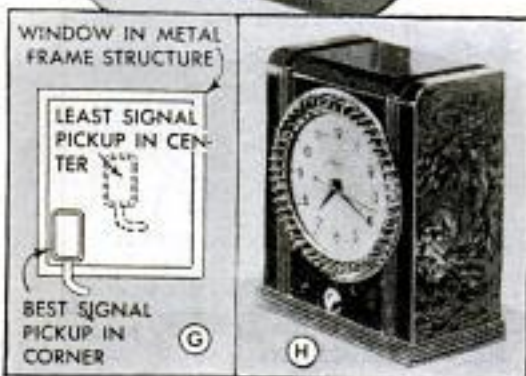
(D) Cracks and tears in speaker cones are easily repaired with radio service cement



(E) Scotch tape holds associated parts for soldering; (F) Separate on-off toggle switch for small set having combination line switch and volume control but no pilot light. Connected in series with line cord it permits presetting of volume control for desired volume



(G) Best signal pickup position for portable set employing extension type loop antenna; (H) Telechron robot timer for turning "on" or "off" radio receiver, light, etc., at predetermined moments; (I) Simple base and panel assembly for student sets



Fighting names

THAT BELONG TOGETHER



"Airacobra, Avenger, Corsair, Hellcat, Lightning, Mustang, Thunderbolt, Black Widow, Wildcat"—these and other equally descriptive fighting names were the scourge of the vaunted Luftwaffe—have ~~all but~~ cleared Jap-infested skies. There's one more name common to all of them that just naturally belongs with such a world's champion team—and that is CHAMPION Spark Plugs.

The Champion Spark Plugs you buy for your car are blood brothers to these aircraft Champions. Naturally they insure an extra measure of performance, economy and dependability in every engine.

CHAMPION SPARK PLUG COMPANY
TOLEDO 1, OHIO

CHAMPION SPARK PLUGS





One of the great dramatic moments in railroading occurred when the Cotton Belt changed the gauge of its 419 miles of track in a single week end. The scene pictured above is our artist's conception of the closing hours of this successful old-time race against time.

CHANGING THE MEASURE OF RAILROADING

It was September in 1886. All along the Cotton Belt, from Bird's Point, Mo., to Texarkana, old spikes came out. Rails were shifted. New spikes sank home under swinging hammers. The entire railroad was changed from narrow to standard gauge over one week end. The Cotton Belt had stepped along with the times.

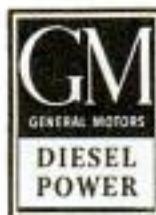
This railroad is still stepping along. It is one of 83 railroads and major industries where General Motors Diesel locomotives are changing the measure of railroading.

Watch what happens when complete lines and systems are GM Dieselized. Far faster freight hauls. Quicker, more comfortable, and more reliable travel for passengers.

And reduced maintenance by sturdiness that goes a million miles or more without major overhaul!

Yes, the measure of railroading is changing — for the better. And GM Diesel locomotives are helping to bring about this new benefit for the railroads, for the country, and for you.

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Buy MORE Bonds



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MULTIPLE UNITS ... Up to 800 H.P. } DETROIT DIESEL ENGINE DIVISION, Detroit 23, Mich.

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Here's how your car feels after MARFAK chassis lubrication

THE REASON WHY: Texaco Marfak lubricant provides a tough, adhesive film that cushions chassis bearings against road shocks, increasing the riding comfort of the car and adding substantially to its life. Marfak maintains its consistency at the outer edges of the bearings, sealing itself in and sealing out grit and dirt.



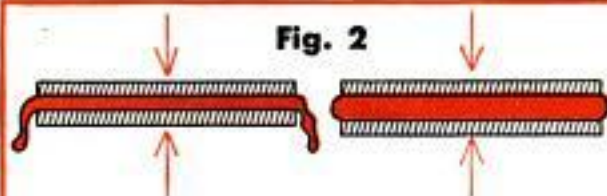
Fig. 1



Marfak cushions the blow, sticks to the job, doesn't spatter when given the hammer test. Ordinary lubricant spatters in all directions, flying away from the job.

Marfak chassis lubricant is scientifically designed to fully protect bearing surfaces against the destructive action of friction and road shock. You can feel its cushioning effect as you drive. Marfak has cohesive and adhesive qualities that make it cling to bearing surfaces

Fig. 2



A lubricant that is lacking in cohesive and adhesive qualities squeezes out of the bearings.

The cohesive and adhesive qualities of Marfak chassis lubricant keep it together and sticking to the job.

and resist any tendency to wash-out, jar-out, or squeeze-out, see Fig. 2.

Turn to Marfak protection today!

THE TEXAS COMPANY



Don't miss the TEXACO STAR THEATRE on Sunday nights with JAMES MELTON and famous guest stars. See your newspaper for time and station.

You're welcome at **TEXACO DEALERS**

Let us
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your car



Swift action against danger and lawlessness demands constant vigilance on the part of scout car police and utmost reliability in their equipment. That's why thousands of police cars throughout America are equipped with AC Spark Plugs. These plugs are serviced by maintenance crews, the usual practice being to clean and regap them every 3,000 miles, as recommended by AC—worn plugs being replaced promptly with AC's of correct Heat Range for today's fuels. Why not insure utmost reliability in spark plug performance for your engine, by following the same easy method? Your car will start easier, run better and save you money in fuel and oil expense.



CLEAN SPARK PLUGS
SAVE UP TO ONE GALLON
OF GAS IN TEN

AC
SPARK
PLUGS

DON'T LET UP NOW—KEEP ON BUYING
WAR BONDS—LET'S FINISH THE JOB

A Billion Dollars' Worth of Dams

(Continued from page 69)

In still another room, men peer through windows at the behavior of water freighted with bentonite, a colloidal clay that allows currents to be studied. The water coming into a reservoir is cold, therefore dense, and it carries silt, which is heavier than water. Thus it flows right under the still water in a "density current" which may carry it clear down to the dam itself. Can reservoirs be so designed as to be self-scouring, flow the silt-laden water right through and thus increase the useful life of the reservoir?

These engineers deal with true planetary forces, almost incomprehensible in magnitude. Backed up behind Boulder Dam, for example, are nearly 40 billion tons of water, which have sunk the planet's crust about five inches, and will sink it further. Hundreds of small earthquakes and earth-slips in the vicinity are attributed to this.

The silt-laden Colorado once built a delta out into the Gulf of California at about one-third of a mile a year. Now the silt-free stream is instead cutting back and melting away its delta, working upstream about three miles yearly.

Other government departments and other governments have borrowed freely from the resources and the brains of the bureau's engineering division. Several hundred studies are going on all the time.

Since this is a tax-supported public project, its data are open for public use. Savings to taxpayers direct, which are many times the division's budget, are probably matched by savings to private industry, which freely uses the bureau's studies.

Science is the Umpire

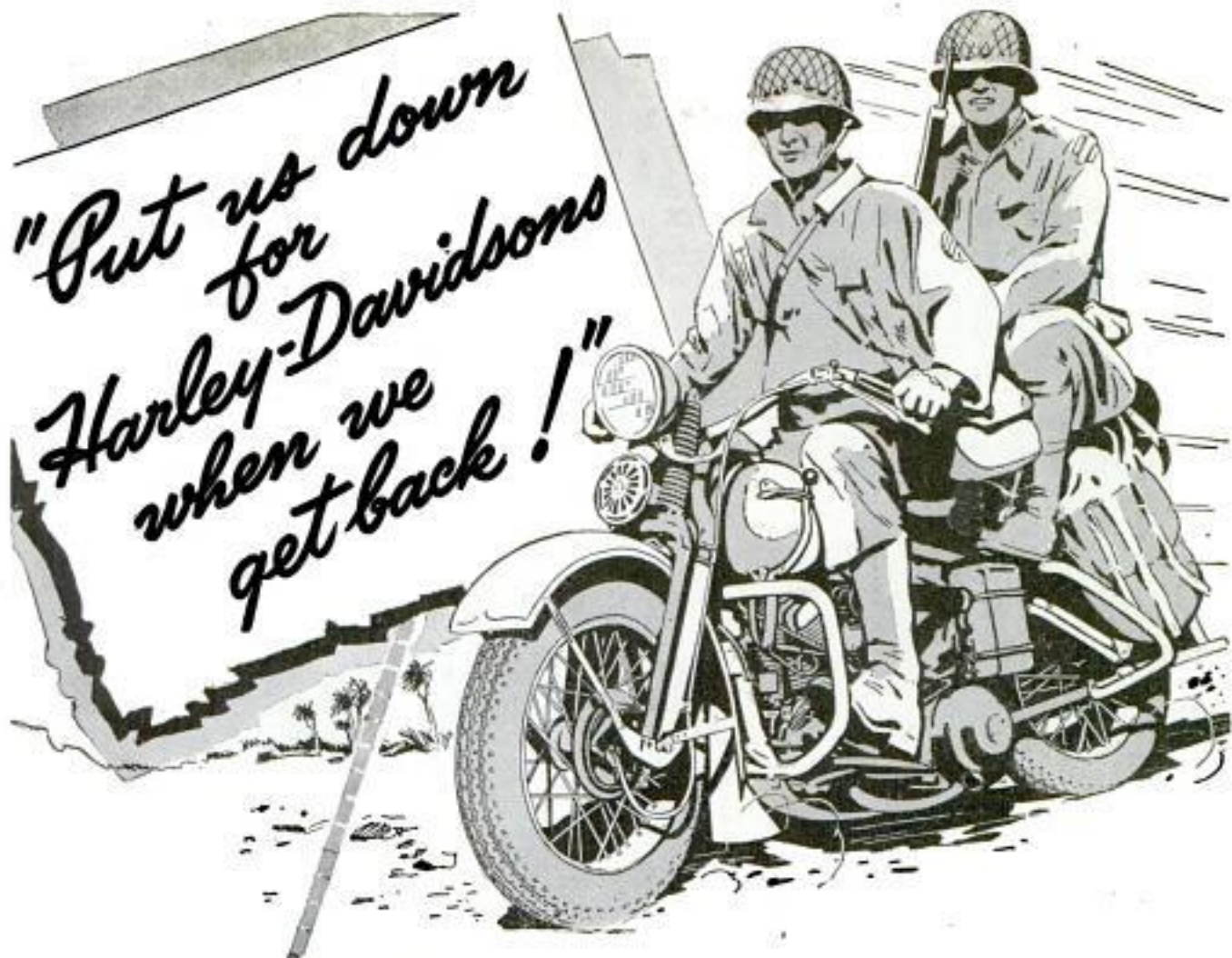
(Continued from page 47)

lesser known sports. The styles of experts will be studied at home by television to improve one's own game.

Sports reporters as we know them will fade out almost completely. Bright young experts at the home office desk will cover the game and sports writing may assume an editorial or interpretive slant.

There will be distinct changes even in sports commentating. Radio reporters today cover games from an enclosed remote booth to drown out the noise of the spectators. A noise-cancellation microphone will enable the radio reporter to describe the game as he walks up and down the field. All crowd noises will be kept away by the "lip mike" which was perfected for

(Continued to page 150)



All through this war, thousands of letters have been pouring in from our fighting men on all fronts. In every instance, the letters tell how Harley-Davidsons stand up under severest conditions of heat, cold, mud, rain and snow. Always, the letters end something like this—"Want to get this war over quickly and get back to those good old motorcycling days. A new

Harley-Davidson will be my first buy." Okay, fellows. The new Harley-Davidsons will be ready soon after the shooting is over. And you can count on it that they will have the same stamina, rugged construction and dependability that made them World Champions before the war — world beaters during the war.

HARLEY-DAVIDSON

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Please send at once free copy of 24-page "Enthusiast" Magazine, filled with motorcycle action pictures and thrilling stories.

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Don't envy others. Your floors can be as brightly spotless as the best of them—and oh so easily! Merely flow Self-Polishing Simoniz onto your floors. No rubbing—no polishing—just let it dry. Then—Presto!—Shimmering loveliness that lasts and lasts. Self-Polishing Simoniz doesn't wash off and have to be replaced every few days. It wears, in fact, much like the original SIMONIZ long famous for enduring beauty on automobiles. Cleaning's so easy, too. A damp cloth whisks off dust and dirt and your floors shine like new again. So, do try Self-Polishing Simoniz—but Soon! Sold by grocery, hardware, drug, paint and department stores everywhere. The Simoniz Company, Chicago, Ill.

SELF-POLISHING
SIMONIZ
FOR FLOORS



use in Army tanks. With the lip mike, a gadget an inch wide and weighing less than two ounces with harness, cord and plug, the future sports radio announcer will be able to keep out all extraneous sound while almost on top of the play.

If you are one of America's 15,000,000 bowlers there are pleasant surprises ahead for you. An automatic pin setter is ready and so is a mechanical "Einstein," a calculator understanding strikes and spares, to keep score.

Fishermen and radar will go down to sea together in the postwar era. Deep-sea boats, A. Paul King of the Beach Haven Tuna Club of New Jersey testifies, will be equipped with electronic detection units that spot schools of fish miles away. American destroyers, using the magic beam, have often blown up schools of fish, believing them to be submarines.

Even such a placid game as chess will be influenced. Arrangements are already under way for American-Russian team matches by short wave.

Science will eliminate the guesswork from almost every sport but one. No progress has as yet been reported on a device to beat the horse races.

"It's Impossible But We'll Try It!"

(Continued from page 81)

Its role then was that of spotter. Once survivors of a disaster were found it could signal a flying boat or surface craft to make the rescue. However, squadron officers had been experimenting with an old parachute harness attached to the end of a line for possible use by an airship in an emergency. Culbertson was carrying this apparatus.

Arriving close to the dye patch, Culbertson dropped a smoke float in the water to mark the location and to signal the PBY. The flying boat came over and had a look but didn't dare risk a landing. For once the surface was too rough for a Catalina.

With the motors throttled back until he just had steerage way against the wind Culbertson settled down close to the surface and moved up to the life raft. The occupant was soaked and shouted that he couldn't last much longer in that sea. "I'll lower a chute harness to you," Culbertson shouted back. "Wave your hand when you have it tied on!" "Right!" came the answer. The harness was lowered out of the airship's opened door. The flyer signaled and three of the crew hauled him up. They dried him out over the cabin heater and gave him hot soup.

Then Ace got a surprise. The rescued

(Continued to page 152)

LIGHTER MOMENTS with
fresh Eveready Batteries



*"I'll have to hang up, dear—one of the boys
wants the phone..."*

"EVEREADY" No. 6 dry cells are still serving in vitally important field telephone equipment for our Armed Forces.

But substantial quantities of these extra-powerful, long-life batteries are available for civilian use—for radios, ignition systems, doorbells, buzzers and other battery-operated devices.

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THE SPHINX USED
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PIPES
LIKE
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LHS TODAY, IT'S
STERNCREST
STERLING

IN EGYPT,
AND EVERYWHERE OUR BOYS HAVE GONE

LHS has never turned out better pipes, nor more pipes, in the 50 years of LHS pipe-making. And yet, so great is the demand that dealers' stock are often depleted. But, good news—with war's end, more and more LHS pipes are now available for our civilian friends. Not all models yet, but a big selection, and all pre-war quality and workmanship. Your dealer has them.



\$5

Sterling Silver Band
Model No. 21
Antique Finish

IMPORTED
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Also in plain finish.
Dozens of other
handsome models.

Also LHS
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Specially selected
imported briar,
14K gold band.
Plain and antique
finishes. . . \$7.50

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KEEP ON BUYING
WAR BONDS



Reg. U.S. Pat. Off.

FREE—"Fountain on Pipes"—Write

L & H STERN, INC., Stern Bldg., 56 Pearl St., Brooklyn 1, N. Y.

man walked forward, thrust out a hand, and said, "Thanks, Pete." Ace said, "Huh?" and looked closer. The man wrapped up in the blanket was a former college wrestling opponent, Frank Baldwin, a Marine Corps pilot.

Ace's dexterous handling of airships comes from much practice in standard maneuvers, then trial in all the situations to which such maneuvers could be adapted. An airship, he maintains, will do practically anything except loop. The cabin begins to fall back into the envelope when you approach the vertical, he explains sadly.

Such pranks are all in the past now. Culbertson has promised to stick strictly to the operations necessary for carrying out his orders. His squadron commander, a good psychologist, exacted that promise after explaining to Ace that unless he calmed down, less competent pilots might get into difficulty trying to imitate him.

So maybe it wasn't Ace who steered his ship right up alongside another airship, away offshore on lonely outer patrol. Urgently, dots and dashes of light began to wink from the arriving airship's signal blinker. Letter by letter, the commander of the other blimp gravely took down the message. It read "Wanta race?"

High Pressure Diver

(Continued from page 53)

used by Browne in the test can be carried on small salvage vessels which do not have decompression rooms. It can also be used in emergencies when a diver has to be brought to the surface in a hurry.

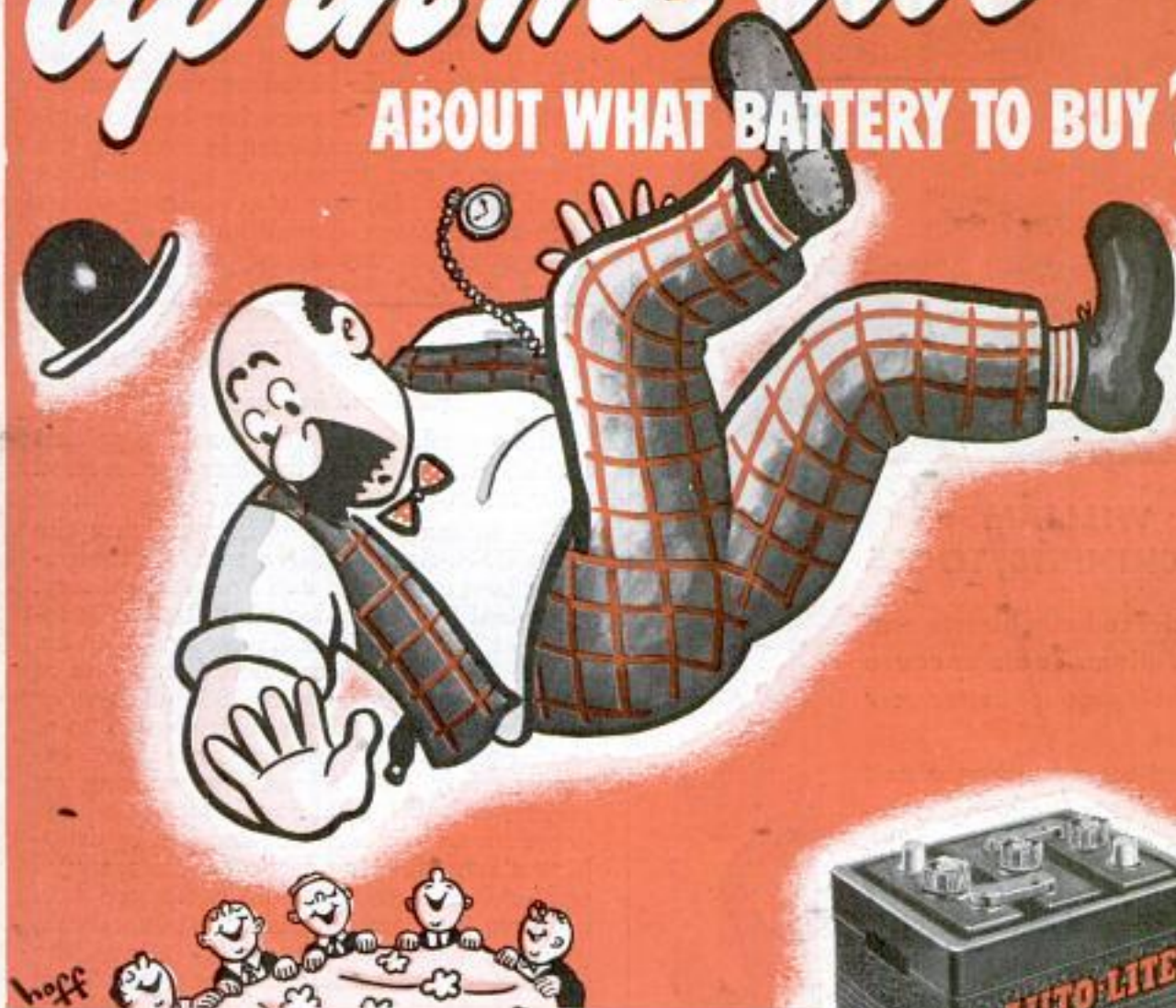
Another Browne creation, welcomed by aviators as well as sailors and divers, is an "escape vest" which carries about a 15-minute supply of oxygen. Tests have shown the vest to be practical for escaping from a submarine at 210 feet, or from bailing out of a plane in the stratosphere. All the pilot or submariner has to do is insert the mouthpiece and keep breathing. In case of ditching, the vest gives a bomber crew more time to escape and also aids in rescuing occupants of a partly submerged plane.

Browne's other inventions include a "damage control vest," similar to the escape vest but permitting work under water for a longer period; a "search board" on which a person can lie face down and peer through a plastic window to locate sunken objects; a plastic and rubber swimming mask which fits over the nose and eyes, taking the place of nose clips and goggles, and a diving helmet made mostly of transparent plastic for amateurs.

(Continued to page 154)

Up in the Air

ABOUT WHAT BATTERY TO BUY?



GET THE BATTERY EXPERTS CHOOSE

You can have the help of experts when you buy your next battery. Follow their example. They choose Auto-Lite batteries for service in the million-mile ocean-spanning Clippers, for service with our fighting forces in jeeps, tanks, half-tracs and other vehicles.

AUTO-LITE BATTERY CORPORATION • TOLEDO, 1, OHIO

Manufacturing Plants at: Niagara Falls • Indianapolis • Atlanta • Oakland • Oklahoma City • Toronto

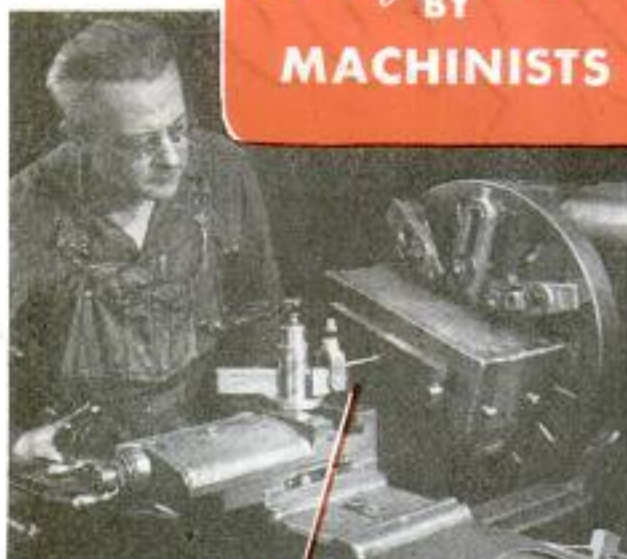
The qualities experts look for in a battery are the same you need in your car battery—long life, quick starts, dependable power and low-cost operation. That's what you get when you buy an Auto-Lite battery—specified as standard equipment by leading automotive engineers.

TUNE IN THE AUTO-LITE radio show starring Dick Haymes, with Helen Forrest, Gordon Jenkins' orchestra. Features stars of stage, screen and radio and 2-way conversations with men and women at the fighting fronts.

AUTO-LITE BATTERIES

ENGINEERED AS A BALANCED UNIT OF THE ELECTRICAL SYSTEM

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WILLIAMS MACHINISTS' TOOLS

Experienced machinists prefer Williams Tools because they help produce better work easier!

Backed by more than a half century of tool-making experience, you'll find these daily-used shop tools not only well-designed and accurately machined, but rugged and long-lasting because they are drop-forged by Williams.

Write Dept. M-10 for free Tool Data Sheets.

J. H. WILLIAMS & CO.
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DROP FORGINGS AND DROP-FORGED TOOLS

Browne has worked with Capt. John Craig and other noted deep-sea divers on many occasions. He helped design a self-contained suit with its own oxygen supply to be used in the Lusitania salvage expedition, which was abandoned just before the war. This suit eliminates the danger of fouling air lines when a diver is working on a wreck. During tests in Lake Michigan, Browne took part in what is believed to be the first radio broadcast under water.

More recently, Browne has helped supply diving equipment used in righting the Normandie and in salvage operations at Pearl Harbor. He predicts that the greatest deep-sea salvage expeditions in history will get under way shortly after the war.

Nine Lives for Battlewagons

(Continued from page 63)

to the vessel. So swiftly was the gallant carrier reconditioned that her men missed their treasured stateside leave.

The mammoth job of hospitalizing the huge U. S. fleet requires some of the nation's best craftsmen and finest machinery. A typical Navy drydock installation is located at Terminal Island, near Los Angeles, where "sick" ships are nosed into one of the two big cruiser docks, 700 feet long, or into the 1100-foot Morreel Drydock, one of the largest in the world and able to accommodate any ship afloat. Resembling an enormous bathtub, Morreel Dock is a huge depression which can be closed off by dropping a large floating section at its seaward end. After a ship has been nudged into position, the floating caisson is pushed into place by a tug and the air is let out, the sinking section sealing off the dock. Then the water can be pumped out of the drydock, leaving the ship high and dry.

In the Terminal Island shop are many highly specialized tools such as a 630-ton machine planer for armor plate. Its smallest casting weighs over 70 tons, yet it is so delicately balanced that special housing must protect it from temperature changes. The nearby optical shop rides on a floating foundation to prevent vibration from disturbing delicate instruments. Steel frameworks are erected in a yard in which, spider-like, walk huge traveling bridge cranes—1000-ton hydraulic giants with fingertip control that a girl can operate. In the riggers' shop, life rafts, cables and other outfitting gear are made. The mold loft makes templates of plywood or paper, to be reproduced in steel, while in the sail loft, the Navy's seamstresses—some old-timers of sailing days—cut and sew canvas.

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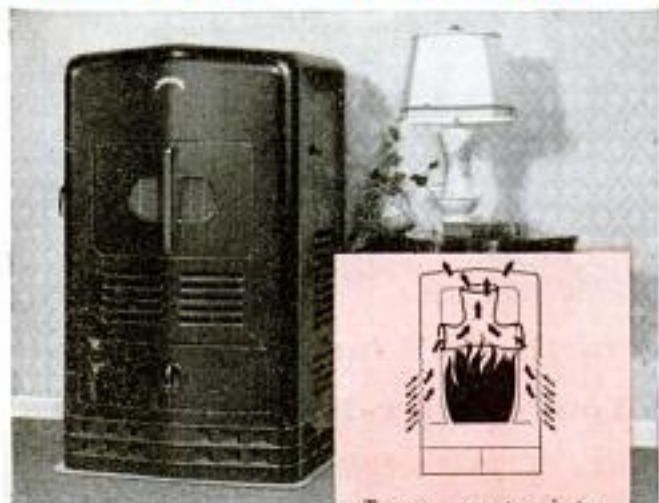


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FOR COAL, WOOD, OIL

"Fleet Under Two Flags"

(Continued from page 87)

Big 14-inch rifles and 6 and 8-inch guns blasted holes in the airfields. Jap opposition was almost negligible from then on.

The full weight of British sea power employed in the Pacific included an estimated 19 battleships, 8 large carriers, 37 cruisers, 255 destroyers, 50 submarines and hundreds of smaller craft.

Based in Australia, the British Fleet used United States bases and anchorages farther up the line in the Western Pacific. British tankers with fuel from the Middle East refueled British warships; British-made ammunition carried in British bottoms was used to rearm British warships; food from all over the Empire—New Zealand butter, Australian flour and meat, Indian tea—was eaten aboard British ships.

The British fleet train consisted of more than 100 auxiliary ships and its supply line was approximately 5000 miles long—about the same distance that the U. S. Pacific Fleet operates from Pearl Harbor. The British fleet train was made up of repair ships, tankers, supply ships, hospital ships, floating drydocks, tugs, etc., plus some types the U. S. Pacific Fleet does not have.

One of these was an aircraft repair ship. This vessel looks like an aircraft carrier and may operate as such, but its main job is to recondition planes. It carries complete machine shops and spare parts.

Another unusual kind of an auxiliary is the "amenities" ship. This is a converted 10,000-ton passenger liner devoted entirely to recreation. It has a brewery capable of turning out 9000 pints of beer a day. It contains a restaurant, store, cobbler's shop, postoffice and an ice cream shop, or "milk bar" as the British call it. A theater with movies and stage shows is open all hours.

Proud though it is of its own accomplishments in the Pacific, the U. S. Navy welcomed the help of its "senior partner." At the close of the Okinawa operation, Fleet Admiral Nimitz sent a message of congratulation to the British task force commander. He said the successful attacks made on Sakashima were most gratifying and that the British ships were to be congratulated on the "auspicious manner" in which they had initiated operations in the Pacific.

The same idea was expressed later when the King George V dropped hook in Apra harbor. A sun-tanned American boatswain's mate ran into a Liverpool signalman and invited him to have a can of beer.

Tilting his can at the Britisher, he said: "You limeys are O. K. Glad to have you out here with us."



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Grand Slam in Subs

(Continued from page 16)

Japan's famous Fujiyama, covered with snow and big as life, taken through the periscope of a submarine. Another sub surfaced so close to the Jap mainland that crew members could watch a horse race in progress. Winning horses were hastily chosen and book was made on the race.

Subs are always out in front. When the Marines were storming Tarawa, subs were sinking Jap ships in the Marianas; when we invaded Kwajalein and Roi and Namur, subs were making patrols into the Philippines. Long before Admiral Halsey took the powerful Third Fleet into the China Sea, subs had been operating there.

It was the submarine fleet again that weakened Japan's mighty bastion of Truk so that it could be successfully by-passed. Supply ships carrying precious fuel, bombs, spare parts and food to Truk were sunk regularly. When Truk was finally attacked by United States carrier planes, its resistance was surprisingly feeble.

In addition to sinking enemy merchant shipping, subs have played an important role in keeping track of the movements of the Jap fleet. A generous portion of the credit for winning the Battle of Midway has been given the submarines for their valuable reconnaissance work. In the decisive Battle for Leyte Gulf (originally called the Second Battle of the Philippine Sea), it was a lone American sub that spotted a Jap task force cruising at high speed northward from the Singapore area. That was the tipoff. The sub radioed the information to Admiral Halsey, sank a Jap heavy cruiser and damaged another.

After the surface action of that battle, which will go down in history as the greatest of sea battles, American subs hung on the flanks of the crippled Jap fleet—polishing off several warships with torpedoes.

Subs have played an important role in rescuing shipwrecked or shot-down personnel. Many a sailor or flyer owes his life to a curious submarine that came poking along at just the right time.

When the mighty Jap stronghold of Truk was being plastered by carrier aircraft in the summer of 1944, the Tang made one of the most daring rescues of all time. Twenty-two Navy pilots were downed within sight of the Japs. But, dodging treacherous coral reefs and risking fire from shore guns, the Tang went right into the Truk lagoon and picked up the water-logged airmen.

The Harder made a similar daring rescue off a Jap-held island when a lone figure,

(Continued to page 160)

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waving a shirt, was spotted on the reef. Was it an American flyer downed at sea—or was it a Jap trick? The skipper of the Harder had to make the decision. He calculated the risks and decided that if a single American life were at stake, it was worth making an effort. So he put his sub in as close as he dared and sent his gunnery officer and three volunteers in a rubber boat to investigate. The man waving the shirt turned out to be an American pilot. Another life was chalked up to the subs.

Along the 1500-mile overwater route from the Marianas to Tokyo, subs have picked up the crew of many a ditched B-29. And in the waters around the Ryukus, shot-down carrier pilots were hauled out of the sea, given dry clothing and hot food and delivered back to their ships.

Even though it made few headlines, the "Silent Service" played a spectacular and brilliant part in the defeat of Japan.

The Big Pit

(Continued from page 5)

drill presses and other tools are powered by individual motors, and the old overhead shaft and belt system is heading rapidly for the scrap pile. Machine shop workers are proudest of their giant planer, powered by a direct current motor which reverses its own direction. Speed is controlled by a rheostat panel, and voltage may be changed by a variable control.

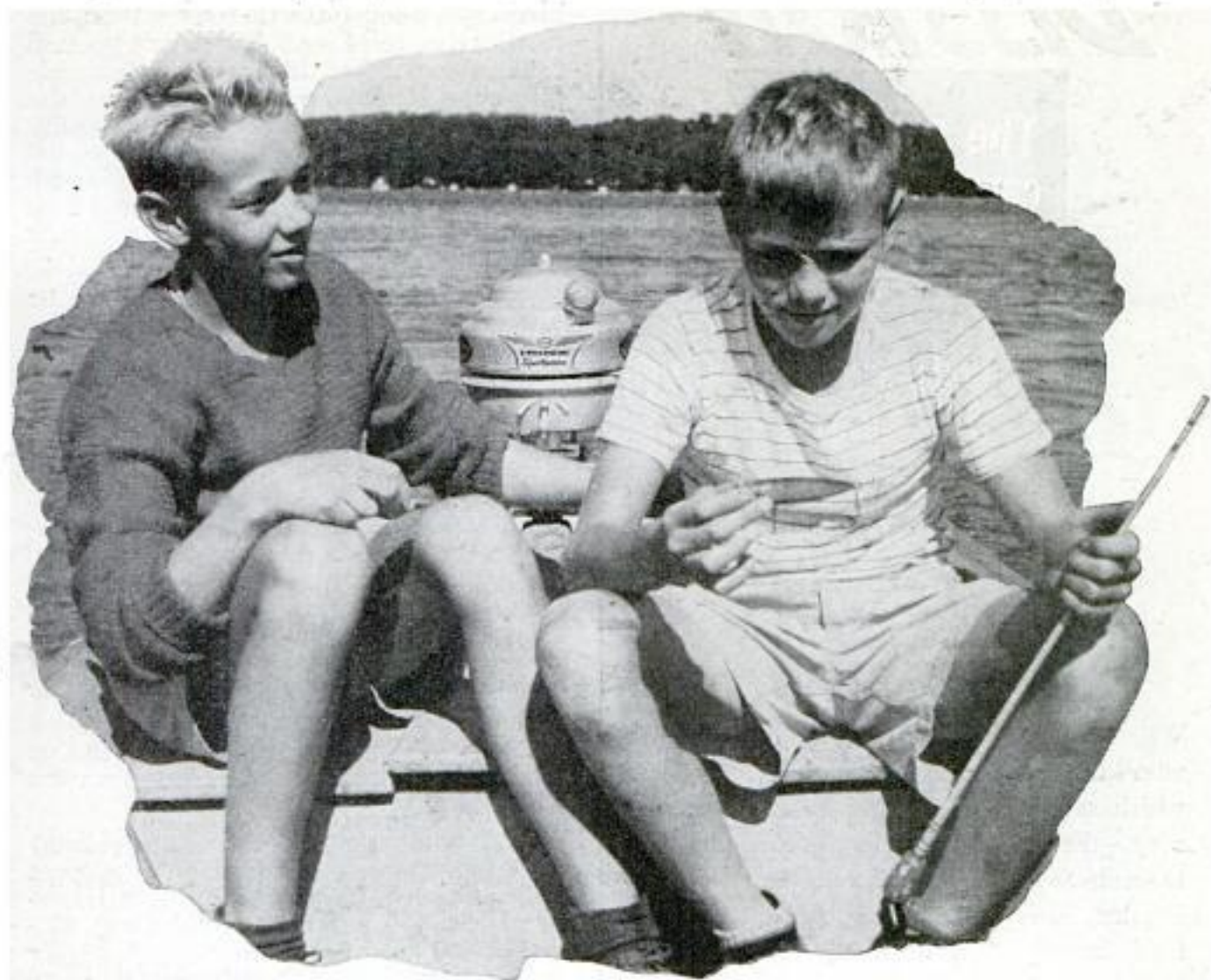
The last word in arc and acetylene welding is found in the welding shop. Here was devised a cable cutter to replace the old process of measuring out cable by hand from a drum. The wire is drawn into the cutter, and pressure on a foot control raises a meter which records in feet the length of cable passing through. In the blacksmith shop are made the big teeth for the shovel buckets, and hammers and drill bits which bite into the earth. Between times in repairing truck bodies and building wedges, carpenter shop workmen construct small houses for the shovel operators. Compact heating units keep them comfortable in chill weather, of which there is a large supply on the range.

Electric motors of all kinds are torn down and rewired in the electrical shop, facilities of which include an electric oven for baking varnish at a 250-degree temperature, maintained evenly by a fan system. In cable repairing, lines are tested at 4000 volts just as in regular operation.

Away from the regular shops is a special garage for Diesel trucks, including the 30-ton dual drive monsters which are the

(Continued to page 162)

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granddaddies of the motorized fleet. Built like a plane hangar, the garage is of fiber-board and wooden trestle construction, the trestles connected by bolts. Four 80-pound rails are anchored in concrete alongside pits over which the trucks roll into the shop. Some light trucks which were found unsuitable for ore handling came in too often for repairs, but they weren't wasted. A quick trip to the machine shop, and they were converted into traveling cranes.

A question often asked after a survey of the intensive mining in all the ranges is: "How long is this going to last? Won't the ore give out if this keeps on?"

It's difficult to get an answer. Mining companies are not anxious to open new locations before they're ready to take out the ore, for the reason that, under Minnesota law, such deposits become taxable assets and are taxed just as producing property. Municipal governments which derive the bulk of their revenue from mining taxes worry about the possibility of losing this rich income, but, significantly, you never hear an executive of a big mining company express fears about the supply of ore.

An exceedingly well informed source gave me this estimate of reserves on the Mesabi Range:

High-grade ore (52 percent natural iron) 900,000,000 tons; concentrates (40 percent natural iron), 150,000,000 tons, and low-grade ore (30 percent natural iron), 57,200,000,000 tons. The low-grade ore supply will last for years. Though practically no low-grade ore has been shipped from the range, those vast piles of waste rock will become a rich source of supply when experiments now under way have developed economical processes for extracting the ore from the rock. That they will come in time is doubted by no one in the industry.

Iron miners look with pride at their war-time record of not one labor stoppage. The mining industry employs about 24,000 at the season's peak. Although mining itself ceases in winter because the ore becomes like concrete and won't flow, management attempts to maintain a high year-round employment level, and has been successful in doing just that long before the annual wage became a subject of conversation. The Oliver Iron Mining Company long has operated on an all-year basis, and keeps its employment level stable by maintenance and stripping work in the winter.

Transportation of the ore from the pits by rail and steamer to blast furnaces is another gigantic operation, to be described in a second article in November.

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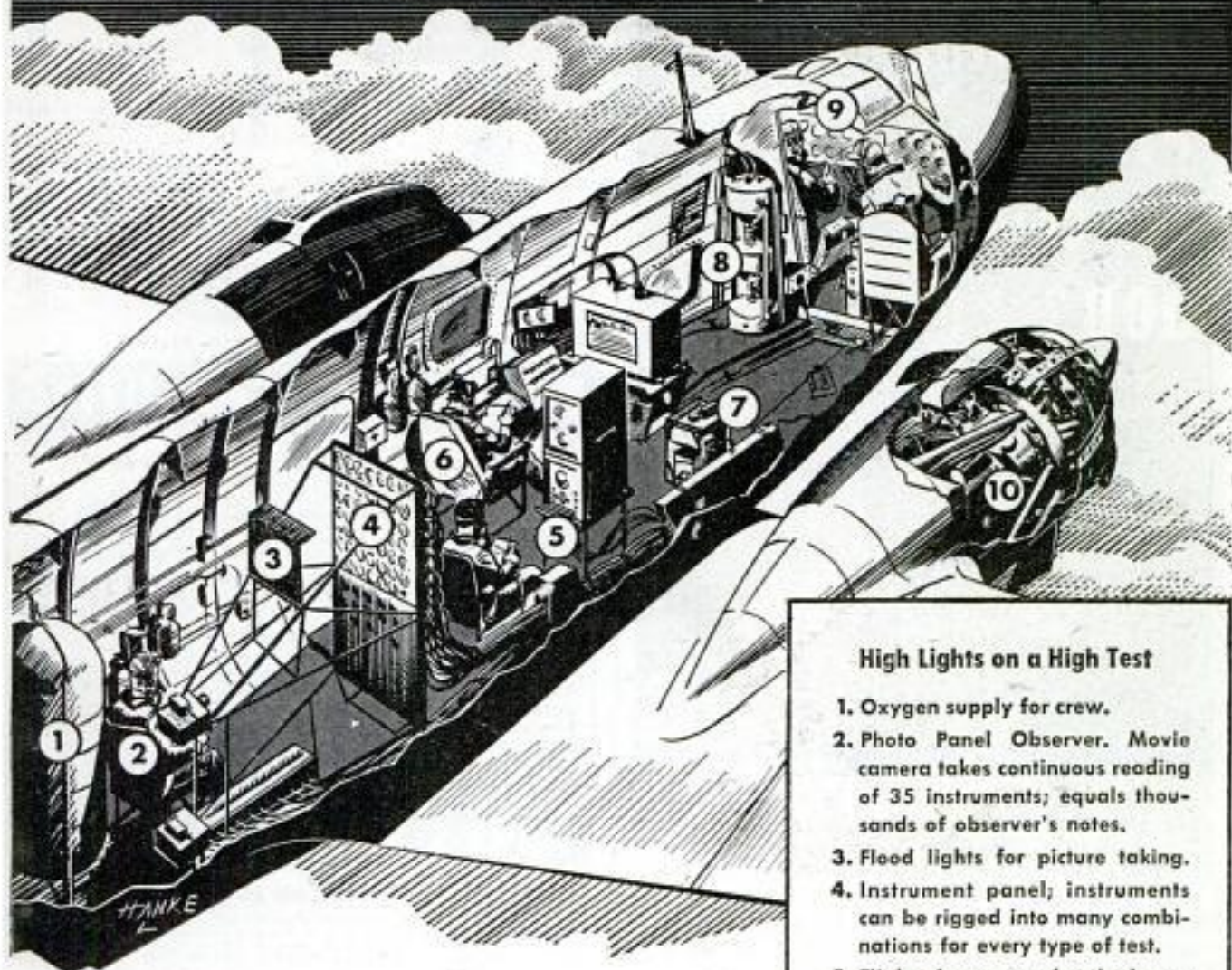
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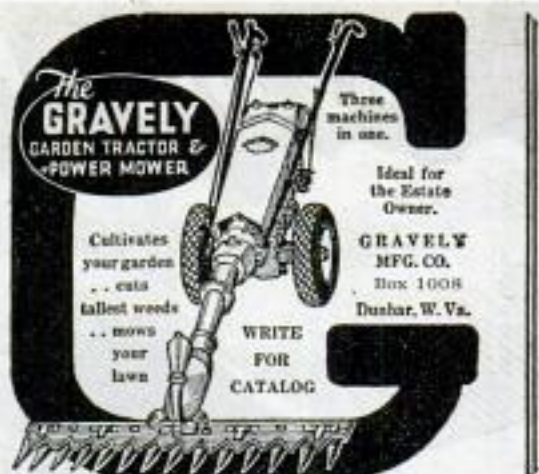
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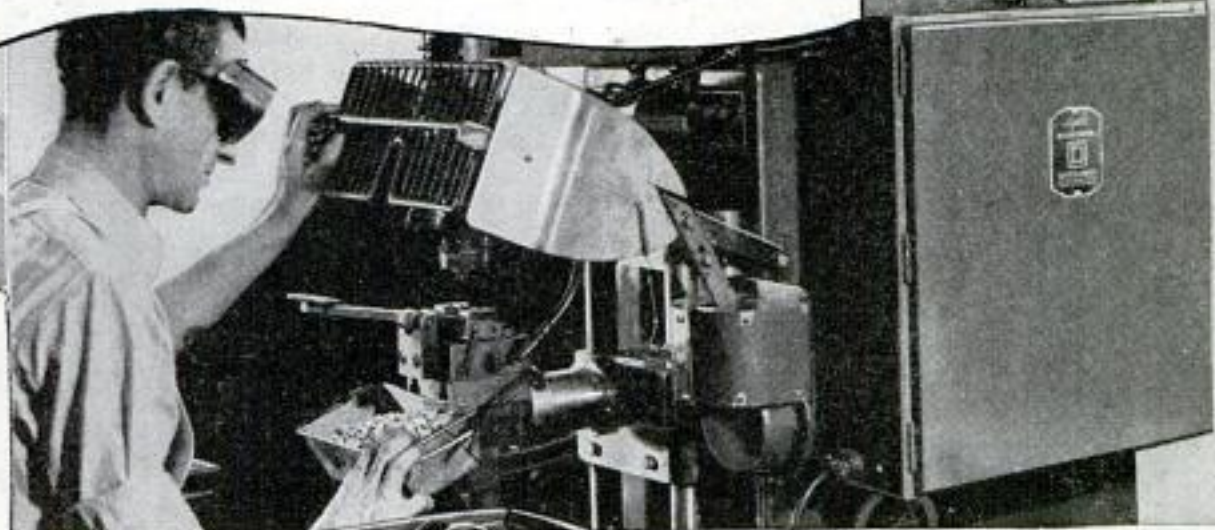
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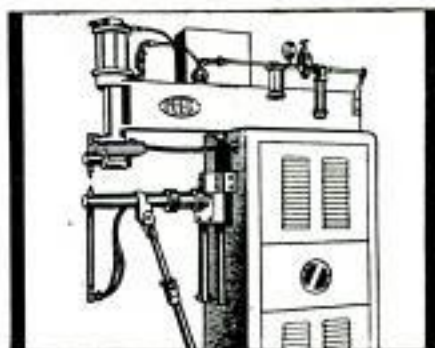
The series of P-20 Peer Welders were developed to provide manufacturers of sheet metal and wire products with automatically air operated machines capable of high speed precision projection and general spot welding. They are sturdily constructed, low priced, direct air operated, press type machines.

Shown above, is a Peer P-20 set up with safety guard which is so adjusted that, when lowered, it trips the switch and causes the welder to pass through a complete welding cycle before the machine automatically lifts the guard and stops, ready for the next operation. Other means such as a foot-switch control, can also be used to actuate the welding cycle.

The standard cylinders furnished with these welders provide nominal electrode force up to a maximum of 1000 lbs. Pressures are easily adjusted by the air pressure regulating valve. The welders may be operated with strokes suitable for work at hand within the range of from 0" to 3".

Shown at right, is the wrapper from a package of Wrigley's Spearmint Gum. This famous wrapper will remain empty until conditions permit Wrigley's Spearmint manufacture in quality and quantity for everyone. Wrigley's Spearmint Gum, will, one day, be back as "a help on the job" to workers in industry. Until then, we ask you to remember this wrapper as a guarantee of finest quality and flavor in chewing gum!

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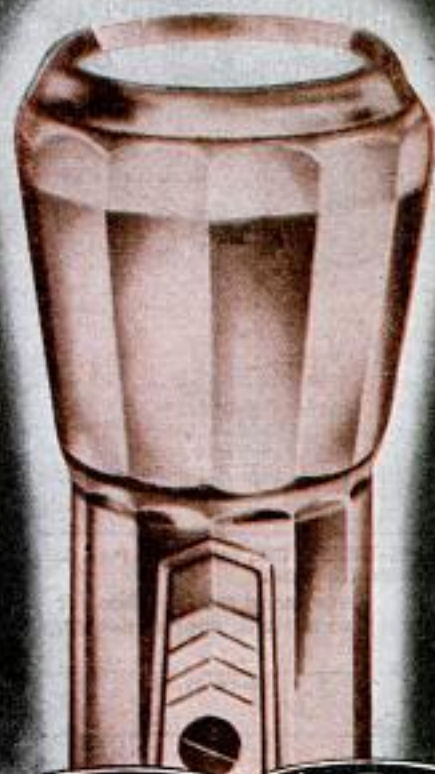


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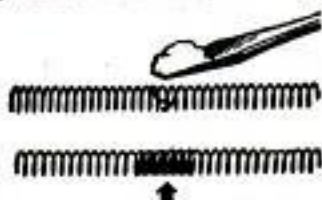
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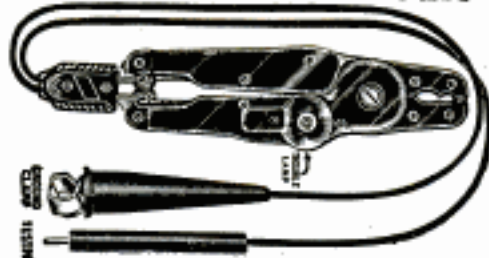
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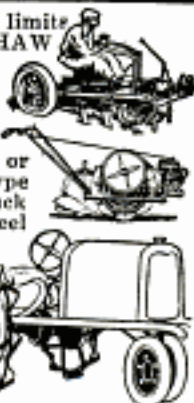
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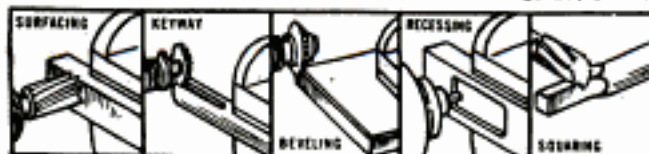
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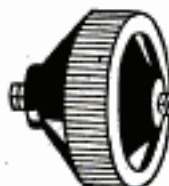
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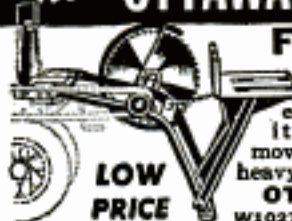
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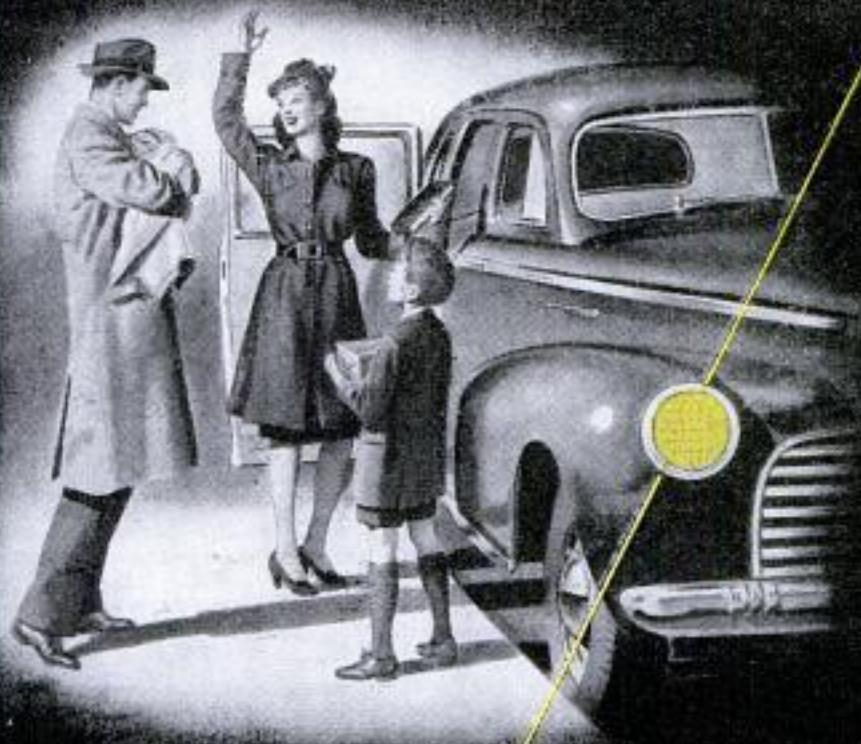


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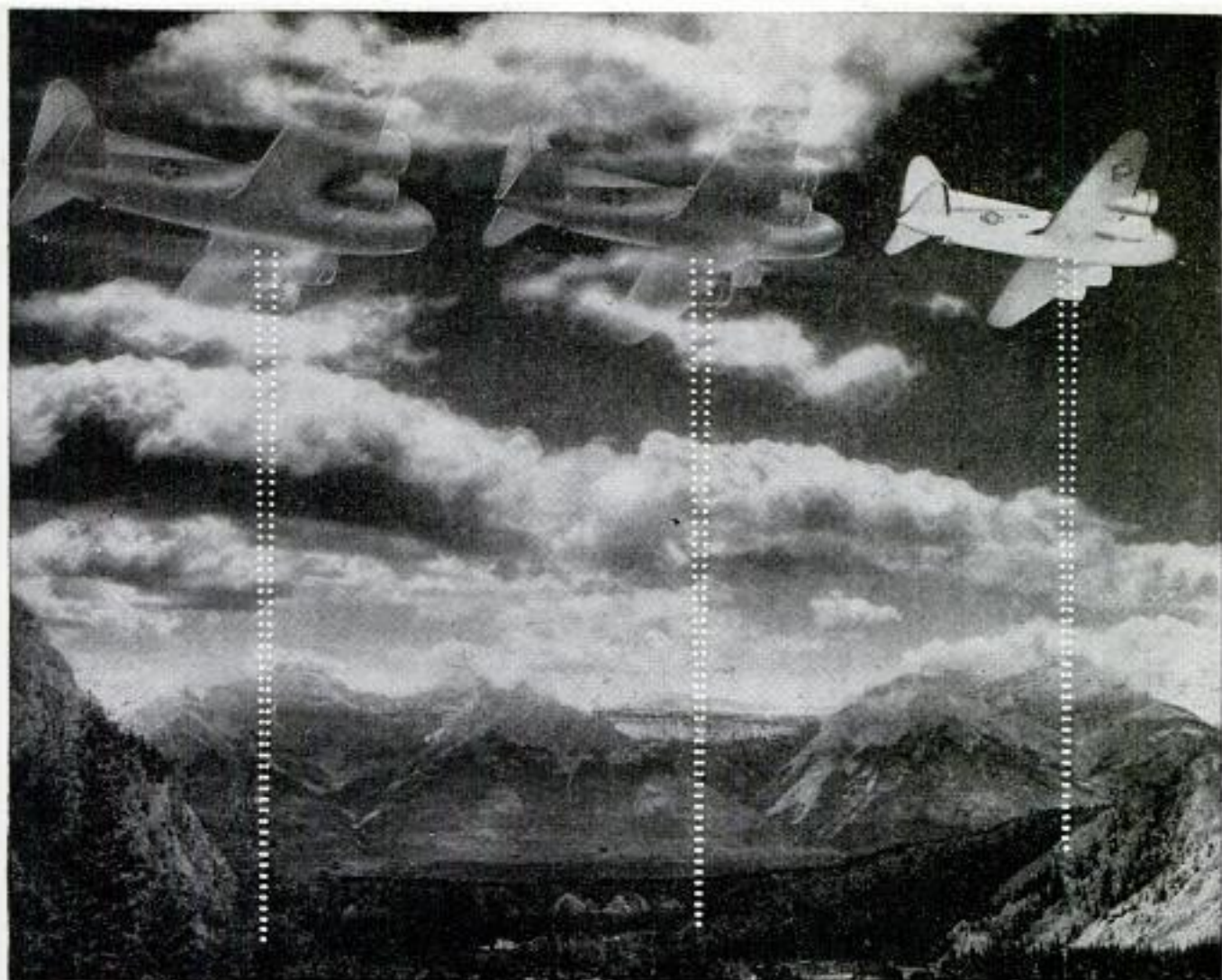
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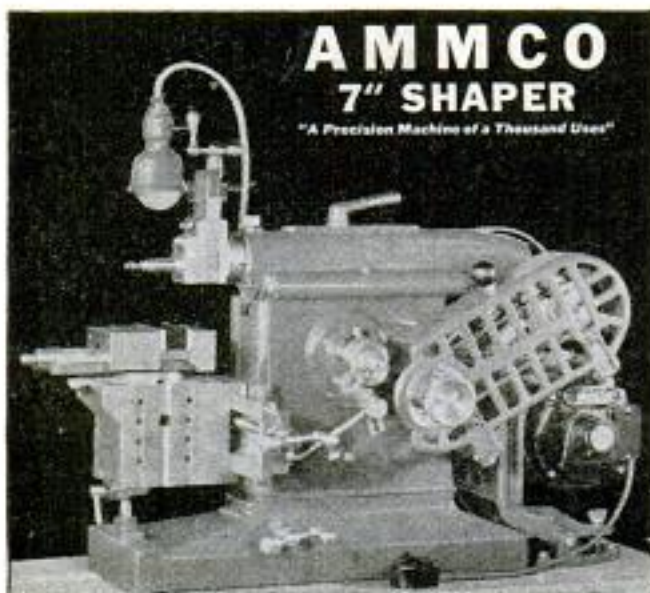
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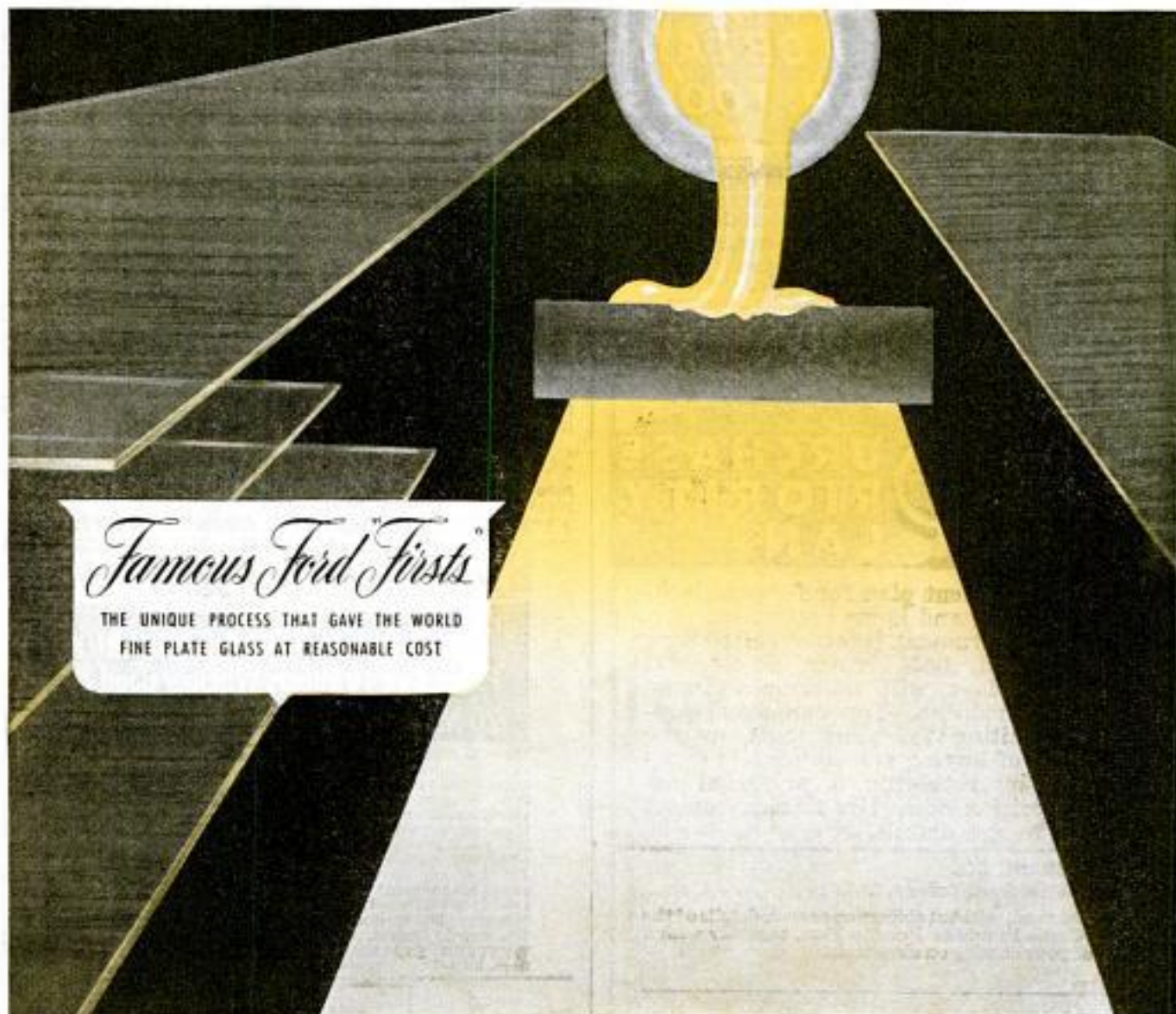
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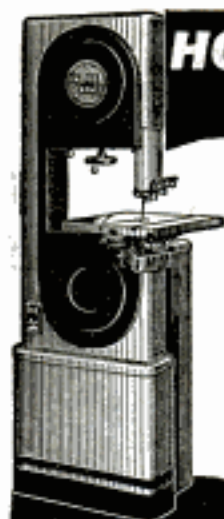
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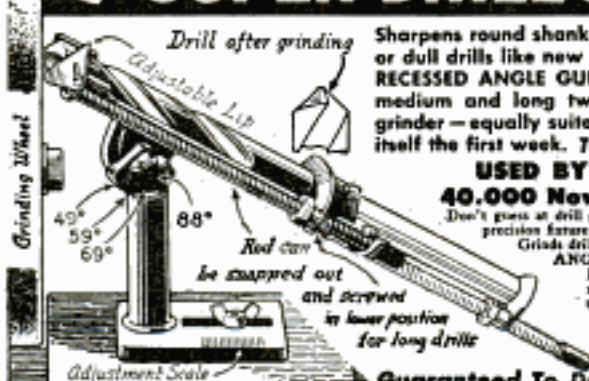
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5/16	4	3.00	13/16	8	7.00
	5	3.25		10	7.25
3/8	5	3.25	7/8	8	7.75
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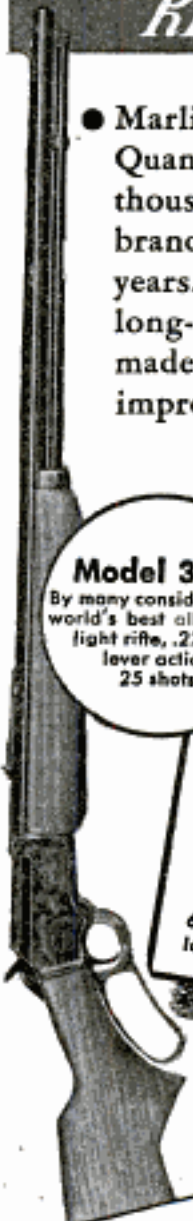
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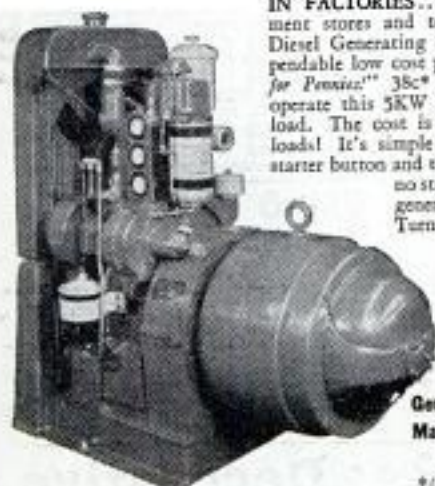
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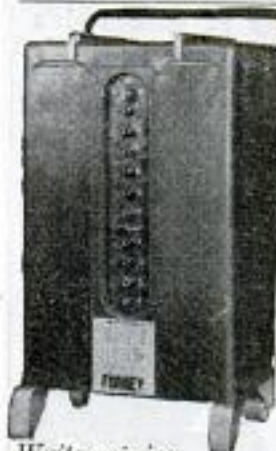
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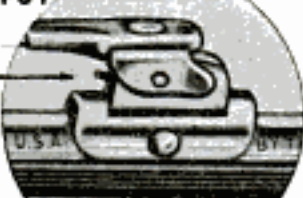
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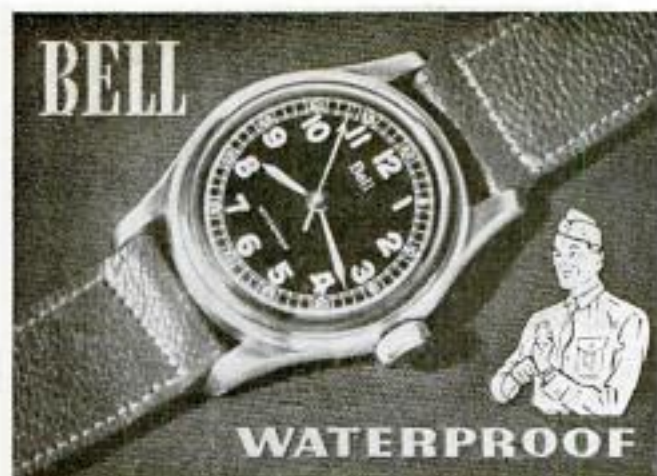
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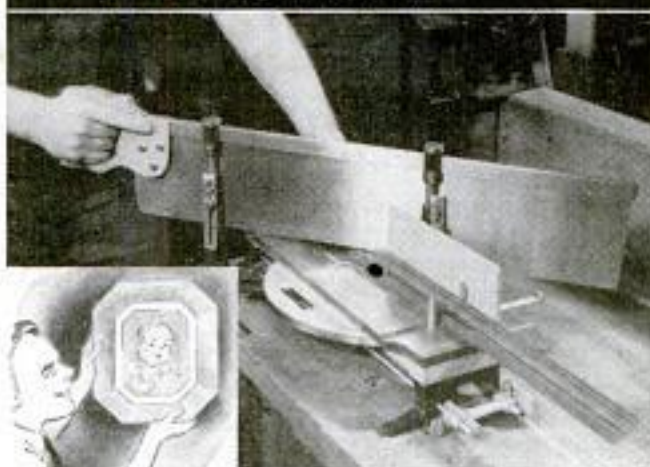
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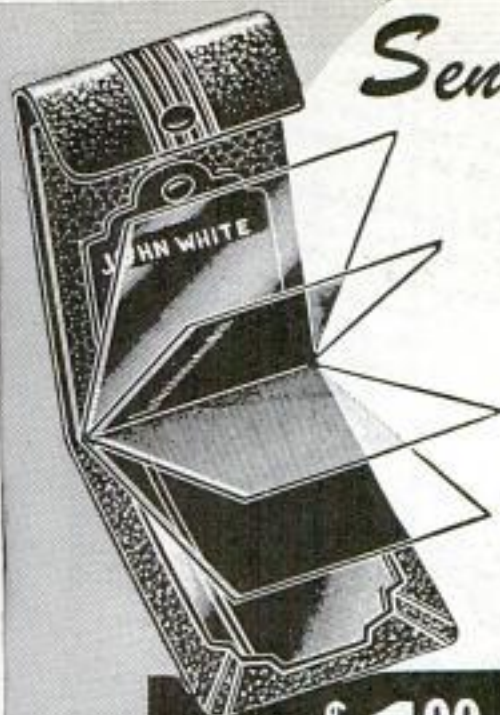
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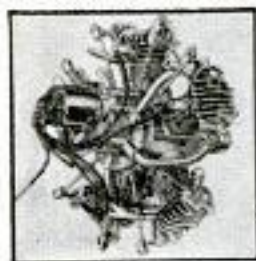
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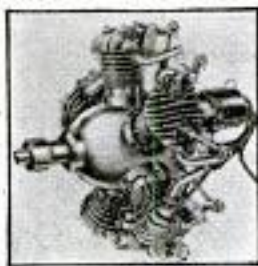
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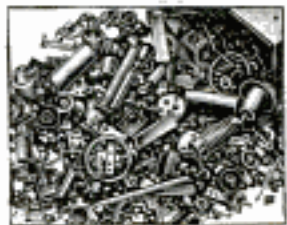
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Rules are simple and fair

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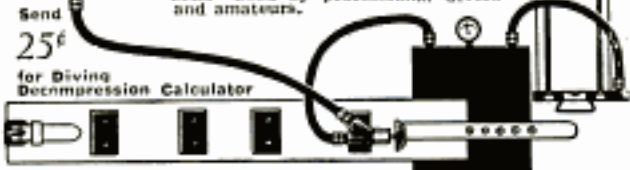
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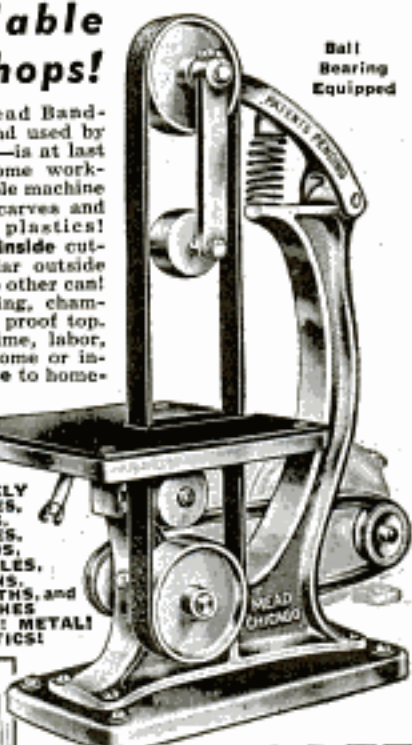
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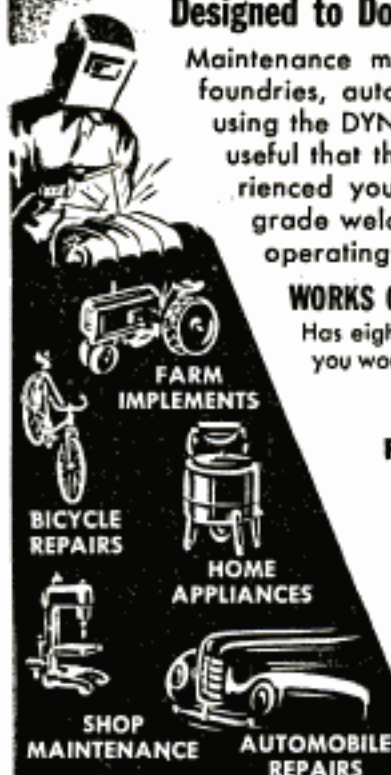
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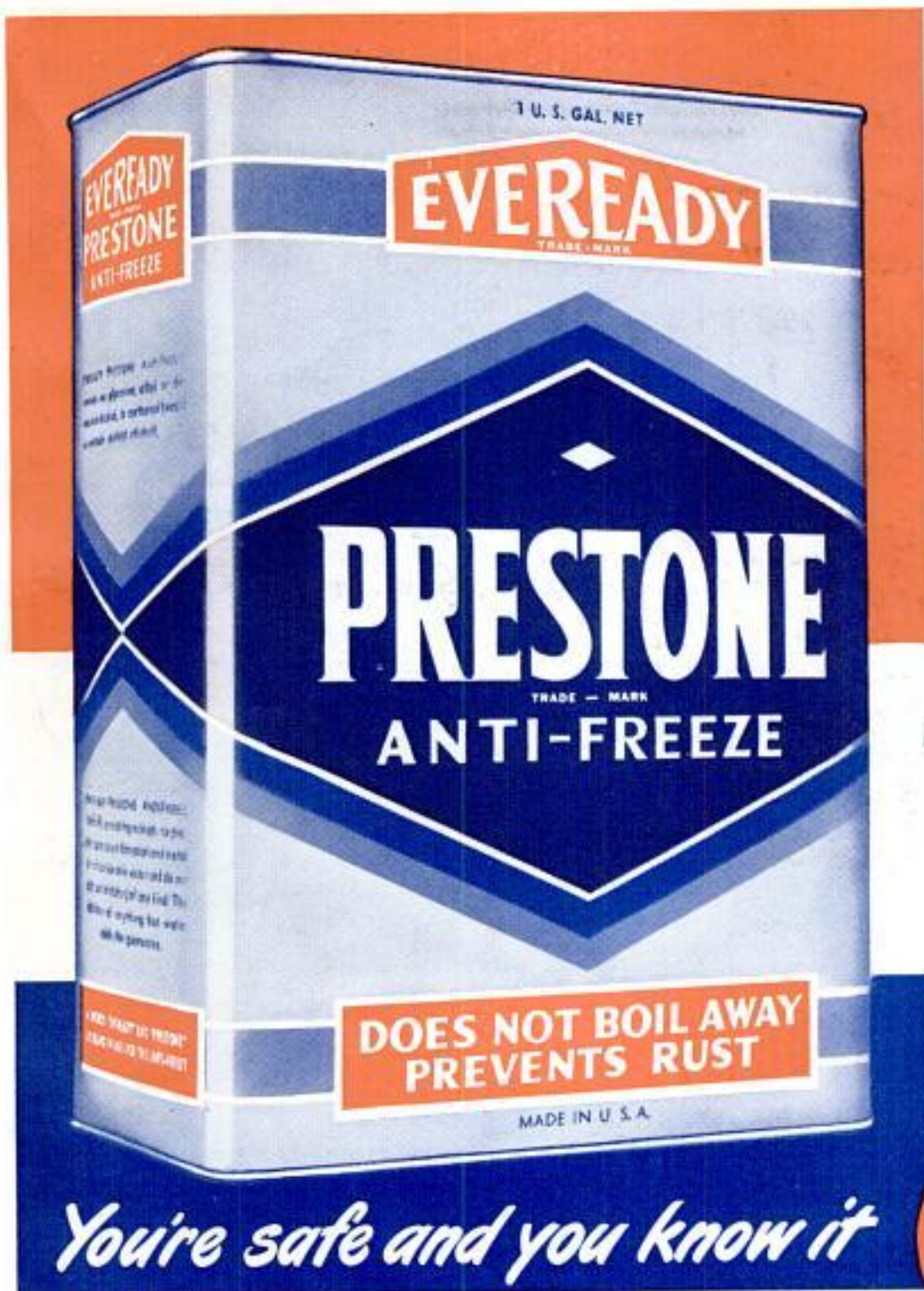
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